45th annual Proceedings

Selected Research and Development Papers - Volume 1
Selected Papers on the Practice of Educational Communications and Technology - Volume 2

Presented Online and On-site during The Annual Convention of the Association for Educational Communications and Technology

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Preface

For the forty fifth time, the Association for Educational Communications and Technology (AECT) is sponsoring the publication of these Proceedings. Papers published in this volume were presented online and onsite during the annual AECT Convention. A limited quantity of these Proceedings were printed and sold in both hardcopy and electronic versions. Volumes 1 and 2 are available through the Educational Resources Clearinghouse (ERIC) System. Proceedings volumes are available to members at AECT.org.

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The Proceedings of AECT's Convention are published in two volumes. Volume #1 contains papers dealing primarily with research and development topics. Papers dealing with the practice of instructional technology including instruction and training issues are contained in Volume #2. This year, both volumes are included in one document.

REFEREEING PROCESS: Papers selected for presentation at the AECT Convention and included in these Proceedings were subjected to a reviewing process. All references to authorship were removed from proposals before they were submitted to referees for review. Approximately sixty percent of the manuscripts submitted for consideration were selected for presentation at the convention and for publication in these Proceedings. The papers contained in this document represent some of the most current thinking in educational communications and technology.

Michael R. Simonson
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Editors

2022 Annual Proceedings – Volumes 1 & 2

Volume 1: Selected Research and Development Papers
and
Volume 2: Selected Papers
on the
Practice of Educational Communications and Technology

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Volume 1

Selected Research and Development Papers

Tools to Create Interactive Digital Communities as our World Embraces Virtual Learning

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Abstract

This interview study offers educators practical tips on how to use tools to improve online learning experiences. Eleven instructors, professors and instructional designers were interviewed about challenges they faced designing and teaching online university courses in Florida. The purpose of this study was to explore how educators and instructional designers innovated learning design to improve instructor presence, engagement, and interactivity. In the wake of a pandemic that expedited the adoption of online learning, this paper is intended to offer advice for educators transitioning from emergency remote learning to strategic online course design that integrates emerging technology. This paper is intended to share what educators learned by experimenting with interactive 360-degree multimedia, virtual reality, videography, and visual design in learning management systems. Some of the tools featured in this paper include Roblox, Flipside, Plotagon, Articulate 360, Canvas, Kaltura and video conferencing apps.

Introduction

While to some it may feel like we are back to normal, it would be a shame if we found ourselves in the same spot we began after living through such a turbulent time of innovation. We must not be so eager to forget the COVID-19 pandemic that we fail to process the moments of magic that grew out of the turmoil. The landscape of learning evolved at supernatural speed. While educators were busy recovering from whiplash, the future arrived. Companies poured millions of dollars into expediting immersive technology to create a new reality. Hired.com called 2020 the year of augmented and virtual reality when they reported a 1,400% increase in AR/VR engineering job openings (Patel, 2020). In 2022, the edtech company Labster raised $47 million to build an "eduverse." Then, Meta announced a $150 million Immersive Learning project (Whitford, 2022). The money is going to help 10 universities open their own metaverse campuses equipped with Meta Quest VR headsets for students. Educators are now on a fast-track to adopt higher-quality technology that was too cost-prohibitive to even imagine before the pandemic. We are perhaps finally about to enter the coming of age that instructional technologists have been waiting for.

Massive investments in immersive virtual learning have not only been coming from the Zuckerbergs of the world. Investments in time, money and effort happened on the front lines of education. As educators, we were aware of how dramatically our teaching changed because of the pandemic. So, we wanted to find out how others were using technology to create interactive digital communities as our world embraced virtual experiences. The purpose of this research was to understand how educators innovated during the pandemic and to share their successes. This paper outlines different tools educators used in their university courses and what they learned about engaging students online. We hope to encourage more collaboration as we explore emerging technology that can bring learning to life.

Research Questions

The questions guiding our research were:

- What are some challenges that educators faced when designing and teaching online courses?
- What are some of the innovative, disruptive solutions educators created or discovered that helped them overcome challenges associated with designing and teaching online courses?
- How have educators embraced emerging technology to increase engagement and promote social learning in online courses?

Literature Review

Prior to the pandemic, the U.S. Department of Education reported one-third of American college students had taken online courses (2020). The number of undergraduates exclusively enrolled in distance education courses grew from 2.4 million in 2019 to 7 million just one year later (2020). This created challenges for educators who tried to battle the negative impacts emergency remote learning had on student engagement and mental well-being (Petillion & McNeil, 2020). Researchers found the abrupt transition from in-person to online courses increased student anxiety and decreased motivation (Petillion & McNeil, 2020). Students lost peer communication networks (Jeffery & Bauer, 2020). The psychological toll of isolation, loss and financial burdens wasn't only felt by students.

While some educators were prepared to teach online, most felt they had insufficient bandwidth and preparation to transition in-person courses to online courses (Dietrich et al., 2020). Strategic online course development was found to be significantly different from courses offered online in response to the COVID-19 crisis (Hodges et al., 2020). Campus support and instructional design teams were not staffed sufficiently to suddenly assist every educator with unique obstacles related to class size and subject matter (Hodges et al., 2020).

Educators struggled to engage students who became increasingly hard to reach. A survey of nearly 3,000 undergraduate students from 30 American universities found access to adequate technology was a major barrier for student success in online classes (Katz et al., 2021). Researchers pushed for more nuanced measurements to better understand digital inequality students experienced. While previous studies found most American students had access to a computer, Katz et al. found that the pandemic revealed a detrimental number of students were under-connected (2021). In their survey, students reported unreliable or slow internet access and digital devices that were insufficient for the needs of fulltime online education. Some students reported needing to share devices with family members because they lost access to on-campus technology they relied on before the pandemic.

In addition to dealing with new obstacles created by the pandemic, remote classes amplified challenges educators already faced adapting to new technology like lack of resources, training, and time (Baldock et al., 2021). Even before the pandemic, many educators struggled to create visually compelling online courses because they lacked multimedia content creation and technical skills (Kebritchi et al., 2017). Van der Heijden (2003) found that visual attractiveness of a learning management system (LMS) can positively impact perceived ease of use and perceived usefulness. In 2020, Ghapanchi, et al. built on this research and evaluated the importance of visual design. They found the impact of "space design on both perceived ease of use and perceived usefulness were significant," (Ghapanchi, et al, 2020). Because strategic instructional design can make it easier for students to engage in online classes, educators need to constantly be on the cutting edge of content creation. Perceived ease of use and perceived usefulness are two main elements in the Technology Acceptance Model (TAM) that we used as our framework for this study (Martín-García et al., 2019).

Some universities are leading the way in acceptance of new education technology and crediting the pandemic with fueling their innovative initiatives. In November 2021, Stanford University published an article describing the Virtual People course which they claim is "among the first and largest courses to be taught almost entirely in virtual reality." Students attend fully remote class meetings through VR headsets using handheld controllers to move around (Hadhazy, 2021).

Many recent studies affirm VR's potential to improve learning. In a meta-analysis of more than 60 research studies, Merchant et al. (2014) not only found that virtual environments are effective teaching tools in higher education. They specifically identified VR gaming as achieving the best student learning outcomes.

Some researchers found that virtual gamified training platforms expanded during the pandemic and created an opportunity for the development of new learning experiences that promoted higher-order thinking (Dustman et al., 2021). In November 2021, Roblox announced they're spending $10 million to launch Roblox Community Fund (Baszucki, 2021). The fund will enable educators to bring virtual reality gamification to their schools. The CEO even wrote about constructivism in the announcement stating that "students learn most effectively when given the opportunity to deepen their knowledge through hands-on experiences, problem solving, and collaboration with other people." Roblox allows users to create and explore immersive 3D places. More than 9.5 million developers have produced their own immersive multiplayer experiences using Roblox Studio since 2018. Roblox Studio is a desktop design tool. But you can access Roblox on PC, Mac, iOS, Android, Amazon Devices, Xbox One, Oculus Rift, and HTC Vive. In April 2020, Roblox had 146 million monthly active users. A year later, that number grew to 202 million monthly active users (Dean, 2021). Sixty-seven percent of them are under 16 years old. As the metaverse becomes more of a reality, it's not unlikely that students will begin to expect immersive co-experiences. Roblox is gearing up to provide customized and more nuanced experiences that will change the way we communicate with one another (Bronstein, 2021). Educators and academic institutions, need to be ready to make the most of these opportunities. In October 2021, Paris Hilton announced on her YouTube channel that she was launching Paris World in Roblox where fans can explore digital replicas of her mansion. In November 2021, Nike launched Nikeland in Roblox where players can wear digital Nike shoes, clothes, and accessories while they play games with friends. A month later, Tommy Hilfiger announced a collaboration with designers from the Roblox community to develop digital clothing for avatars. The popularity of games like Roblox could not only help gamify learning, but their familiarity with this technology could help reduce cognitive load as students start using Roblox for education.

Framework

Because we wanted to understand what impacts an educator's decision to embrace new learning technologies, our research was informed by TAM. Under TAM, perceived usefulness and perceived ease of use are crucial factors in adoption of new technology (Martín-García et al., 2019). The pandemic created a unique ecosystem in which educators faced new and worsening challenges engaging with students. To examine how educators met that challenge, we framed our study around the theory that educators were more likely to embrace a solution that was useful in solving their problems and easy to learn. For that reason, we spent time asking about the problems they faced. Some educators admitted that a new technology had the potential of addressing their problems, but they struggled to accept the technology out of fear of the unknown, time it would take to learn, and cost. Because we hypothesized that emerging technologies had the power to solve some of the educators' problems, we were curious to investigate the factors that influenced their decision to embrace new technology so we could better understand what stands in the way of innovation.

Methods

We started our qualitative study by reaching out to educators and instructional designers at the University of South Florida (USF). We interviewed two professors, four instructors and five instructional designers via Zoom. Interviews ranged from 30 minutes to nearly two hours. Their disciplines included music, journalism, biology, English, advertising, graphic design, and sustainability.

During the interviews, we asked initial questions about their discipline, class size and grade level. We asked how they designed classes in their learning management system and why.

We were curious to learn more about whether their online courses were previously in-person and what challenges they faced transitioning the courses online.

For our qualitative data analysis, we coded memos and reviewed interview transcripts for thematic analysis. We coded each tool educators mentioned to better understand who used it and why. Our codebook included tools like online gaming creation systems, 3D animation software, learning management systems, course authoring tools, video platforms, videoconferencing tools, discussion platforms, virtual reality (VR), and augmented reality (AR). We coded for hybrid, HyFlex, asynchronous, in-person and synchronous courses.

Findings

Many of the people we interviewed shared similar struggles teaching online. Online discussions came up in every interview. Several people we interviewed complained about the time it took to find and learn tools to solve their problems. Visual design was a common topic educators spoke about. The most fascinating responses came from the questions we asked about solutions they found or created to meet these challenges. While pedagogy and design theory were often considered as part of their course creations, the emerging theme was a strong focus and reliance on tools.

A common thread in our interviews that appeared to mirror sentiment across the country stressed that universities need institutional support to meet the challenges educators face engaging students online. Several educators we interviewed argued that virtual reality (VR) headsets should be sent to every student to empower them to have an experience that is as immersive as possible.

Another theme identified in our interviews was apprehension. It’s a bit scary to use a new tool with students who may expect you to be all-knowing. It can be intimidating to try to learn a new tool that you haven’t used before. People also said it’s hard to know what new technology is available. Some struggled to think of ways to create engaging experiences for students online. Nonetheless, every person we interviewed found a way to use a tool to meet these challenges. The following findings are organized by the tools educators adopted and how they perceived those tools improved student engagement and motivation.

Roblox

Let’s start with one of the most innovative professors we interviewed and the tool he used, Roblox. Before the pandemic, this professor taught climate change and sustainability in person. When COVID-19 forced him to move his classes online, he used the Roblox game to digitally recreate his classroom to give students a sense of normalcy. He soon realized, “if I could take the students anywhere, why would we go back to the classroom?” Instead of teaching students with PowerPoint decks, he turned his slides into digital billboards in their Roblox world. Student avatars rode together in a cart on a rail and virtually passed the digital billboards. Shortly after launching the digital billboard tour, he asked, “why are we walking around in the virtual world, when we can fly?” He geocoded a map and let student avatars fly. He offered his students a fun way to socialize and create community, which he believes was a key reason for this tool’s success. Roblox may have helped reduce isolation and loneliness students felt during the pandemic because students could interact with the course content and engage as an active participant in their learning. The effort this professor put into creating something special appeared to give the students more motivation to learn.

As his experiments gamifying learning evolved, he shifted his thoughts from solving problems created by the pandemic, to better understanding the problems associated with teaching in person. He couldn't shake thoughts of the "sage on the stage" concept. He realized that the traditional classroom is "horribly designed." The space itself is intimidating for students since the educator is physically often placed at the front of the class behind a lectern. He found that online learning was more human because it fights this concept of a professor as a power figure. When the pandemic forced educators to teach remotely, professors often taught from home, sometimes with babies and pets on their laps. He appreciated that online teaching meant that professors could be themselves and not feel so pressured to play a role. He insisted that, if done correctly, online teaching can be less conforming, more authentic, and more fun.

He felt like the pandemic was an excuse to be more generous with students. "Suddenly, everything I dreamed of was ok to try." Instead of deadlines, he gave "lifelines" to students who need extensions to reduce anxiety. He said part of him wishes we didn't have to go back to normal after the pandemic. He noted that the pandemic pointed out the shortcoming of physical buildings. On top of costing a lot of money, he argued that campus buildings aren't sustainable. He said classrooms don't know if they're theatres or detentions or jail cells. "We can use classrooms in theatrical ways with mood music and adventures with storytelling, but most professors aren't teaching that way, so why be in classrooms that are designed like amphitheaters?"

Flipside

Flipside is another innovative tool that one of the educators we interviewed used to engage students in virtual production. Flipside says it's the world's first virtual TV studio for live real-time motion capture of animated content. It allows creators to customize animated 3D characters and their environment. While Flipside Studio lets users create and voice simple animations, its extended reality (XR), VR and AR tools are expansive. It can use data from full-body suits to track real movement that appears in 360-degree environments as animated characters. A professor we spoke with used Flipside to create animated videos for his online course. He voiced animated characters to make the course more fun and add instructor presence. The videos introduced the course materials and helped students understand what's expected of them.

Plotagon

One professor used Plotagon so students could create a virtual world together to learn applied research. Plotagon is a mobile and desktop app that turns text into videos. The user interface lets students customize the way characters look and what they wear. Students wrote scripts and narrated character dialogue. Then they assigned movements to the characters that they selected from a bank of animations. Students had the choice of narrating the character scripts themselves or Plotagon can automate text to speech. The professor said students felt engaged and motivated when they were empowered to create their own learning content in a creative way.

360-degree video

Instructional designers we spoke with used 360-degree cameras to shoot videos and photos that students could view on a desktop, a mobile device or in a mobile VR headset. 360-degree video can have great appeal since it's still novel in education, and can have profound effects on cognition and emotion (Makransky & Petersen, 2021). For a death and dying course, USF digital learning videographers created a virtual reality tour of a cemetery at the height of the pandemic using a 360-degree camera. Students learning from home could wear a mobile-VR headset and turn their heads around for a personal and intimate point of view that made them feel like there were standing in the middle of the cemetery. The video team also interviewed people who worked there on camera to give students a more impactful and memorable viewing experience. As 360-degree video cameras increase in quality and ease of use, they've become a powerful tool to immerse students in online course content.

Video conferencing

It was no surprise that everyone we interviewed talked about videoconferencing tools. Zoom went from 10 million to 300 million daily meetings in the first four months of 2020 (Evans, 2020). Microsoft Teams usage grew 894% from February to June of 2020 (Marks, 2021). Educators and instructional designers we spoke with agreed that video conferencing tools enabled schools to quickly transition to remote learning at the beginning of the pandemic. But when teachers were met with black squares instead of web cams, they felt the lack of social connection, and felt nostalgic for in-person classes. While many expressed frustration that they couldn't convince students to turn on their web cameras, others acknowledged that they developed more empathy for students who lacked sufficient devices and broadband to fully engage in courses over Teams and Zoom from home.

As a result, several educators we spoke with began offering resources about how to connect computers to routers using ethernet cables. Some said their students didn't understand how to get the most out of their at-home internet, like sitting closer to their Wi-Fi routers. Others recommended students access free Wi-Fi or hotspots at libraries.

Educators expressed that at the start of the pandemic, they struggled to think of ways to advance their video conferencing meetings beyond passive learning like lecturing at the students for the entire duration of the class. But as time passed, their institutions had more conversations about how to design and get the most out of synchronous sessions. Some found success with chunking sessions to improve the pacing and keep students interested. They created synchronous lesson plans where they would start with ice breakers, then do breakout rooms followed by short assessments and frequent knowledge checks. Breakout rooms became one solution that several educators appreciated to make larger class discussions more manageable.

A music professor shared his unique experience using video conferencing tools for ensemble lessons. While he struggled to record high-quality audio of synchronous student performances, he discovered one element of video conferencing that he preferred over in-person class. He said that Zoom breakout rooms allowed smaller groups of students to practice together more effectively. While in person, his students would break into groups and practice playing instruments in their own corner of the room. Online breakout rooms meant they weren't distracted by the noise of other groups practicing different parts of the music.

Another advantage of video conferencing tools is that it enabled collaboration with guest speakers or teams across the country or even around the globe. An online Spanish class used video conferencing to pair students up with other students in Spanish speaking countries. They engaged in conversations in Spanish in a more authentic way than they would if the class was in person. This also added a cultural learning element to the course.

Videoconferencing played an interesting role in courses with large class sizes. One professor we interviewed taught a biology course with 250 students. Before the pandemic, the course was taught in one very large lecture hall. To accommodate that many students during the pandemic, she experimented with flipped hybrid-flexible, or HyFlex, course delivery where students could choose whether they would attend in person or online. She used a combination of in-class instruction, asynchronous content and synchronous sessions using Microsoft Teams. Her goal was to create a flipped course where students watched video lectures on their own time and then came to class prepared to discuss or work on activities based off the online course learning materials. Most classes contained 15 to 25 multiple choice clicker questions that gave her real-time data about what students understood or failed to understand. Then, she had students break into smaller groups to complete an activity or discussion. In-person students physically grouped together, while online students went into Teams breakout rooms. Toward the end of the 75-minute course, students returned to share what they learned in their groups.

The professor was surprised at how well this teaching method worked for her class. She expected to have less connection and less accountability with the online students but wondered if it was better because those students chose to be online. She noted that it was easier to learn students' names on Teams since their names appear on the screen. This may have helped students get to know one another better. She also admitted that it was easier for students to hear one another in Teams breakout rooms, so discussions may have been better online than in-person where students were physically distanced.

The professor assessed students on first day and then repeated the questions on the final exam to see if they learned. She found zero difference between scores from the online students and the in-person students. The main challenge she acknowledged was not with the videoconferencing part of the class, but with executing a flipped class. She believes that students prefer showing up to class and being passively entertained, but in the flipped classroom they had to show up to class and work. While she felt that flipped classes lead to greater learning, she assumed that students think flipped models are harder because they have to be pro-active and complete the readings and videos before class. Especially combined with the clicker assessments, students knew they'd have to answers questions on the spot so there was more pressure to be prepared for class sessions regardless of whether they were in person on online.

Perusall

In an attempt to increase engagement between students, one professor we interviewed used the social annotation tool Perusall, in the learning management system, Canvas. He uploaded readings and videos into Perusall where students wrote comments and took notes. Perusall marked timecodes when students commented on video lectures to make it easy to find video annotations. He felt like it was a more authentic form of communication than traditional threaded discussions. It also offered a form of automated grading where student comments can get more points when they're upvoted.

Canvas

The Canvas learning management system (LMS) was seen as both a challenge and a solution to teaching online. Canvas was without a doubt the most frequently talked about tool that every instructional designer and educator brought up during the interviews. While some offered tips for getting the most out of Canvas, others critiqued downsides of Canvas that led them to switch parts of their online classes to other tools.

Generally, instructional designers spoke more favorably about Canvas than educators. This appeared to be tied to familiarity with the LMS and department training and support or lack thereof. Instructional designers saw Canvas as an integral part of their jobs. They were trained more thoroughly on Canvas and were more aware of options unknown to most educators. One solution that was mentioned by several instructional designers was templates. Instructional designers created more classes than most instructors and professors, so templates were especially useful at increasing efficiency. Instructional designers use and create templates that they share in the Canvas Commons section for anyone at their institution to download. The challenge with this solution is that not many people outside of the instructional design team were aware these templates existed. Canvas Commons allows you to see how many times the templates are downloaded. During one interview, an instructional designer noticed a template they considered useful, barely had any downloads and insisted they would try to bridge this disconnect in conversations about communication with colleges.

While templates in Canvas saved time, they also provided another solution that became a common theme in interviews. Templates provided consistent visual design. This visual design wasn't only aesthetically appealing, several instructional designers pointed out that consistent placement of content and resources in an LMS helps students reduce cognitive load (Sweller, 1988) that hopefully results in improved student learning and less frustration.

Several people we interviewed stressed how important it is for educators to use a "getting started" module at the top of their Canvas courses to provide resources for students who don't necessarily know how to navigate their online courses. They mentioned that educators often assume that digitally native students know how to use every tool, but often find students struggling well into the semester because they lacked an understanding of how to use Canvas.

An instructor who taught large asynchronous online courses for years recommended educators consider using Canvas' peer review function. Canvas can automatically assigns two peers to review each assignment. This encourages students to get to know one another and helps students see where their work stands compared to classmates. For the peer review to work, he said it's vital to create clear and concise grading rubrics and deadlines. In addition to grading one another's assignments, students also had to provide rationale which he argued helps students learn as they review.

The most common complaint educators had about Canvas was about discussions. Many felt that Canvas threaded discussions felt inauthentic. One instructional designer stressed the importance of phrasing a threaded discussion in a way that elicits more authentic engagement. He recommended that any teacher assigning a discussion think more thoroughly about their discussion prompts. He argued poor discussions are often a result of poorly thought-out questions. He insisted that discussions are more successful if educators in large classes break discussions into smaller groups. He said this improves the user experience because it eliminates the need to scroll past a hundred posts.

He also made a point about due dates. Many educators set assignment due dates for Sunday at 11:59 p.m. He argued it's "somewhat criminal" to not be available to students before an assignment is due. He insisted, if you don't work on Sunday, don't have assignments due on Sunday. His tip was to have assignments due on a weekday when educators are accessible. Regardless of which day/s and time/s an educator selects, many people we interviewed argued that consistent due dates are crucial at helping students succeed while they're often balancing deadlines for several other classes at the same time. Making assignments due on the same day every week should help students stay organized.

Another critique is that Canvas is not designed for real-time social interaction like Slack and Discord. Several people we interviewed also complained that Canvas analytics are limited. While it's possible to see how much time students spend in the course, educators said they wished analytics were more detailed so they could use the data to adjust their courses.

Kaltura

Several of the instructional designers we interviewed said the media hosting platform Kaltura can be a great tool to get those in-depth analytics that educators can use to fine tune their decisions. Kaltura can be integrated into an LMS like Canvas which makes assessments more efficient. Educators or instructional designers can embed check points during a video that asks students to answer questions or reflect on what they're watching before they can watch the rest of the video. Student answers can go directly into the Canvas gradebook. This type of assessment can be more interactive and engaging than traditional quizzes. It also keeps students accountable to watch course videos. Educators can also see exactly when a student stopped watching. Identifying patterns in student viewing habits can inform how long videos should last, for example, or whether certain parts of the videos can be improved.

One instructional designer we spoke with said she often uses these analytics to show educators that their course videos are too long. Kaltura lets users create chapters which segments videos into shorter durations. This chunking method is now common practice in instructional design. It was originally credited to George A. Miller in 1956. He researched working memory and argued that chunking content helps educators reduce cognitive load that leads to better retention (Mathy, & Feldman, J. 2012).

A few other cool features include the ability for students to search though video captions for keywords and then jump to that part of the video. Teachers can also use Kaltura to screen capture what's on their computer, like a PowerPoint presentation. Kaltura can also record from your web camera.

Articulate 360

Articulate 360 also offers more options for educators to incorporate frequent assessments in creative ways that aren't always available directly in an LMS. Instructional designers we spoke with mostly used Storyline 360 but some also used Rise 360. Storyline 360 is an eLearning authoring tool that resembles PowerPoint. It comes with more template options that are specific to the needs of educators or trainers. It also has a large bank of real and animated character images with different body language or facial expressions. Storyline 360 allows for more engaging interactions than traditional linear presentations. For example, an educator can create branching scenarios where students "choose their own adventure." Instructional designers we met with often used the drag and drop feature to give students a break from traditional multiple-choice questions. They often embed videos of instructors inside the Storyline 360 experience.

One of the use cases we encountered during our interviews was for a geosciences course. The digital learning group teamed up with a professor to take online students on a trip down a river. They used drone cameras to capture the trip from above. Videographers kayaked alongside the professor as he spoke to the camera from the middle of the river. They also used waterproof cameras to immerse students in the environment. The point of the lesson was to teach students about how the water and environment changed as the river flowed south. The video team edited short videos at several stops along the river. Then, the instructional design team created a map of the river and embedded it into the Canvas course. Students could click on hotspots along the river to watch the videos. While students may have enjoyed kayaking down the river in person, it would have been harder to hear what their professor was saying. With high-quality video cameras and microphones, the videos of the professor may have led to greater learning for students.

Discussion

To make it easier for educators to embrace new technology, institutions must prioritize supporting educators and learners with devices that enable them to engage in powerful, new ways. Additional funding and more affordable technology mean more educators could begin to utilize VR and AR to gamify learning. However, devices are only half of the solution. TAM suggests that ease of use is an important factor in technology acceptance. Instructional design departments in higher education can offer structure and support that educators need to feel confident embracing new technology in their courses. The relationship between educators and instructional designers can be better nurtured by institutions that can do a better job of communicating available resources to educators. Institutions should implement a culture of innovation by promoting exploration and experimentation with emerging education technologies that may be able to solve our current challenges with online education. Blaming emergency remote classes on student learning loss and lack of engagement is not helping us move toward a more innovative future. Instead of rushing to return to normal, institutions could learn from the pandemic and identify opportunities to improve online learning. According to TAM, perceived usefulness plays a large role in accepting technologies. More research on this topic could help educators and institutions identify ways in which innovative tools can be useful in engaging students and achieving student learning outcomes. More research like this is also needed to support educators to strategically develop methods of adopting and adapting to new technology.

As we work toward creating more connected online communities, accessibility must be considered and adjusted for. Technology is great, but we still live in a world where low-income students are likely to face greater challenges getting the most out of new technology because they lack access to powerful digital devices and reliable high-speed internet. This inequality must be designed for. That means making files as small as they can be without sacrificing quality. It means creating content that can be accessed on a variety of devices. It also means being compassionate toward students who may need to call into a video conference instead of joining with a webcam. Accessible design should of course also comply with the Americans with Disabilities Act which, in part, requires things like providing captions or transcripts of videos or audio, and adding metadata in photos for screen reading software.

Conclusion

At the end of each interview, we asked whether people could think of a course that could not be taught online. Every person we spoke with thought about the question and came to the same realization. No. After facing pushback from students against emergency remote learning at the start of the pandemic, every educator we interviewed emerged from their experiences with confidence that anything can be taught online. Some hands-on classes may be better in person. But educators came away from this trying time with a new mindset. Not only can new tools be used to solve their problems, strategic course design and adult learning theories can give them confidence to know they're approaching their obstacles with evidence-based solutions.

Many found the pandemic helped validate research-based instructional design principles and more deeply engrain them into the university culture. Several people recommended that educators approach course design by asking themselves why they're changing an assignment and how technology serves this purpose. They offered advice that focused on deeply understanding how any element in a course directly helps achieve strategic goals. They also found that sometimes, less is more. Removing unnecessary content or assessments helped reduce extraneous cognitive load and give students the time to focus on what really matters. One interviewee may have summed it up best when he said, "if I can create relevance, that overcomes anything. There's no tool in the world that can beat relevance. When a student understands why they're doing something, and they believe that there's a good reason to do it, then they're much more willing to engage."

While different disciplines may lend themselves to different design techniques, all of them can be improved by integrating more interactive emerging technology and greater instructor presence. The flexibility that this affords students can also help prepare them for a world where remote work is becoming increasingly more common.

When faced with an immense challenge, they all did what good educators do. They learned. They figured out creative workarounds to their problems. They embraced the inquiry mindset that we try to instill in our students. They experimented and found solutions to problems they didn't every realize they had before the pandemic. While the success of innovation doesn't mean that every class will be taught online from here on out, it did empower educators to approach courses with an open mind. Perhaps there is a better way of doing things than the way it's always been done. As the culture in our schools evolves in the wake of COVID-19, educators are now more comfortable with technology and online learning strategies that will lead us into the future of teaching.

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How does Synchronous Online English Education Impact on Learners?

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Introduction

Synchronous online language teaching and learning has unique characteristics which can transcend time and distance. Distance education used to be carried out by specialists in technologies by using a video conferencing system. During the past few years, most language teachers have gained the skills to handle face-to-face and online modes of teaching due to the pandemic. The online mode has two forms: synchronous and asynchronous. These two forms of instructional designs can be local or international. At a local level, most English teachers at a university have experience of synchronous online teaching in their classes using such Web systems as ZOOM or Webex. As for an international level, Collaborative Online International Learning (COIL) is a great example. Academic English class at Aoyama Gakuin University, for example, has collaborated with Tokyo University of Foreign Studies, International Christian University, and University of California, Irvine asynchronously and synchronously (Anzai & Fukuda, 2021). Now English classes have opened a new door to the world. Despite the potentiality of the powerful instructional design, there is not many studies done to clarify the impacts of synchronous online English education. Thus, the aim of this study is to develop a compact scale for measuring the impacts of synchronous online English Learning on the perception of the learners. The identified factors would also serve as a guide to design effective synchronous online English education.

Methods

Research framework

The constructs of synchronous online English learning are developed based on Social Presence (Garrison & Anderson, 2003), Openness (Anzai, 2011), World Englishes, English as a Lingua Franca, Willingness to Communicate (MacIntyre et al., 1998), Self-efficacy (Bandura 1997) and discussions with university students, language teachers, and researchers in Educational technology.

Procedure

The survey was conducted online in the second semester of 2021, which consists of 91 items. The participants were 235 Japanese university students. They responded to Google Forms, an online survey tool, and the data were analyzed using SPSS.

Results

Exploratory factor analyses were conducted to decide the number of factors for synchronous online English learning. After examining the initial Eigenvalues, the Scree Plot, and applying various rotations, a five-factor model turned out to be most interpretable (See Fig. 1).

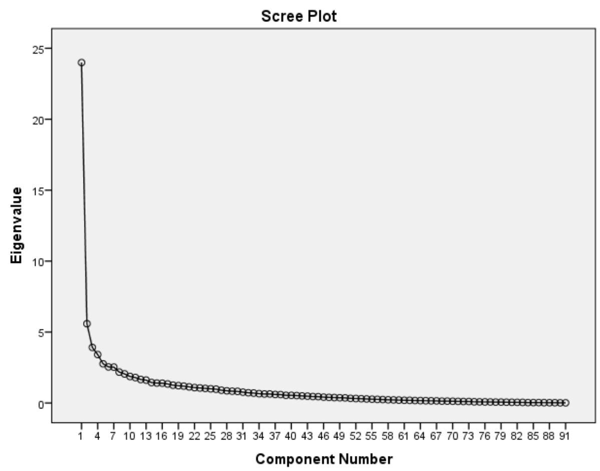

Figure 1. Scree Plot

A five-factor solution accounted for 45.5%. Those factors with seventy-six items were: Friendliness, Openness, Layer-Layer Interaction, Self-efficacy, English as a Lingua Franca (ELF). The specific items are listed on Table 1.

Table 1. The Results of Exploratory Factor Analysis

	Component				
	1	2	3	4	5
28 I feel others friendly when they speak to me in a kind tone.	.752	.180	.180	.036	.022
39 I feel others friendly when I see them smile.	.706	.204	.161	.184	.048
19 I feel closer to others when they speak in a way I can understand.	.703	-.008	.108	.009	.068
57 I feel closer to others when we have something in common.	.691	.162	.130	.157	-.085
45 I feel friendly toward others when I can sense they are willing to cooperate.	.680	.163	.147	.071	-.025

47 I feel favorable toward others when they respect my opinion.	.669	.235	.086	-.020	.045
50 I feel closer to others when they ask me questions about my daily life.	.665	.215	.168	.138	-.004
65 I feel closer to others when we are empathizing with each other.	.648	.204	.200	.111	.073
79 I find others friendly when their mood is cheerful.	.632	.148	.203	.020	.230
18 I feel friendship when others are willing to answer my questions.	.629	.078	.116	.095	.081
12 I feel close to others when they call each other by name.	.615	.282	.285	.003	.184
9 I feel close to others when they call me by my name.	.614	.180	.369	.081	.113
66 I feel others friendly when they talk to me in a relaxed mood.	.585	.281	.178	.078	.000
5 I find others friendly when they nod to me.	.537	.103	.064	.056	.001
7 I feel friendship with others when they ask me questions about what I am saying.	.522	.233	.284	.107	.218
23 I sympathize with others when they are having a hard time talking in English.	.501	.221	.110	-.152	.129
70 I feel at ease with others when they are not pushy.	.458	.180	.048	.181	.147
52 I heard and understood others' pitch and tone of voice by emoticons, text, or audio/video in the online classroom.	.456	.316	.158	.080	.205
25 I feel close to others when there is two-way communication with them.	.397	.256	.259	.039	.149
90 I can learn collaboratively with people who are geographically distant from me.	.359	.094	-.051	.251	-.037

37 I read and understood others' facial expressions by emoticons, text, or audio/video in the online classroom.	.350	.323	.068	-.092	.324
67 I can learn anything.	.068	.617	.204	.284	.207
10 I have various choices in communication.	.329	.593	.117	.166	.069
3 I have a variety of choices in learning methods.	.284	.571	.055	.070	-.028
51 I can learn at anytime.	.255	.562	.170	.196	-.006
29 I can feel others close to me.	.146	.543	.207	.137	.315
82 I can learn from anyone.	.315	.532	.075	.260	.000
17 I have a wide variety of content in study support services.	.276	.522	.058	-.052	-.047
68 I can learn in any place.	.291	.520	.199	.251	-.012
84 I think learners can learn individually.	.238	.518	.115	.215	.048
41 I can learn depending on our needs.	.152	.516	.325	.079	.126
6 I felt others close to me in the online classroom.	.184	.495	.286	.108	.177
40 I felt emotionally close to others in the online classroom.	.286	.460	.289	.114	.271
56 I have learned valuable knowledge in the online course.	.206	.455	.323	.346	-.008
49 I have a wide variety of choices in the media.	.116	.455	-.015	.133	.069
87 I can enjoy online international exchange in English.	.272	.431	.315	.417	-.039
80 Learning is often free of charge.	.191	.423	.155	.245	.100
91 We can learn collaboratively overcoming time difference.	.275	.398	.053	.341	-.046
77 My economic barriers is lowered.	.147	.372	.168	.046	.247
11 I was aware of others' presence.	.160	.351	.135	.012	.129
22 I share my emotions with others by emoticons, text, or audio/video.	.308	.320	.186	.161	.315

36 I found myself not treated fairly by others.	.048	-.311	.022	.019	-.299
33 I can collaborate with other learners.	.251	.206	.663	.145	.073
73 I can speak up more easily in a breakout room.	.291	.152	.650	-.013	.083
76 I can speak up more often in a breakout room.	.318	-.016	.631	.120	.117
4 I can speak more easily in a main session after the breakout rooms.	.146	.294	.590	-.019	.002
69 I feel relaxed in a breakout room.	.059	.308	.586	.078	.136
46 I have no feelings of being happy with others.	.131	.191	.528	.135	-.265
8 I have a warm and comfortable relationship with others.	.115	.250	.503	.074	.231
86 I feel less shy in a breakout room.	.215	.100	.490	.044	.144
34 I often discuss learning issues with others.	.090	.094	.481	.281	.177
71 I can learn about individual participants in a breakout room.	.260	.044	.465	.260	.040
89 I feel that we have group activities frequently.	.293	.102	.445	.257	-.101
53 I feel that we can reflect the group's opinion to the whole class.	.092	.287	.388	.267	.075
43 I can reflect my own opinions to the group.	.048	.300	.386	.368	-.007
44 I rarely answered others' learning questions.	.100	-.139	.375	.301	-.304
75 My understand my role clearly.	.094	.086	.372	.215	.198
61 I felt alone.	.039	-.004	.360	.058	-.153
27 I find myself encouraged by others.	.240	.308	.348	.165	.189
60 I can ask questions in English.	.219	.046	.177	.764	.042
58 I can talk with Americans and other "native English speakers" in English.	-.070	.261	-.020	.736	.043

59 I can communicate with non-native English speakers in English.	-.007	.245	-.095	.710	.068
74 I can express my opinions in English	.124	.076	.319	.680	.101
94 I can communicate with other people.	.209	.219	.252	.626	-.061
26 I can communicate with my teacher.	.043	.253	.220	.601	-.030
85 I can collaborate in English.	.072	.208	.144	.527	.153
54 I can communicate with people around the world in English.	.104	.380	.047	.503	.083
78 I can persuade a foreigner in English.	-.129	.183	.207	.481	.404
55 I can achieve my learning goal.	.148	.279	.384	.424	.172
62 I cannot get good grades.	-.017	-.135	.052	.350	-.134
１I feel others friendly when my English is understood.	.183	-.011	.202	.349	.121
15 I don't need to speak like a native English speaker (American, British, etc.) as long as my English is understood.	.059	-.043	-.064	.037	.666
2 I think it is okay to have a Japanese accent in my English.	.040	.081	-.017	.142	.651
13 I think it is okay to have a Japanese accent in my English.	.159	.257	.133	-.004	.592
32 I think that the content of English is more important than the pronunciation.	.229	.030	.162	-.001	.428
20 I think that various kinds of "world Englishes" such as Asian and European Englishes are accepted today.	.118	.254	.143	.038	.309

Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization

a. Rotation converged in 7 iterations.

The short version of the scale was developed taking five items from each factor.in order from the item with the highest loadings.　As a result, a scale was developed, consisting of five items for each of the five factors, which has become twenty-five items in total.

1. Friendliness:
1. I feel others friendly when they speak to me in a kind tone.
2. I feel others friendly when I see them smile.
3. I feel closer to others when they speak in a way I can understand.
4. I feel closer to others when we have something in common.
5. I feel friendly toward others when I can sense they are willing to cooperate.

2. Openness:
1. I can learn anything.
2. I have various choices in communication.
3. I have a variety of choices in learning methods.
4. I can learn at any time.
5. I felt others close to me.

3. Layer-Layer Interaction
1. I can collaborate with other learners.
2. I can speak up more easily in a breakout room.
3. I can speak up more often in a breakout room.
4. I can speak more easily in the main session after the breakout rooms.
5. I feel relaxed in a breakout room.

4. Self-efficacy
1. I can ask questions in English.
2. I can talk with Americans and other "native English speakers" in English.
3. I can communicate with non-native English speakers in English.
4. I can express my opinions in English
5. I can communicate with other people.

5. English as a Lingua Franca
1. I don't need to speak like a native English speaker (American, British, etc.) as long as my English is understood.
2. I think it is okay to have a Japanese accent in my English.
3. I think that the Japanese accent in my English is a kind of self-expression.
4. I think that the content of English is more important than the pronunciation.
5. I think that various kinds of "World Englishes" such as Asian and European Englishes are accepted today.

Discussion and Conclusion

A scale "Synchronous Online English learning (SOEL)" was developed based on rigid empirical studies. The scale consists of five factors: Friendliness, Openness, Layer-layer interaction, Self-efficacy, and English as a Lingua Franca. The first factor was named Friendliness because online learners would feel intimacy, closeness, and familiarity to other online learners with these items. The second factor was named as Openness because these items are key features of open learning which Bonk (2009) claims "anyone can learn anything from anyone at any time." The third factor was named "Layer-layer Interaction" because we have a new type of interaction between individual-group, group-group, and group to the whole by using Web conferencing systems. The fourth factor was named "Self-efficacy" because items relate to the learners' perception of their English proficiency. The fifth dimension was named English as a Lingua Franca, because the items explain that English is used as a global communication tool. This study is an exploratory study to develop a short scale to measure the impacts of online language learning. The finding will serve as an evaluation of the effects as well as a guide for an instructional design.

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The Relationships Between Students' Profiles of Self-Regulation Skills and Academic Achievements Regarding Their Online Interactions

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Abstract

Nowadays, with the widespread use of online learning environments studies on the development of self-regulation skills of students in online learning environments has increased considerably. When the profiles of online students based on self-regulation skills are examined, different events related to each self-regulation skill may have emerged. This study is aimed to define the relationship between self-regulation dimensions gathered from log data and academic achievement. The result indicated that, time management and help seeking dimensions of SRL and the academic achievement scores are not correlated significianlty. The results of this study, which can be characterized as an important study in modeling students in the context of self-regulation skills, are remarkable to support their online SRL skills.

1.Introduction

1.1. Profiling of SRL Skills

Actively engagement of students in online learning processes is very important, but in this learning process, students may not be able to regulate their self-regulation skills (Cerezo et al., 2016; Dabbagh & Kitsantas, 2005). In this sense, online students who have high levels of SRL skills play an active rol in achieving their academic goals (Klug et al., 2011; Pintrich, 2004). Students interaction data such as page views, access to learning materials, frequency and duration of logins, assignment submission deadlines, number of clicks on learning materials, number of forum posts by students, and quiz and assignment scores (Aljohani et al., 2019; Kuzilek et al., 2017; Lodge & Corrin, 2017) can be examined from the log data in the online learning environments. On the other hand, determining of SRL profiles in onlıne leraning envrionment mostly using student self-report tools (Barnard et al., 2010; Broadbent & Fuller-Tyszkiewicz, 2018; Valle et al., 2008; Yot-Domínguez & Marcelo, 2017) but these tools, which are easy to implement and measure, may not reflect the actual learning behaviors of online students directly (Araka et al., 2020; Gašević et al., 2017). Students' engagement behaviors and learning patterns in LMSs can be measured using trace data and so level engagement behavior an indicator of SRL level. Various studies analyzed trace data that comprised of logs related to access of learning materials, completion of quizzes, and answer logs to develop profiles in SRL using trace data (including number of completed quizzes, total access time, reviewing time, scores of completed quizzes) while examining the SRL process (Li et al., 2018). While determining of SRL profilies, several learning analytical techniques were used. In one of those studies, Ning and Downing (2015) examined differences in university students' SRL strategy orientations with latent profile analysis and explored profile differences in students' academic performance. Greene et al. (2019, p. 101201) identified three groups of students who systematically differed in the frequency of their enactment of SRL activities. In another study, Cicchinelli et al. (2018) to identify and measure SRL. An example of clustering and classification is which used k-means clustering to understand student SRL behaviour in an LMS(Manzanares, Sánchez, García-Osorio, & Díez-Pastor, 2017). Besides, Zheng et al. (2020) SRL behaviors were clustered four groups: competent, cognitive-oriented, reflective-oriented, and minimally self-regulated learners, using K-means cluster analysis. In addition, Hong et al. (2020) performed latent profile analyses to find three metacognitive learning profiles (i.e., infrequent metacognitive processing, planning and self-evaluation, and monitoring via self-assessment) among 1326 students on a biology course.

Overall prior studies showed that, different online interaction behaviors result different self regulatory behaviors. Since, the idea that there is relationship between SRL and academic achievement, we hypothese that when using LMS for online learning, the level of development of SRL skills is proportional to the students' academis achievement.

1.2. Research Question

Fewer studies investigate the self-regulation strategies when combined with detailed data about student t interactions with online learning activities, and their academic performance so research question of this study is;

What are the relationships between clustered constructed through students' online SRL skills and academic achievement ?

2.Method

2.1. Research Model

In this research, data collection and analysis techniques based on learning analytics are employed within the framework of relational data mining.

2.2. Participants

The research group consisted of fourth-year students studying at the Department of Computer and Instructional Technologies Education in the Fall semester of the 2019/2020 academic year. The implementation was carried out within the scope of the Scientific Research Methods course, which was taught in the fall semester and lasted for 12 weeks.

2.3. Data Collection Tools

2.3.1. Log Data

In learning analytics studies, interaction data is mostly recorded through log records in LMS systems. System log records, which are used in various studies today, are a data collection method used in most learning analytics studies (Hadwin, Nesbit, Jamieson-Noel, Code, & Winne, 2007; Winne & Perry, 2000). In this study, the events determined on the basis of the literature were included in the log records as 89 events.

2.3.2. Online SRL Scale

In order to test the accuracy of the indicators developed for students' self-regulation skills by the Zimmerman (2000) model, developed by Barnard et al. (2009) and adapted to the turkish literatüre by Kilis and Yıldırım (2018). It was adapted to Turkish by 9 researchers and 2 linguists, and its sub-dimensions were; Goal Setting, Environment Structuring, Task Strategies, Time Management, Help Seeking and Self Evaluation. The scale contains 24 items and the internal consistency coefficients (Cronbach's alpha coefficients) of the scale for which reliability calculations were made vary between 0.67 and 0.87, and the reliability coefficient for the whole scale was found to be 0.95.

2.3.3. Data Analysis

Within the scope of this research, the data mining analysis process recommended by Han, Kamber and Pei (2011), one of the educational data mining and learning analytics studies, was followed and cluster analysis (K-means) method, one of the data mining techniques, was used in order to group students who have similar patterns of interaction behaviors based on SRL skills of students in online learning environments.

3.Findings

Students' online SRL interaction data and scale data were used as analysis input to determine the profiles of students on SRL skills. The research findings were presented within the framework of the clusters according to the level of development of the students for the SRL sub-dimensions within the scope of the Zimmerman model.

Goal Setting

It has been determined that students who have the goal setting dimension of online SRL skills based on students' interaction behaviors form three clusters. K-Means clustering algorithm was tested to define Goal Setting dimension based on interaction data of online students. The analysis result showing that the data set can be grouped into three different clusters is displayed in the relevant tables and graphs. The distribution of the students in the three clusters, who exhibit similar interaction behaviors, is presented in Table 2 below.

Table 1. Cluster Means of Interaction Behaviors by K-Means Analysis Technique

Variables	*Cluster 1 (n=25)*	*Cluster 2 (n=16)*	*Cluster 3 (n=12)*
Course View (S-C)	568	269	1058
Glossary View (S-C)	81	26	149
Assignment View (S-C)	181	102	282
Assignment Uploaded (S-C)	16	10	21
Quizz View (S-C)	39	21	69
Glossary Updated (S-C)	1	0	1
Goal_Setting_Scale	15	15	17

When Table 2 is examined, the interaction data associated with the online students' SRL skill Goal_Setting dimension emerged as course_view, glossary_view, assignment_view, assignment_upload, quiz_view, glossary_update, goal_setting_scale. When the mean values of these behaviors are examined, the fact that the average scores of the students in Cluster 3 (n=12) are higher indicates that the online SRL skills of the students in Cluster 3 based on the interaction data are higher in Goal_Setting. On the other hand, the statistical information obtained as a result of the analysis (ANOVA) implemented in order to see whether the interaction data of the events associated with the Goal Setting skill of the online students is meaningful in clustering is presented in Table 3.

Table 3. ANOVA Analysis Results Regarding Goal Setting Dimension

Variables	Cluster		Error		F	p
	Mean Square	df	Mean Square	df		
Course View (S-C)	2145075,590	2	14571,401	50	147,211	,000
Glossary View (S-C)	51904,162	2	2826,499	50	18,363	,000
Assignment View (S-C)	111825,016	2	3952,913	50	28,289	,000
Assignment Uploaded (S-C)	490,723	2	30,521	50	16,078	,000
Quizz View (S-C)	7993,147	2	281,874	50	28,357	,000
Glossary Updated (S-C)	6,126	2	3,849	50	1,592	,214
Hedef_Belirleme_Slçek	21,076	2	14,691	50	1,435	,248

Overall, it has been observed that ***course_view***, which is among the interaction behaviors of the online students splitted into 3 clusters, has come to the fore significantly, while the ***assignment_view*** and ***qlossary_view*** behaviors based on the student-content interaction type are seen to be secondly. Therefore, it can be thought that the course_view interaction behavior of online students in the goal setting dimension is an event that should be taken into account.

Environment Structuring

Interaction data and scale data based on online students' SRL skills were used as analysis input. As a result of the analysis, it is shown in Table 4 that the students with the environment dimension divided into three clusters.

The system interactions used to identify the students in three clusters that emerged as a result of the analysis, formed the interaction behaviors of the students' online SRL skills in Table 5 below.

Table 5. Cluster Means of Interaction Behaviors by K-Means Algorithm

Variables	*Cluster 1 (n=25)*	*Cluster 2 (n=19)*	*Cluster 3 (n=9)*
Course View (S-C)	618	296	1126
Forum View (S-C)	84	28	217
Environment_Structuring_Scale	15	14	15

The interaction behaviors of online students in the context of Environment_Structuring dimension emerged as course_view, forum_view, environment_structuring_scale. When the mean values of these behaviors are examined, it is seen that the scores based on the interactions of the students are higher in Cluster 3 (n=9) than the others. On the other hand, environment_structuring_scale behavior emerged as the the least average score in this cluster. When the average scores of the students for the behaviors in Cluster 1 (n=25) and Cluster 2 (n=19) were examined, it was seen that Cluster 1 had a higher average score than Cluster 2. At this point, Cluster 1 (n=25) is clusters created by Environment_Structuring_Adequate and Cluster 2 (n=19) is set by students for Environment_Structuring_Undeveloped. The statistical ANOVA test information obtained as a result of the analysis of is presented in Table 6.

Table 6. ANOVA Analysis Results on Dimension of Environment_Structure

Variables	Cluster		Error		F	p
	Mean Square	df	Mean Square	df		
Course View (S-C)	2123543,247	2	15432,694	50	137,600	,000
Forum View (S-C)	109405,324	2	5043,452	50	21,693	,000
Environment_Structuring_Scale	4,298	2	9,893	50	,434	,650

When Table 6 is examined, it is concluded that behaviors other than "Environment_Structuring_Scale" interaction behavior are significant in categorizing them into clusters. In addition, when the F values in the Table 6 are examined, it can be concluded that the most effective interaction behaviors of clusters are ***course_view*** (S-C) (F=137,600, p<0.01) and ***forum_view*** (S-C) (F=21,693, p<0.01).

Task Strategies

The system interactions used to define the students in the three clusters that emerged as a result of the analysis in the dimension of Task_Strategies for SRL skills determined based on the interaction data of online students. The distribution of these behavioral clusters are shown in Table 8 below.

Table 8. Cluster Means of Interaction Behaviors by K-Means Algorithm

Variables	*Cluster 1 (n=25)*	*Cluster 2 (n=16)*	*Cluster 3 (n=12)*
Course View (S-C)	568	269	1058
Glossary View (S-C)	81	26	149
Assignment View (S-C)	181	102	282
Assignment Uploaded (S-C)	16	10	21
Chat View (S-S)	37	16	78
Chat Sent (S-S)	17	4	64
Forum Viewed (S-S)	20	7	69
Chat View (S-T)	23	4	50
Book View (S-C)	10	3	15
Forum Created (S-S)	1	1	3
Forum Created (S-T)	2	0	9
Forum Viewed (S-T)	3	1	5
Glossary Updated (S-C)	1	0	1
Forum Updated (S-T)	0	0	0
Task_Strategies_Scale	12	11	12

When table 8 is examined, the interaction behaviors of online students in the context of Task_Strategies skill have emerged as ***course_view***, ***glossary_view***, ***assignment_view***, ***assignment_upload***, chat_view, chat_sent, ***forum_view***, resource_view, forum_created, glossary_updated, forum_updated, task_strategies. When the average values of these behaviors were examined, it was seen that the average scores of the students in Cluster 3 (n=12) based on their interaction behaviors were higher. As a result of the average scores based on the interaction behaviors, it was revealed that the online SRL skills of the students in Cluster 3 were higher in Task_Strategies. At this point, this cluster can be called the Task_Strategies Advanced students. ANOVA (One-Way Analysis of Variance) test was conducted in order to examine the significance values of related behaviors in creating clusters in the dimension of

Task_Strategies based on the interaction data of online students' statistical information is presented in Table 9.

Table 9. ANOVA Analysis Results for Task Strategies Dimension

Variables	Cluster		Error		F	p
	Mean Square	df	Mean Square	df		
Course View (S-C)	2145075,590	2	14571,401	50	147,211	,000
Glossary View (S-C)	51904,162	2	2826,499	50	18,363	,000
Assignment View (S-C)	111825,016	2	3952,913	50	28,289	,000
Assignment Uploaded (S-C)	490,723	2	30,521	50	16,078	,000
Chat View (S-S)	13636,536	2	923,653	50	14,764	,000
Chat Sent (S-S)	13551,743	2	2842,866	50	4,767	,013
Forum Viewed (S-S)	14172,852	2	855,842	50	16,560	,000
Chat View (S-T)	7289,450	2	1114,526	50	6,540	,003
Book View (S-C)	502,877	2	74,460	50	6,754	,003
Forum Created (S-S)	18,704	2	11,013	50	1,698	,193
Forum Created (S-T)	271,877	2	30,025	50	9,055	,000
Forum Viewed (S-T)	47,545	2	50,313	50	,945	,396
Glossary Updated (S-C)	6,126	2	3,849	50	1,592	,214
Forum Updated (S-T)	1,132	2	1,778	50	,636	,533
Task_Strategies_Scale	7,502	2	9,080	50	,826	,444

When table 9 is examined, it is presented that the results obtained in the distribution of the other clusters are statistically significant, except for Forum_Created (S-S), Forum_View (S-T), Glossary_Updated (S-C), Forum_Updated (S-T), Task_Strategies_Scale behaviors.

Time Management

The values of the data set grouped in three different sets of Time Management, whose cycle is based on the interaction data of the students, are shown in the relevant table. The system interactions used to identify the students in the three clusters that emerged as a result of the analysis, the interaction behaviors of the students' online SRL skills analysis. The distribution of these behaviors clusters is shown in Table 11 below.

Table 11. Cluster Means by K-Means Algorithm

Variables	*Cluster 1 (n=9)*	*Cluster 2 (n=5)*	*Cluster 3 (n=39)*
Course View (S-C)	11000	719	77918
Assignment View (S-C)	269282	107488	115940
Forum Viewed (S-C)	205221	1892936	96811
Chat View (S-T)	1546742	436310	114905
Book View (S-C)	40524	84238	61638
Time_Managemen_Scale	9	7	9

When Table 11 is examined, the interaction behaviors of online students in the context of Time_Management dimension are course_view, assignment_view, ***chat_view***, ***forum_view***, resource_view, time_management_scale interaction behaviors. When the mean values of these behaviors are examined, it is seen that the mean scores based on the interaction behaviors of the students in Cluster 3 (n=39) are higher than the others. When the mean scores of the students in Cluster 1 (n=9) and Cluster 2 (n=5) were examined, it was seen that Cluster 1 had a higher average score than Cluster 2. At this point, if Cluster 1 (n=9) is Sufficient in Time Management and Cluster 2 (n=5) called as Time Management Undeveloped. ANOVA test was conducted in order to analyze the statistical results of the behavior of the Time Management dimension of the SRL skill determined within the framework of the interaction data of the online students. The statistical information obtained as a result of this analysis is presented in Table 12.

Table 12. ANOVA Analysis Results on Time Management Dimension

Variables	Cluster Mean Square	df	Error Mean Square	df	F	p
Course View (S-C)	25836402795,788	2	119678957420,130	50	,216	,807
Assignment View (S-C)	89106379232,006	2	99411649516,493	50	,896	,415
Forum Viewed (S-C)	7182872509623,199	2	142011829103,848	50	50,579	,000
Chat View (S-T)	7502238929652,405	2	124494501763,439	50	60,262	,000
Book View (S-C)	3227149317,040	2	15933923217,063	50	,203	,817
Time_Management_Scale	13,836	2	6,645	50	2,082	,135

When table is examined, it is seen that the distribution of other interaction behaviors to clusters, except for course_view (S-C), assignment_view (S-C), book_view (S-C), Time_Management_Scale behaviors, are significant.

Help Seeking

The interactions used to identify the students in three clusters whose help seeking were created based on interaction data of online students' SRL skills clusters are shown in Table.

Table 14. Cluster Means of Behaviors by K-Means Algorithm

Variables	*Cluster 1 (n=42)*	*Cluster 2 (n=10)*	*Cluster 3 (n=1)*
Chat View (S-S)	28	77	168
Chat Sent (S-S)	14	32	356
Forum Viewed (S-S)	18	51	180
Chat View (S-T)	46	205	264
Chat Sent (S-T)	38	122	664
Forum Created (S-C)	2	7	12
Forum Created (S-S)	1	2	20
Forum Created (S-T)	1	7	32

Forum Viewed (S-T)	1	9	20
Forum Updated (S-T)	0	0	4
Help_Seeking_Scale	12	13	11

When table 14 is examined, interaction behaviors of online students in the context of help_seeking skill are ***chat_view***, ***chat_sent,*** forum_view, ***forum_created***, forum_updated, help_seeking_scale. When the average values of these behaviors are examined, the mean scores of the behaviors based on interaction data of the student in Cluster 3 (n=1) are higher than the others. As a result of the average scores of interaction behaviors, it was seen that the Help_Seeking dimension of the online SRL skills of the student in Cluster 3 was higher than the other clusters. At this point, this cluster called the Help Seeking Advanced. On the other hand, the statistical information obtained as a result of the One-Way Analysis of Variance (ANOVA) test of the online students is presented in Table 15.

Table 15. ANOVA Analysis Results for Help Seeking Dimension

Variables	Cluster Mean Square	df	Error Mean Square	df	F	p
Chat View (S-S)	17939,240	2	751,544	50	23,870	,000
Chat Sent (S-S)	57531,396	2	1083,680	50	53,089	,000
Forum Viewed (S-S)	16236,106	2	773,312	50	20,996	,000
Chat View (S-T)	119032,814	2	1222,470	50	97,371	,000
Chat Sent (S-T)	210718,234	2	6427,808	50	32,782	,000
Forum Created (S-C)	158,452	2	14,082	50	11,253	,000
Forum Created (S-S)	185,695	2	4,334	50	42,849	,000
Forum Created (S-T)	544,548	2	19,118	50	28,484	,000
Forum Viewed (S-T)	399,606	2	36,230	50	11,030	,000
Forum Updated (S-T)	7,299	2	1,531	50	4,766	,013
Help_Seeking_Scale	5,647	2	9,528	50	,593	,557

When table 15 is examined, it is seen that they are statistically significant in separating the other behaviors into clusters, with the exception of the "Help_Seeking_Scale" behavior. In addition, when F values are examined, the most effective behaviors in the formation of clusters are chat_view (S-T) (F=97,371, $p<0.01$) and chat_sent (S-S) (F=53,089, $p<0.01$).

Self Evaluation

K-Means clustering algorithm was applied to define the Self-Evaluation dimension based on the interaction data of the students. The system interactions used to identify the students in the three clusters that emerged as a result of the analysis, interaction behaviors of the students' online SRL skills behaviors into clusters is presented in Table 17 .

Table 17. Cluster Means of Behaviors by K-Means Algorithm

Variables	*Cluster 1 (n=16)*	*Cluster 2 (n=33)*	*Cluster 3 (n=4)*
Assignment View (S-C)	82	202	387
Assignment Uploaded (S-C)	7	18	26
Quizz View (S-C)	18	44	93
Quizz Review (S-C)	8	30	66
Chat View (S-S)	3	14	29
Forum Created (S-S)	0	1	7
Self_Evaluation_Scale	12	14	12

When table 17 is examined, the interaction behaviors of online students in the context of Self-Evaluation dimension are assignment_view, assignment_upload, quizz_view, quizz_review, chat_view, forum_created, self_evaluation_scale. When the average values of these behaviors were examined, the mean scores of online students in Cluster 3 (n=4) based on their interaction behaviors were higher than the others. On the other hand, the statistical information obtained as a result of the ANOVA of the Self-Evaluation skill based on the interaction data of online students is presented in Table 18.

Table 2. ANOVA Analysis Results for Self-Evaluation Dimension

Variables	Cluster		Error		F	p
	Mean Square	df	Mean Square	df		
Assignment View (S-C)	171219,319	2	1577,141	50	108,563	,000
Assignment Uploaded (S-C)	928,296	2	13,018	50	71,311	,000
Quizz View (S-C)	9892,682	2	205,893	50	48,048	,000
Quizz Review (S-C)	6161,666	2	238,979	50	25,783	,000
Chat View (S-S)	1269,742	2	332,099	50	3,823	,029
Forum Created (S-S)	76,417	2	8,705	50	8,779	,001
Self_Evaluation_Scale	16,924	2	14,285	50	1,185	,314

When table 18 is examined, other behaviors are statistically significant created of then clusters, with the exception of the “Self-Evaluation_Scale” behavior. In addition, when the F values are examined, the most effective interaction behavior is ***assignment_view*** (S-C) (F=108,563, p<0.01), ***assignment_uploaded*** (S-C) (F=71,311, p<0.01), ***quizz_view*** (S-C) (F=48,048, p<0.01) and ***quizz_review*** (S-C) (F=25,783, p<0.01). The least effective behaviors are chat_view (S-S) (F=3,823, p<0.01), forum_created (S-S) (F=8,779, p<0.01).

Overall

As a result of the analysis, online students were divided into 3 clusters according to their self-regulation skills in each dimension. The clusters and the number of students who are advanced, sufficient and undeveloped students are presented in table 19.

Table 19. As a result of the analysis, clusters consisting of advanced, sufficient and undeveloped students

Constructed Clusters	*Advanced*	*Sufficient*	*Undeveloped*
Goal Setting	N=12 (S3, S7, S8, S9, S12, S17, S18, S27, S30, S31, S40, S42)	N=25 (S1, S2, S4, S5, S10, S13, S14, S15, S23, S24, S25, S28, S29, S33, S34, S36, S37, S38, S41, S43, S46, S49, S50, S52, S53)	N=16 (S6, S11, S16, S19, S20, S21, S22, S26, S32, S35, S39, S44, S45, S47, S48, S51)
Environment Structure	N=9 (S7, S8, S9, S12, S18, S27, S30, S40, S42)	N=25 (S2, S3, S5, S10, S13, S14, S15, S17, S23, S24, S25, S28, S29, S31, S33, S34, S36, S37, S38, S41, S43, S49, S50, S52, S53)	N=19 (S1, S4, S6, S11, S16. S19, S20, S21, S22, S26, S32, S35, S39, S44, S45, S46, S47, S48, S51)
Task Strategies	N=12 (S3, S7, S8, S9, S12, S17, S18, S27, S30, S31, S40, S42)	N=25 (S21, S2, S4, S5, S10, S13, S14, S15, S23, S24, S25, S28, S29, S33, S34, S36, S37, S38, S41, S43, S46, S49, S50, S52, S53)	N=16 (S6, S11, S16, S19, S20, S21, S22, S26, S32, S35, S39, S44, S45, S47, S48, S51)
Time Management	N=39 (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S13, S17, S18, S20, S22, S23, S24, S25, S27, S28, S29, S30, S33, S34, S35, S36, S37, S38, S40, S42, S43, S44, S45, S47, S48, S50, S51, S52, S53)	N=9 (S12, S14, S15, S19, S21, S26, S31, S46, S49)	N=5 (S11, S16, S32, S39, S41)
Help Seeking	N=1 (S40)	N=10 (S2, S3, S5, S7, S9, S12, S28, S30, S34, S43)	N=42 (S1, S4, S6, S8, S10, S11, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S29, S31, S32, S33, S35, S36, S37, S38, S39, S41, S42, S44, S45, S46, S47, S48, S49, S50, S51, S52, S53)
Self Evaluation	N=4 (S3, S18, S27, S40)	N=33 (S1, S2, S4, S5, S7, S8, S9, S10, S11, S12, S13, S14, S17, S19, S20, S23, S24, S25, S28, S29, S30, S31, S33, S34, S36, S38, S41, S42, S43, S46, S50, S52, S53)	N=16 (S6, S15, S16, S21, S22, S26, S32, S35, S37, S39, S44, S45, S47, S48, S49, S51)

The Relationship of Clustered Students with Academic Achievement

The relationships between the profiling of students based on interaction data in the context of online SRL skills and academic achievement are presented in the following headings.

Goal Setting & Academic Achievement

Variables	Variance Source	Sumof Squares	df	Mean Square	F	p
Goal setting	Between Groups	2970,689	2	1485,344	8,745	0,001
	Within Groups	8492,566	50	169,851321		
	Total	11463,255	52			

The cluster analysis mean scores show that the events of course_view, assignment_view, glossary_view receive more interaction and these events come to the fore in students with high GS. The glossary updated event with a lower average score was negligible and glossary_updated event was found to be meaningless in the ANOVA test results. The course_view event is found important to have GS skills and students who interact more with the course content have high GS skills. In addition, online students goal setting skills is significantly relationship with the academic achievement on ANOVA results [F (2-50)=8, 745, p< 0.01].

Environment Structuring & Academic Achievement

Variables	Variance Source	Sumof Squares	df	Mean Square	F	p
Environment structuring	Between Groups	3265,381	2	1632,691	9,958	,000
	Within Groups	8197,873	50	163,957		
	Total	11463,255	52			

The cluster analysis mean scores indicate that course_view, forum_view, events get more interaction and students with high ES skills also come to the fore. No other event with a lower mean score was found. The effect of this ES cluster on academic achievement is significantly related according to ANOVA test results [F (2-50)= 9,958, p< 0.01].

Task Strategies & Academic Achievement

Variables	Variance Source	Sumof Squares	df	Mean Square	F	p

Task strategies	Between Groups	2970,689	2	1485,344	8,745	,001
	Within Groups	8492,566	50	169,851		
	Total	11463,255	52			

It is found that the events of course_view, assignment_view, glossary_view and chat_view received more interaction regarding students with high TS skills. On the other hand, forum_created_SS, forum_view_ST, glossary updated and forum_updated events with low mean scores were found to be negligible. ANOVA test results were also found to be meaningless. TS cluster on academic achievement is significantly related according to ANOVA test results [F (2-50)= 8, 745, p< 0.01].

Time Management & Academic Achievement

Variables	Variance Source	Sumof Squares	df	Mean Square	F	p
Time Management	Between Groups	439,589	2	219,794	,997	,376
	Within Groups	11023,666	50	220,473		
	Total	11463,255	52			

In the context of cluster analysis mean scores, it is seen that forum_view, chat_view, events get more interaction and these events come to the fore in students with high TM skills. On the other hand, the course_view, assignment_view, book_view events with lower mean scores were negligible within the framework of this variable, and the ANOVA test results were found to be meaningless. Beside this, the effect of this TM cluster on academic achievement is no significantly related according to ANOVA test results [F (2-50)= 0, 997, p>0.01].

Help Seeking & Academic Achievement

Variables	Variance Source	Sumof Squares	df	Mean Square	F	p
Help Seeking	Between Groups	755,011	2	377,505	1,763	,182

	Within Groups	10708,244	50	214,165		
	Total	11463,255	52			

The cluster analysis show that chat_view and chat_sent events get more interaction and students with high HS skills. Thus, chat_view and chat_sent events were important within the framework of student-student_SS and student-teacher_ST interactions in online students' having HS skills. Accordingly, students who interact with these events have high HS skills. Beside this, the effect of this HS cluster on academic achievement is no significantly related according to ANOVA test results [F (2-50)= 1, 763, p>0.01].

Self Evaluation & Academic Achievement

Variables	Variance Source	Sumof Squares	df	Mean Square	F	p
Self Evaluation	Between Groups	3456,340	2	1728,170	10,792	,000
	Within Groups	8006,914	50	160,138		
	Total	11463,255	52			

Students with high SE skills interacted more with assignment_view, quizz_view, quizz_review events. Accordingly, the students interacted via assignment view event and quizz events have high SE skills. The effect of this SE cluster on academic achievement is significantly related according to ANOVA test results [F (2-50)= 10, 792, p< 0.01].

4.Discussion and Conclusion

Researchers argue that successful students actively participate in their learning in terms of regularly, self-evaluating their learning, asking questions when they need help, and attentively communicating with others (You, 2016). One can infer that students' online interactions in learning activities reflect SRL and may influence in academic performance. Several studies that utilized LMS data have shown that participation indicators and patterns are strongly correlated with academic achievement (Asarta & Schmidt, 2013; Goldstein & Katz, 2005; Michinov et al., 2011; Rafaeli & Ravid, 1997). Similarly, other studies have reported the benefits of utilizing learning analytics in terms of retention and the prevention of academic failure (Campbell et al., 2007; Dietz-Uhler & Hurn, 2013; Jayaprakash, Moody, Lauría, Regan, & Baron, 2014). Self-regulation failures in online learning contexts have been suggested to lead to greater detrimental effects (Dabbagh & Kitsantas, 2004; Jonassen, Davidson, Collins, Campbell, & Haag, 1995; King, Harner, & Brown, 2000; Warnock, Bingham, Driscoll, Fromal, & Rouse, 2012) compared with those obtained from failures in traditional learning environments. The results derived from a naturalistic experiment among a cohort of first year engineering students showed that positive and negative self-regulated strategies affected both the interaction with online activities and academic performance (Pardo, Han, & Ellis, 2016).

Ths sub dimensions of SRL may affect academic achievement differently. For example, the fact that students with a high Goal Setting skills score have more interactions with the content indicates that the course_view event is important in this dimension. Therefore, it has been emphasized in various studies that interaction with the content increases the engagement to the courses so that goal-oriented students performs highly correlated with the their SRL skills (Cho, Cheon, & Lim, 2020). In contrast to prior studies Jo et al. (2015), in this study, time management is not significianlty correlated with the academic achievement. The order of log in and the log in time, which are kept in the log records of the adult students on the LMS system, positively affect their learning performance.

Overall, the results show that different self-regulated skills presented by online learners results different interactions in various online tools and this affect academic achievements.

5. Suggestions

The indicators that emerge as a result of the self-regulation skills-based clusters of online students are gathered with the help of affordances of the LMS. In future studies, considering the clusters some artificial intelligence techniques may be applied to provide support for students. On the other hand, in this study, online interaction behaviors indicating the time management and the help-seeking dimensions did not provide meaningful relationships with academic achievements. We think, this interesting finding is remarkable to be examined in future study in depth. We hope this study may shed a light for examining online SRL via learning analytics techniques.

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Inquiry on Technology Use and Practices During the Pandemic: Experiences and Challenges from Selected Countries

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Introduction

The COVID-19 pandemic impacted all levels of society worldwide. The literature provides lessons on how schools and higher education institutions cope with disruptions and challenges. With limited access and lockdowns in most places in 2021, teacher preparation programs found the situation problematic in getting their students complete onsite practical experiences such as practicum, internship, and student teaching.

The researcher wondered how different institutions in other countries cope with the rapidly changing scenario caused by the pandemics. Also, he asked questions on how faculty members, students, and administrators used technology to support teaching and learning practices. In reaching out to individuals for answers, he collected thoughts and stories that provided snippets of understanding of what happened during the pandemic.

This paper attempts to provide a snapshot of experiences and challenges during the pandemic's second year. It describes and discusses actions and responses to the pandemic by teacher education programs in higher education institutions in India (Joshi, Binay & Bhaskar, 2020), Namibia (Boer & Asino, 2022), Nigeria (Eze, Sefotho, Onyishi, & Eseadi, 2021), and the United States (Leech, Gullet, Cummings, & Haug, 2022).

Methodology

Based on the written narratives and conversations with four participants from other countries and the United States, the researcher described what they saw and heard as they managed the impact of the pandemic on their university's teacher education programs. The descriptive study inquired about the use of technology, the challenges of teaching, and changes in program policies.

Using a snowball sampling strategy, the researcher recruited faculty members in teacher education programs in several countries, including the United States. As a non-probability sampling technique, the method uses existing subjects to provide "referrals to recruit samples required for a research study" (para #1). However, instead of starting with one subject, the lead author/researcher solicited information from a source and identified other individuals. A potential participant received an invitation to participate.

As a sampling technique, snowballing "can be extensively used for conducting qualitative research, with a population that is hard to locate." The researcher informs the individuals identified that the information shared would be reported in a publication. Researchers first need to develop that kind of rapport with the participants, agreeing to the potential of being identified as an individual or group. The sampling technique might require more time to complete. The researcher analyzes the data of feedback and opinions after receiving them from the respondent. The data collected can be qualitative or quantitative and represented in graphs and charts.

Data Collection

For the data collection, the researcher used a recruitment strategy similar to snowball sampling. After connecting with several teacher education faculty, the researcher recruited nine individuals from seven countries to participate in the project. In providing structure to the data collection, the participants received a set of questions categorized into eleven inquiry areas.

1. Degree program information
2. Curricular content knowledge and skills
3. Instructional framework or pedagogical approach
4. Recruitment and admission
5. Student population
6. Graduation requirements
7. Faculty background
8. Technology use and practices before and during the pandemic
9. Challenges to teaching before and during the pandemic
10. Program policy changes
11. Context and culture.

After the initial collection, four of the nine participants responded to the set of questions. The participants came from India, Namibia, Nigeria, and the United States. Half of the participants identified as male, and the rest as female.

Using a table created in a Word application, the researcher typed in the responses collected from each participant (Column) for each area (Row). Once the transfer of information from word documents to a table (see Figure 1), the researcher scheduled a meeting with each respondent to review the summary of responses given the questions for each area of inquiry.

Figure 1. Example of a Table Format Used to Prepare Data Collected for Analysis

Participant	Country of Location	Data Supporting an Area of Inquiry
A	India	
B	Namibia	
C	Nigeria	
D	USA	

The meeting with participants allowed the researcher to confirm the accuracy of the data collected. Also, the researcher had opportunities to ask clarifying questions related to interpreting the narrative given contexts not initially included in the written responses. After completing all meetings with the participants, the researcher made edits and additions to the initial written submissions.

Data Analysis

For each area of inquiry, the researcher created a table containing the responses of each individual representing a country for eleven tables. The researcher used content analysis as a strategy to code the contents of each table. The coding of the narrative from the participants provided opportunities to identify significant themes and similar patterns across the four data sources in a given area of inquiry.

After analyzing themes and patterns, the researcher chose which area to report. Initially, there are eleven areas of inquiry. Still, for this paper, the researcher focused on the teacher education programs' goals and instructional focus and how they responded to the pandemic using technology to support delivery. Also, the paper included a discussion of policy changes made in response to the impact of the pandemic.

Findings

Based on participants' responses to the inquiry, the researcher used summary tables focusing on the six areas of inquiry to facilitate understanding of the results. Three summary tables focused on the degree program, curricular content knowledge and skills, and instructional framework or pedagogical approach. The remaining tables presented a narrative about the impact of the pandemic, such as technology use and practices, challenges to teaching, and policy changes. The paper highlights the significant themes found in each area of inquiry.

Degree Program

The researcher asked participants to describe their institutions' teacher education programs (at least one). All participants reported that their institutions deliver a teacher education program. However, the degree offerings differ from each institution. Participant A said those who want to teach must pursue a second-degree focus on teacher education. Other participants (B, C, D) reported that students completed only one degree in education to become educators.

Most degree programs reported (India, Nigeria, and the USA) that students have options of teaching from a select block of different subject areas. Participant B (Namibia) mentioned that this was not the case for the university. Participants reported that their program curriculum includes content focusing on diversity issues and skills for adapting to changing situations. However, the emphasis varies across institutions.

Most participants reported that students can choose to take partially or fully online courses, except for Participant B (Namibia), saying that class offerings are still in face-to-face mode. The program's completion time pointed to four years. However, the time taken to complete the degree can vary by student, depending on individual progress or credits transferred, if applicable. Finally, three participants have similar starting dates for their academic year except for Participant A (India), which starts school in January.

Curricular Content Knowledge and Skills

The teacher education program curriculum seems to vary across participants' institutions. A report from Participant A stated an extensive amount of curricular content covered in four semesters. Other participants reported that their curriculum coverage does not have the same issues that Participant A wrote. Two participants said that their curriculum includes teaching the use of technology to support student learning. Most programs focused on preparing teachers to teach in subject areas. However, Participant D described that the program chosen to write about has a curriculum focused on special education. Finally, Participant B shared that during the COVID-19 pandemic, the university created the current curriculum to mitigate the negative impact on the educational system.

Instructional Framework or Pedagogical Approach

Participant A (India) reported that the teacher education degree program focuses on developing the core teaching skills and competencies of post-graduate students. The university modeled the program on Outcome Based Educational (OBE) practices and the revised taxonomy of Benjamin S. Bloom. Participant B (Namibia) reported that the current degree program resulted from the work completed by instructional designers and curriculum developers. Participant C's degree program uses a school community-based approach. Finally, Participant D shared that the degree program requires admission to the teacher education program first before students can enroll in professional education courses. The students must meet the certification assessment required by the State's Professional Standards Commission.

The instructional framework used by the various degree programs considers developing students' skills in working in face-to-face or online settings, given the COVID-19 situation. However, Participant D's degree program, specifically the Special Education program, centers around acquiring skills in delivering teaching methods in all modalities: online, hybrid, and face-to-face.

Participants reported that their degree programs include field experiences before graduation. The in-field experiences could take the form of teaching in a public school (similar to student teaching) and completing an internship. The length of time to complete these field experiences varies across programs. However, Participant D conveyed that teacher education students completing field experiences received supervision from qualified cooperating teachers who evaluated their classroom performance.

Technology Use and Practices Before and During the Pandemic

Participants reported changing their teaching practices during the pandemic due to the university closing, access to physical space, and Internet connectivity issues. Many institutions were forced into a new situation regarding teaching remotely and had to experiment with technology and use whatever technological skills they already possessed. Participants A reported that the program started online classes and provided training to faculty and students on using various technology-based tools, such as Google Classroom, Google Meet, TeachMint, and Webex, among others. Participant B's university provided students with modems with data to use. Training opportunities mushroomed for learning how to use Zoom, Skype, and Google Meet in teaching. Participant C reported that the faculty and students at the university had a more challenging time adjusting.

Participant D stated that faculty members' attitudes toward teaching and technology seemed far more positive. The pandemic highlighted the need to find innovative ways to increase collaboration and networking and seek solutions to problems. Faculty used creative problem-solving to include virtual break-out rooms to allow students the opportunity to collaborate. Faculty and students faced many challenges transitioning to virtual learning due to the pandemic. However, in the department, there was significant use of technology before the pandemic, which made the transition much less challenging.

Challenges to Teaching Before and During the Pandemic

Challenges in teaching with technology are not new. However, the pandemic's impact on communities, especially those involved in education, caught everyone off-guard. A significant challenge focused on the lack of preparation or readiness in using technology to support teaching and learning. Faculty members and their students have limited knowledge and skills to use technology. Participant A (India) shared that the lack of know-how to design learning experiences and online assessments hindered faculty members. Also, a related barrier to teaching surfaced involving one's inability to integrate technology tools and digital resources into the curriculum. Participant B identified other faculty training issues with teaching online, such as the ineffective use of web-based applications (e.g., Zoom, Google Meet, and Skype) to support online communication and interaction.

Poor Internet connectivity is a common refrain across participants' narratives. During the pandemic, challenges to teaching included the internet going down, apps freezing while teachers were teaching, and limited computer ownership, as some could not afford one.

The lack of access to technology devices contributed to the problem (Participant B). The situation contributed to the apprehension in transitioning towards emergency remote teaching (Participant C). On the positive side, Participant D reported that faculty and students were comfortable and confident in the virtual format, attributed to the technology-rich activities provided before the pandemic.

Participant D reported other challenges to teaching during the pandemic, including the need to identify additional classroom spaces for high-priority face-to-face courses and marking furniture with masking tape to indicate unusable seating, given social distancing requirements. Also, the inconvenience of wearing a mask or appropriate face-covering on campus and having to notify the health center to schedule a virtual appointment if showing symptoms of COVID-19 created a sense of imbalance in daily activities.

Program Policy Changes

Many higher education institutions changed the delivery of their teacher education degree programs, given the changing situation brought about by the COVID-19 pandemic. For Participant A, the university provided e-learning courses, e-learning platforms, and virtual tools training. Also, the faculty received encouragement to teach online and design syllabi with technology utilization, pedagogy, and practical application elements. Additionally, the faculty created virtual classrooms with evaluations and assessments administered online.

For Participant B, structural changes happened but not due to the pandemic per se. The university administration made the policy changes and eventually impacted the teacher education program. Similarly, Participant C mentioned that the policy changes required the faculty to use information and communications technology (ICT) in the classroom. Further, with the recommendations of the National Universities Commission (NUC), the government provided training to meet the ever-evolving needs of using and integrating technology to support teaching and learning. Finally, Participant D shared that the degree program developed an online option that allows students to pursue a high-quality education while fully employed.

Discussion

The findings included descriptions of degree programs, curricular content knowledge and skills, and instructional framework or pedagogical approaches. The researcher expected to find program types, curriculum focus, and instructional orientation variations. A response from Participant A about degree programs stood out because the students have completed their undergraduate degrees in specific disciplines and are returning to become educators. The program focuses on curriculum development and teaching skills toward degree completion. Other countries allow students to take significant teacher education courses after completing the general education curriculum. The students in Participant A's program have the advantage of an earned undergraduate degree in a specific disciplinary content (e.g., English, Math, and Science) before pursuing a second degree in teacher education. In contrast, Participants B, C, and D allow students to pursue teacher education at the undergraduate degree level.

Another finding focused on how each program managed the impact of the pandemic. Participants' written responses seem to say that their actions depend on available and accessible technology and resources. One teacher education program integrated technology into all courses before the pandemic, while the rest did not. The findings point to the struggle of these programs to connect their students online and transition to emergency remote teaching.

Finally, the researcher found that all participants experienced challenges in delivering the programs remotely or at a distance during the pandemic. Lessons learned from these narrative responses point out several things needed for faculty, students, and administrators to get up to speed in making their program viable. The participants seem to agree that there is a need for continuous training in using and integrating technology, stable Internet connectivity, affordability of technology devices, and accessibility of digital resources to support teaching and learning activities.

Conclusion

As an exploratory study, the researcher sees the potential for expanding knowledge on how teacher education programs beyond the United States have managed the impact or disruption created by the pandemic. Based on the initial analysis of the data collected from four participating individuals in different countries, it looks like the programs are making adjustments based on stakeholders' needs. However, the change process for the better seems to be moving at a slower pace, given the lack of infrastructure to facilitate online or blended teaching and learning activities. Further, participants identified the need for more faculty, students, and support staff training. All stakeholders must be ready once a higher education institution embarks on an alternative delivery mode beyond the face-to-face format.

In retrospect, the researcher believes in sharing practices, challenges, and innovative solutions to changing the higher education landscape, especially in teacher education programs. Knowing what is happening in other places is critical to adapt or perish from the deluge of challenges for those who are unprepared. Those who graduate from a teacher education program must equip themselves with knowledge and skills to respond to the changing educational environment brought about by current and emerging technology tools, applications, and resources. Also, they need to learn new and creative instructional approaches, given the diversity of student characteristics and capabilities.

The descriptive study is just a beginning effort to capture the actions and responses to the pandemic by those engaged in preparing teachers as professionals in the United States and abroad. It is an effort to document similarities and differences in practice and response to the pandemic with the existing contexts and demographics. The researcher plans to expand the number of study participants to understand how teacher education program faculty and administrators design and develop strategies and solutions for a better learning experience for would-be educators at all levels and disciplines.

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Investigating Theoretical Frameworks and Strategies for Instructional Video

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Video is increasingly becoming a mainstay in education and workplace training. In 2020, 74% of corporate training was delivered through video (Bouchrika, 2020). Despite this widespread usage, it is not clear when video instruction is the best media to achieve the desired behavioral and performance outcomes. For instance, videos do not consistently support learners in being able to recall information (Chen & Thomas, 2020; van der Meij, 2019). Researchers have been investigating all different aspects of the use of video for instruction to better understand what works, what doesn't work, and why. This understanding can help instructional designers when they are making decisions about including video as part of an overall instructional strategy.

The task for instructional designers is to select the video approach and technical features that are best suited to the instructional goals. However, the instructional designer has to consider many different aspects of the video that extend beyond the framing of the content (e.g., lecture, story, demonstration). There are developmental decisions about video length, perspective (i.e., first-person or third-person point of view), level of realism, and so much more. Throughout this paper, I will use the term "design decisions" to refer to the depth and breadth of Instructional Design decisions, which goes beyond the D in ADDIE. I begin with a literature review and an exploration of the current understanding of instructional video in practice.

Literature Review

In order to investigate the different uses of instructional video, it is important to define *instructional video.* In the broadest sense an instructional video is any moving picture that is used to provide instruction. Using a video as part of instruction does not make it an instructional video. If we think of pictures in a textbook, some are instructional and others are not. This could become complicated, but for purposes of this research, the video must provide instruction on its own or be critical to the instruction.

I conducted a literature review of peer-reviewed journal articles describing research into aspects of instructional video. I specifically wanted to understand what research has uncovered about different approaches using video for instructional purposes. I included studies in K-12, the university, medical schools, and the workplace, as long as the studies looked at aspects of video for instruction. I excluded studies that looked at uses and features for virtual meetings, virtual instructor led training, alternate reality/virtual reality, and even the use of video for data collection about training.

I began my literature review by looking at a 10-year period, but quickly realized that the technology was changing so quickly that a study from 10 years ago might not be relevant today. For example, van der Meij and van der Meij (2016) wanted to investigate the impact of review videos. In order to isolate the effect of the review video from the effect of rewatching a video, they removed the ability for learners to rewind or fast-forward. While this made sense with their research purposes, it demonstrated the impact of the pace of technological change. Today, most learners watch videos from an individual device and have controls over the player. The study was only 5 years old, yet today's learners have access to all the video controls, particularly as they watch videos on their own devices. For this reason, I restricted the literature to 5 years.

My literature review included articles from: *Journal of Workplace Learning, International Journal of Training and Development, British Journal of Education Technology, Multimedia Tools and Applications, Human Resource Development Quarterly, Educational Technology Research and Development, Performance Improvement Quarterly.* I had a total of 29 articles, and all but one involved an experiment or study of some kind. Most of the studies took place in an educational setting. Table 1 provides a count of the studies based upon different demographic information, including the location of the study.

Table 1

Demographics from Experimental and Quasi-Experimental Studies Included in Review

Ages of Participants (years)	**Number of Studies**
8-18	5
18-30	13
17 and older	4
Adults (ages not specified)	6
Location of study	
School (K-12)	6
College or University	17 *
MOOC	1
Medical School	1
Workplace	2 *
General public	2

Note. *Denotes inclusion of a study that is listed in both categories.

The age groupings provide a way to identify whether a study looked at school-age children, college-age adults, and larger ranges of adult ages. If a study did not provide ages, but specified adults, including college students, the study is listed under adults (ages not specified). The category of 17 and older is specifically for studies that indicated the age of adult participants. For example, Ramlatchan and Watson (2020) had participants aged 17-66 years old.

Location refers to where the study took place or, in the case of MOOC, where the video instruction was delivered. College or University includes vocational education, but MOOC is listed separately. Medical school is listed as a separate category because it is not fully a college, and it has some similarities with workplace training, specifically because it provides training on how to perform job-specific tasks. Further, one study (Cattaneo & Boldrini, 2017) took place in a dual vocational educational program and is counted under college or university and workplace. General public includes a study of YouTube videos and a study (Molnar, 2017) that did not identify the study environment, but was not school or work related. Only two studies were situated in the workplace despite the prevalence of the use of instructional video for workplace training. While the ideas learned in one context can inform research in other contexts, there is a need for more research into instructional video in the workplace.

Cognitive Theory of Multimedia Learning (CTML)

Fully half of the studies did not have a theoretical grounding for their research. The other half used theories commonly found in instructional design such as cognitive load theory, Bandura's theory of observational learning, constructivist theory, and the cognitive theory of multimedia learning (CTML). For this paper, I am limiting the discussion to CTML, which describes how people learn when faced with materials that combine words and images (Mayer, 2021). The words in multimedia instruction can be written or spoken, and the images can be still images or moving as in animations or video. CTML has many different principles that explain how people learn and interact with multimedia. For example, the signaling principle states that "important information should be highlighted through signaling" (Chen & Thomas, 2020, p. 2149). Another example is the dynamic drawing principle which states that "people learn better from a video lecture when the onscreen instructor draws graphics on a board while lecturing rather than referring to already drawn graphic" (Mayer et al., 2020, p. 841).

Since videos are multimedia in format, many researchers investigating instructional video have used the principles of CTML to inform their research. The literature demonstrated that these principles are limited in their application to instructional video, and this section discusses a few such examples.

One example comes from Chen and Thomas (2020) who investigated the principles of temporal contiguity and signaling. According to the temporal contiguity principle, the audio and visual of an action should be presented at the same time. The signaling principle says that "important information should be highlighted through signaling" (Chen & Thomas, 2020, p. 2149). Chen and Thomas compared the conditions of viewing an instructor drawing during a video to viewing partial motion (a series of still images similar to PowerPoint animation) and static images for lecture videos teaching concepts related to drag and lift with airplanes. In all of the videos, the images were the same, but the videos used different levels of animation or drawing. The full-motion condition showed images being drawn while the lecturer talked. The partial motion condition had a video of a PowerPoint slide where the appropriate image appeared as the lecturer spoke. The static image condition showed one static image (i.e., a PowerPoint slide) with all of the images shown from the beginning so that the learner had to know where to look as the instructor spoke. All participants saw three videos with one of the videos in each condition and answered a questionnaire after each video. Videos showing the instructor drawing had an effect on the learner's level of interest in the video but had no effect on learner's ability to pass a knowledge test (i.e., recall) or to apply the knowledge to a different situation (i.e., transfer).

Another CTML-related study (Fiorella et al., 2019) looked at the principle of gaze guidance, which says that "people learn better from a video lecture when the onscreen instructor shifts gaze between the audience and board while lecturing rather than looking only at the audience or board" (Mayer et al., 2020, p. 841). Fiorella et al. (2019) found that eye contact with the camera (i.e., students) led to better performance than eye gaze as an attention tool (i.e., gazing on what students should look at). Fiorella et al. investigated the effect of the instructor eye contact in lecture videos about human kidney function. Participants were undergraduates from educational psychology, and there were two conditions: (a) a conventional whiteboard with instructor's back to the camera and (b) a transparent white board with instructor facing the camera. Participants completed a retention test, transfer test, and a lecture engagement questionnaire. The eye contact group outperformed the traditional whiteboard group on transfer, but not on retention. The eye contact group also reported higher levels of engagement. There was no difference in self-reported mental effort or perceived difficulty. Fiorella et al.'s findings run counter to the principle of gaze guidance. In addition, Fiorella et al. discussed how the findings indicate that the instructor's presence on screen may provide benefits beyond helping learners know where to focus their attention.

The Role of the Instructor

Kokoç et al. (2020) investigated the role of the instructor on screen when teaching software and found that the instructor on screen was most helpful to the learners who had the greatest difficulty in focusing on the content. Kokoç et al. investigated different types of video lecture (voice over, picture-in-picture, and screencast) in teaching Python (i.e., software) to undergraduate students. The voice-over condition showed the PowerPoint slides that the instructor used for the lecture, but did not show the instructor's face. The picture-in-picture showed the PowerPoint slides along with a small image (video) of the instructor talking throughout the lecture. The screencast showed actual usage within Python as the instructor described what he was doing. Prior to beginning the study, participants took a computer-based test to determine their sustained attention levels. The lowest scores overall were from the low attention students in the screencast group. The finding related to the static images is particularly interesting given the dynamic drawing principle of CTML, which states that "people learn better from a video lecture when the onscreen instructor draws graphics on a board while lecturing rather than referring to already drawn graphics" (Mayer et al., 2020, p. 841). Learners with high attention had statistically significantly higher scores with videos that included the instructor's face along with the screencast as compared with videos that did not include the instructor's image. Learners with low attention also did better with the videos that had the instructor's face. According to Kokoç et al. these improved outcomes suggest that the instructor on screen may support the development of a social connection between instructor and student.

Ramlatchan and Watson (2020) also looked at the role of the instructor on screen. They used five different conditions for the same 20-minute video presentation about social media: instructor only, slides only, video switching (alternating view between the instructor and the slides), dual windows (slide and instructor shown side by side), and superimposed (the instructor superimposed in front of the slides). After watching the video, participants answered a questionnaire about the instructor's credibility and nonverbal immediacy. Instructor credibility is a combination of competence, concern for the learner, and trustworthiness. Nonverbal immediacy is a combination of different nonverbal communication techniques such as hand gestures, facial expressions, and vocal quality. The group that scored the highest for credibility was the dual windows group followed by the superimposed group. The instructor only scored the lowest for credibility. Thus, the slides only condition scored higher for instructor credibility even though the participants could not visually see the instructor. As for nonverbal immediacy, the highest score was the superimposed video followed by video switching, and then the instructor only. Ramlatchan and Watson suggested that having the instructor on screen is not enough--students expect to see slides as part of a lecture. The studies from Kokoç et al. (2020) and Ramlatchan and Watson demonstrate that the issues related to the instructor on screen are complex.

Importance of Culture

One interesting finding from the initial literature was related to the importance of culture in the design of instructional video. *Culture* is a set of beliefs, norms, and practices that are accepted by a group of individuals (Schein, 2017). There are local cultures, national cultures, and organizational cultures, and even occupational subcultures. It might be tempting to avoid considering the culture, especially since only one study (van der Meij, 2019) looked at the impact of culture within the context of instructional video. However, that one study demonstrates the importance of culture in the design of instructional video.

van der Meij (2019) researched the role of national culture on instructional video that teaches software. This is particularly interesting since one might assume that learning software is a culturally neutral activity. van der Meij investigated the use of advance organizers in video, and chose to conduct the study in China with Chinese students because: (a) there was a growing demand for Chinese developers to create training materials and (b) the design of the instruction varied depending upon whether it was created by Chinese or Western designers. According to van der Meij, Western students prefer to learn a single solution at first while Chinese students prefer to be presented with several different solutions. Thus, while a video created for a western audience would present a single approach, a Chinese audience would assume that the presentation of one single approach meant there was only one solution. van der Meij discussed the importance of considering the culture of the learning audience to design instructional videos that align with the learner expectations.

In order to consider the cultural needs, we need to look at what the broader literature on the role of national culture, organizational culture, and occupational subculture on training, regardless of whether the training uses video. I now discuss a few examples from the literature.

National culture - Knassmüller and Veit (2016) investigated how national culture affects hiring and promotion practices which then impact training participation and outcomes. Knassmüller and Veit looked at the training participation and outcomes among civil servants in Germany, Austria, Switzerland, and the Netherlands. In Germany and Austria, people perceived training as something that people did when and if they lacked expertise. Thus, training among Germans and Austrians was a sign of weakness or inexperience, and the civil servants in these countries were less likely to attend training.

Organizational culture - One aspect of organizational culture that affects training participation and outcomes is the hiring and promotion practices. Rodman et al. (2020) found that highly competitive promotion practices could lead to a culture where knowledge sharing is less likely, even if knowledge sharing is the critical learning modality within the organization. Rodman et al. studied the United States Coast Guard (USCG) where most formal training occurs prior to going to sea (i.e., afloat), and most on-the-job training occurs through knowledge sharing among USCG members when they are afloat. While all members of the afloat community seek to command a ship, a very small number of those who are qualified will be promoted to that level. Rodman et al. found that the competitive nature of promotion practices in the USCG led people to feel they needed to present themselves as being the best at all times, which then made them less willing to share knowledge with others (admitting mistakes could have detrimental effects on the sharer's career growth). At the same time, all participants mentioned needing shared knowledge more when they were afloat. In other words, the workforce recognized that knowledge sharing was an important component of their professional growth and development, but they did not feel comfortable sharing their knowledge with others.

Occupational subculture – An occupational subculture is a group of professionals who have cultural norms and practices related to the profession. Occupational subcultures have "their own unique sets of values, which influence what should be learnt, when and how, within their own group" (Mak & Hong, 2020, p. 238). These unique sets of values can sometimes conflict with those of the larger organization (Becker, 2018). In one example, the occupational subculture negatively affected firefighters' willingness to change their professional practice (Lucas & Kline, 2008). Lucas and Kline (2008) conducted a case study understand how occupational subculture among emergency medical services (EMS) professionals and firefighters affected training participation and outcomes. The municipality in the study sought to move from a volunteer fire department that had integrated emergency services to providing emergency services by cross-trained EMS professionals and firefighters. The participants included management, firefighters, and EMS professionals. The firefighters had a hierarchical structure and used this as an excuse to resist change, saying that they wanted to learn to do things differently but they could not because they were beholden to "tradition" (Lucas & Kline, 2008, p. 283). The EMS professionals had a culture that was more flexible where individuals made decisions on their own; as such, it was difficult for the EMS professionals to understand or relate to the challenge facing the firefighters.

The studies from Rodman et al. (2020), Knassmüller and Veit (2016), and Lucas and Kline (2008) do not address the role of culture in the design of instructional video, but they do indicate that culture plays a role in both training participation and outcomes. And if that training is provided in video form, then the design of the instructional video should consider the culture of the learners.

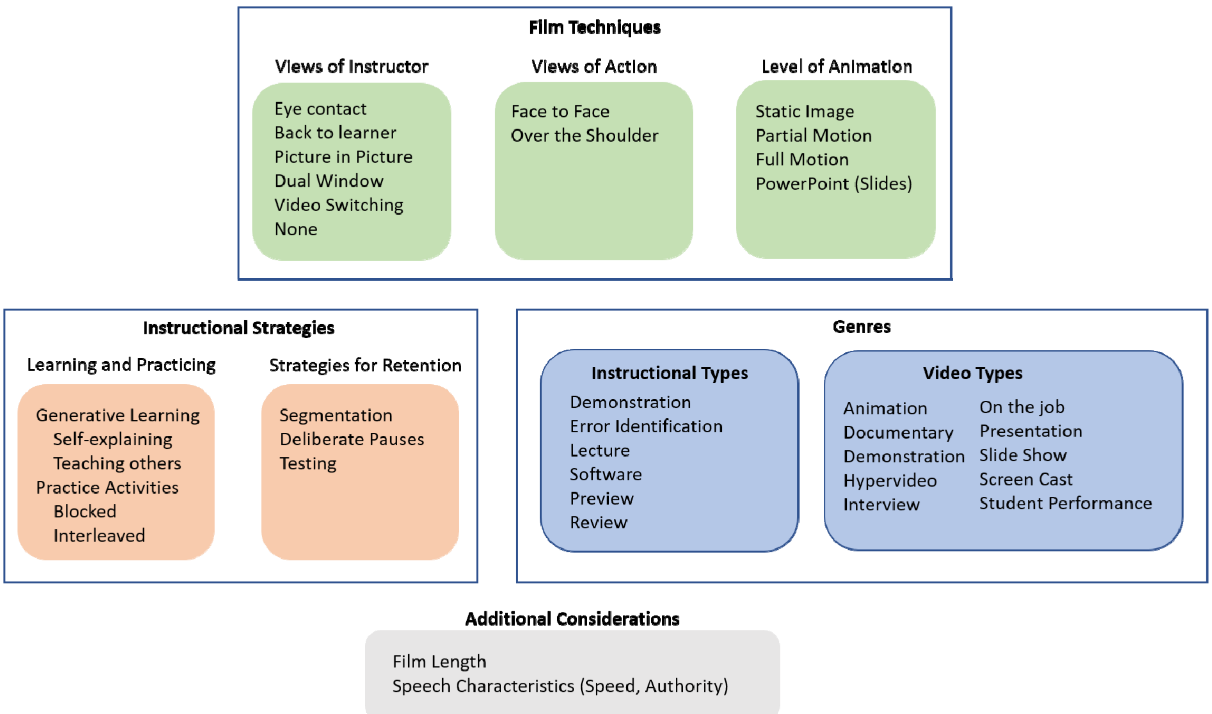
Instructional Video Design Choices

There are many factors that need to be considered when designing an instructional video. In order to understand all of these factors, I created a schematic that presents the different film techniques, instructional strategies, and genres that were discussed in the literature (Figure 1). The film techniques are divided into categories based upon approaches to creating video, and a video might include one item from each of the three subcategories. For example, a video might have the instructor making eye contact while showing the action from a face-to-face point of view, with full motion. Some of the combinations might be more beneficial to learners than others, and other combinations might be difficult to achieve.

The instructional strategies are divided based upon whether the focus of the strategy is for learning, practicing, or retention. And the genres are divided into instructional genres and video genres. As with film techniques, the subcategories may be combined in different ways.

The schematic does not include the instructional aspects of learning objectives, the type of learning (e.g., Gagné et al.'s (2005) five varieties of learning: intellectual skills, verbal information, cognitive strategies, motor skills, attitudes), the needs of the learners, and any unique environmental or cultural factors. For example, if the learning objectives include developing the ability to use a particular software (i.e., intellectual skills and motor skills), then the video should provide support for skill development. The video type might be Screen Cast or Slide Show. The instructional strategy for retention might be to: (a) include segmentation, which is when a video automatically pauses and the learner must take some action to make the video continue. in the video and (b) build testing into the video sequence. The film technique might involve including the instructor on screen. This is just one possibility for an approach to instructional video for software skill development, but there are many other combinations and permutations that might work equally well. It is possible that certain combinations are best suited to specific cultures and for specific varieties of learning, but that research was not found in this literature review.

Figure 1
Instructional Video Design Choices



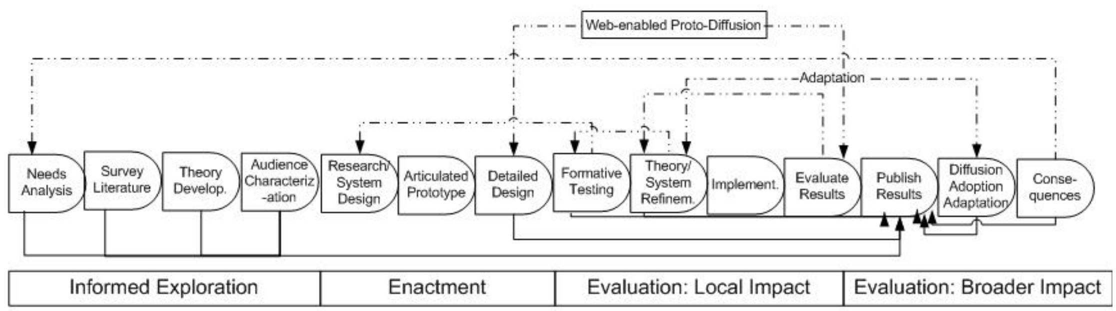
The diagram does not present desired connections or otherwise indicate the relationships between the different categories and subcategories, even apart from learning objectives and culture. The research is in its infancy with respect to determining these relationships and connections. As such this an initial diagram that will be revised as the field matures.

Design-Based Research

The problem of determining which instructional video approach(es) to use for a particular learning context is daunting if we rely upon research methods that separate out one (or even a few) components in order to determine which combinations provide the best outcomes. Further, conducting such research outside of the real-world context limits the application of the findings to those real-world environments. And instructional video is meant to be used with real learners in a real, and specific context. We need a research approach that is focused on solving complex challenges and addressing problems of practice. Design Based Research (DBR) provides us with a research approach that can help us meet this challenge. But DBR offers something else of significance: the ability to solve a real-world challenge even as we are researching the approach. Design Based Research is sometimes referred to as Education Design Research (EDR), and is a systematic approach to addressing problems of practice by designing and implementing learning solutions (i.e., interventions) while simultaneously building theory (McKenney & Reeves, 2019; Plomp & Nieveen, 2013).

As Figure 1 indicates, there is not one single problem of practice, but rather many problems of practice. Different contexts and different learning needs require different approaches, and research is needed for all of these. The integrative learning design framework (ILDF) is a DBR approach that allows for addressing local problems of practice through research and then researching those findings in broader contexts. Figure 2 depicts the ILDF (Bannan-Ritland, 2003). The four main phases within the ILDF are: informed exploration, enactment, evaluation: local impact, and evaluation: broader impact. Throughout each phase the researcher works with the community impacted by the problem in a co-design effort. Each phase is iterative and recursive. In addition, the entire process is recursive and iterative, allowing for researchers and practitioners to move forward and backward as needed.

Figure 2
Integrative Learning Design Framework (ILDF)



Note. From "The role of design in research: The integrative learning design framework" by Bannan-Ritland, 2003, *Educational Researcher, 32*(1), p. 22. Copyright by the Author and Educational Researcher.

During the informed exploration phase, the researcher-practitioner team are building their understanding of the specific training problem, and formulating their initial ideas about what is needed to solve the problem (Bannan-Ritland, 2003). They are identifying the requirements or features that will be needed. This stage includes activities typical of a needs analysis such as stakeholder identification, literature review, analysis of the current environment, site visits (or other approaches to building cultural understanding), and interviews/focus groups.

During the enactment phase, the research-practitioner team is designing and developing a solution (Bannan-Ritland, 2003). This includes developing prototypes and testing out different designs. The designs will include approaches for: delivering the training, collecting data, and building understanding that can be applied to other (broader) environments.

The evaluation: local impact phase is when the researcher is looking data collected during a more in-depth implementation phase (Bannan-Ritland, 2003). The researcher is evaluating the intervention and the theoretical underpinnings that were used to design the intervention. As appropriate, the team may do some additional analysis and exploration tasks. One important distinction between DBR and traditional research approaches is that DBR allows for, and even expects, that there will be changes to the design along the way. If something is not working or if tweaking the design will improve the outcomes, then the design team will likely make changes.

Throughout the entire process, the team is collecting data and keeping records. After all, the purpose of DBR is to develop an educational solution that addresses the problem of practice and can be replicated in other broader contexts. During the local impact phase, it is important to note which aspects of the design are successful in the current environment but might not be workable in other contexts. For example, if the design is highly successful, but there are cultural nuances that help to make this work, then those cultural components need to be noted.

The last phase is when the intervention is implemented and examined in a broader context (Bannan-Ritland, 2003). This is when the researcher shares what was learned in the local context in a manner that enables others to use it. The sharing includes publications and further study. This could mean developing an instructional video solution for one form of workplace training (e.g., ethics) and then testing out those approaches in other forms of training (e.g., sales or marketing). It might involve looking at how an approach in one cultural context can be applied to other cultures, or even taking an approach that worked in one industry and testing it in other industries. The broader impact possibilities are endless.

Conclusion

Instructional video is an important component for training. Yet, the instructional design field has limited understanding of which approaches to video design are best for different learning needs and contexts. Research is needed in practice, and DBR is a research approach that can be used to solve local training needs while building theory and understanding.

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Exploring the Effectiveness of Flipped Learning on Mathematical Triarchic Abilities Among Secondary School Students in India

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Abstract

One of the skills learned in mathematics is the capacity to deal with abstractions and a problem- solving strategy (NCF-2005). As a result, one of the major goals of mathematics in schools should be to mathematize a child's cognitive processes (NCERT, 2006). The findings of ASER 2017: Beyond Basics suggest that school going children in India are still struggling to apply their mathematicalskills in real-life circumstances. According to Cross (2005), the students who are actively involved in studying are more likely to learn than students who are not. In the flipped classroom, various active learning activities like think-pair share, brainstorming, discussions, presentations are conducted where all the students actively participate rather than passively receiving the information. In this context, the researcher conducted a study so as to make an attempt to increase the triarchic abilities (practical, analytical and creative abilities) of the students that is essential for students to be successful in life (Sternberg, 1999) by introducing an active learning strategy called flipped learning.

Introduction

Maintaining concentration and following one's assumptions through to their logical conclusions are two essential components of mathematical achievement. Math is necessary for anyone who desires to reach a level of professional fulfilment and financial stability in their career. The formalisation of a child's mental processes through the use of mathematical concepts needs to be the primary goal of a mathematics education. On January 16, 2018, a report titled ASER 2017: Beyond Basics was made public by the non-governmental organisation Pratham. Students between the ages of 14 and 18 are the focus of the ASER study that was conducted in 2017. The findings indicate that a significant number of young people struggle when it comes to putting their literacy and numeracy skills into practise in the real world. At this point in time, 10 percent of Indians fall into the age range of 14 to 18 years old. Teenagers are in the process of acquiring both the fundamental and specialised information that will be necessary for them to function well as adults. For today's youth to reach their greatest potential, they require the appropriate support.

Many children of school age do not reach their full potential because the methods of instruction they are exposed to are inefficient. Sternberg developed the "Theory of Successful Intelligence" (Sternberg, 1999) and a number of different teaching methodologies in order to satisfy the requirements posed by students as well as those posed by teachers. The psychological theory of intelligence that is utilised in teaching for success in intelligence is one that has been demonstrated to be successful. The primary assumption of this concept is that in order to be successful in life, an individual needs to be in possession of a particular skill set (triarchic in nature). Sternberg contends that in order to achieve success, an individual must first define that term for himself within the context of his particular sociocultural setting.

A person is considered to be a practical thinker if they are able to recognise what they are lacking in order to flourish and then design tactics to achieve it. They are able to work effectively with people to accomplish goals, and they have a solid understanding of the strategies that do and do not succeed in their industry. An analytical mind can be recognised by academic success, which manifests itself as excellent grades, strong performance on tests, and an overall appreciation of studying. The process of intentionally altering one's mental operations in order to arrive at a conclusion that is logical is what is meant to be understood as the ability to think analytically. Critical thinking and the capacity to make intelligent decisions are the two most crucial talents that must be demonstrated. Making a decision is a process, and at the end of that process is either the evaluation and selection of different options or the appraisal of different possible outcomes. This man is capable of thinking in unique ways, coming up with new and interesting ideas, and carrying them out all on his own. His capacity to think synthetically and make links between ideas that at first glance seem to have no bearing on one another is one of his talents. A person is said to be creative thinker if they are capable of innovative ideas as well as imaginative activity. Sternberg and Lubart (1995a, 1995b) assert that original thinkers are similar to successful investors in the sense that they have the ability to "buy low" and "sell high" by acting contrary to the received opinion. A person who possesses true creative ability will have a balanced set of qualities that include creative, analytical, and practical skills.

In the year 2014, the Flipped Learning Network was the first organisation to begin using the phrase "flipped learning." The definition of flipped learning-

"a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the education guides students as they apply concepts and engage creatively in the subject matter." (Flipped Learning Network [FLN], 2014, Para.1)

As students receive direct instruction during their own independent study time, there has been a change away from an emphasis on group instruction and toward an emphasis on individual instruction. Instead of being the place where students are exposed to new concepts, the classroom should be viewed as their own private space. The classroom is a typical example of a place designated for group activities. As of the year 2018, the Academy of Active Learning Arts and Sciences (AALAS), a non-profit organisation, has been hard at work on a project to develop global flipped learning standards. This was produced by the collaborative efforts of six chair people, one hundred international delegates, practitioners of flipped learning, researchers, professors, education technologists, and learning professionals from 49 countries. One of the numerous benefits of flipped learning is that it allows students to learn at their own pace, which benefits both the individual students and the classroom as a whole (Long, Cummins, & Waugh, 2016). Interactions between students and teachers that are of a high quality appear to be beneficial for a number of aspects of students' development, including their ability to acclimatise to school, their social skills, and their academic achievement (Kaufman & Sandilos, 2011).

Need for the Study

Although the effect of flipped learning in higher education has been documented (e.g., Florence,2017; Ghafoor, 2019; Priyadarshini, 2019; Sickle 2015; Vasilchenko, 2017), it is essential to examine the impact of flipped learning at K-12 settings (Akcayir & Akcayir, 2018; Lo et al., 2018). Moreover, the effect of flipped learning on higher order thinking skills, critical skills or triarchic abilities is also not well researched. In order to address these gaps, the researcher conducted this study to investigate the impact of flipped learning on mathematical triarchic abilities namely practicalabilities, analytical abilities and creative abilities among secondary school students and record the perceptions of the students, teachers and the instructor on flipped learning.

Research Questions

RQ1: What is the effect of flipped learning on triarchic ability of secondary students in mathematics?

RQ2: What are the perceptions of the participants on flipped learning?

Theoretical Framework

The flipped learning classes that were utilised in the study were constructed with the assistance of Merrill's (2002) First Principles of Instruction and Anderson and Krathwohl's (2001) Revised Bloom's Taxonomy. Both of these resources were utilised in order to carry out the research. Merrill (2002) presented five principles after conducting an analysis of numerous different methods of instructional design. These are the "Problem-centered principle," the "Activation principle," the "Demonstration principle," the "Application principle," and the "Integration principle." The flip session of the flipped learning class consisted of what was called the "Activation, Demonstration, and Application phase." The Problem-centered Environment practise session that was held in the flipped learning class incorporated all of the educational phases, including "activation," "demonstration," "application," and "integration." The revised version of Bloom's Taxonomy divides cognitive processes into six distinct levels: recall, comprehend, apply, analyse, and evaluate. The final level is creation. The "Flip" session of the flipped learning class consisted of the learning components "Remember," "Understand," and "Apply." The practise session for the flipped learning lesson included the cognitive processes of "Applying," "Analyzing," "Evaluating," and "Creating," respectively.

Literature Review

The purpose of this study was to fill in some of the gaps in the existing literature on flipped learning in mathematics. According to the published material on flipped learning in a variety of fields, the vast majority of research is conducted in higher education, whereas only a very small number of studies are conducted in K-12 institutions (Akcayir & Akcayir, 2018). According to the reports from the Indian studies, the majority of the research that was done was in the STEM fields, which are comprised of science, technology, engineering, and mathematics. The studies that were looked at for the flipped learning in mathematics found that the majority of the research was done in higher education (Yang et al., 2019), despite the fact that flipped learning is beneficial at all levels of education. Even very little is known regarding the effectiveness of flipped classrooms in K-12 settings compared to classrooms that do not use the flip learning model (Lo et al., 2018). The United States of America is the location of the majority of the research on flipped learning in mathematics in K-12 settings. On the other hand, according to Lo & Hew (2017) very few research projects have been carried out in other nations such as Taiwan, Canada, and England. Based on this information, it appears that researchers in other countries are only getting started with experimenting with flipped classrooms.

Some researches came to the conclusion that when it came to learning performances, pupils fared better in flipped classrooms as opposed to traditional classrooms. According to the findings of some studies, both groups fared equally well (e.g., Braun et al., 2014; Saunders, 2014). Even further, the literature uncovered the fact that students' impressions of flipped learning remain confusing due to the fact that they are of a mixed character. This presents a problem for the field of mathematics education. There is a paucity of research that examines the impact that flipped classrooms have on students' critical thinking abilities or higher order thinking skills in the field of mathematics. The majority of studies looked at students' performance in mathematics (e.g., Katsa et al., 2016, Hwang & Lai, 2017, Lo & Hew, 2020).

The researcher was able to better design and decide on the intervention's flipped practise session activities because to the information gleaned from the literature review. Almost universally, students in these studies (e.g., Schmidt & Ralph, 2016, e.g., Braun et al., 2014; Charles-Ogan & Williams, 2015; Kennedy et al., 2015; Salimi & Yousefzadeh, 2015) were first exposed to the material via video lessons before ever setting foot in a classroom. During the flipped class session, the researcher opted to hand out the course materials to the students in the computer lab. Pre-class formative assessment of learned material was advocated for in the literature (e.g., Schmidt & Ralph, 2016; Heo & Choi, 2014; D'addato & Miller, 2016; Hwang & Lai, 2017). With this research, the researcher incorporated a recap and test into the flipped classroom's rehearsal session. She had the students do a lot of work out of their math books and offered them analytical issues to discuss in small groups.

Numerous iterations of the flipped learning model, such as the "classic flip" (Vasilchenko, 2017) and the "flipped mastery" model, have been put to the test (Wiginton, 2013). In contrast, the review of the relevant research conducted by one researcher turned up no papers on the "in-class flip model."

Methods

Research Design

An explanatory sequential design of mixed methods methodology was utilised in this study, as suggested by Creswell and Plano Clark. The purpose of the study was to investigate the effects of the flipped learning strategy as well as the traditional learning approach on the triarchic mathematical abilities of secondary school students (2011). This strategy can be broken down into two distinct but interconnected phases: (1) a quantitative phase, during which data is gathered and analysed with both descriptive and inferential statistics, and (2) a qualitative phase, during which the results from the quantitative phase are interpreted and contextualised.

(1) Quantitative Phase

During the quantitative phase, we employed a sampling method that was similar to an experiment and involved purposeful sampling of the data. A quasi-experimental pretest-posttest control group technique was chosen for the quantitative phase of the study because randomization was not allowed by the authority of the selected school in order to avoid the interruptions in normal school functioning. The research was conducted using a design known as non-equivalent groups, which means that the pre-test and post-test groups were not identical. In addition, the results of a mathematical triarchic test, which included a mathematical practical test, a mathematical analytical test, and the Sharma and Sansanwal Mathematical Creativity Test, were compared before and after Flipped Learning was implemented to determine the effectiveness of the method. Analysis of Covariance (ANCOVA), a statistical technique, was applied to the quantitative findings in order to remove the impact of differences that were already present between the Experimental and Control groups.

(2) Qualitative Phase

In order to provide context for the quantitative findings, the qualitative phase consisted of a thematic analysis of interviews with students, math teachers, and the reflective notebook kept by the instructor.

Procedure

There were 179 ninth graders from the 2019-2020 school year who took part in the study; 90 were assigned to the experimental group, and the other 89 served as a control. Over the course of 24 weeks, the study was conducted. During the course of a research study, students were instructed in seven different mathematics chapters from the CBSE NCERT textbook. In the traditional classroom, the lecture covered the chapter, and the home assignment consisted of working through the exercises in textbook. Students in flipped classrooms organised according to the flipped classroom model and were given access to fresh information in the form of online videos on YouTube in the Computer laboratory in school. After that, they took part in exercises that required them to apply what they had learned. They were required to work together in class on a mathematics exercise that was taken directly from the textbook. The instructor provided assistance to the students with their respective assignments. After that, we gave them 4 analytical problems to solve, and it was up to them to think of 2 creative problems on their own. For the purpose of gathering information, the researcher developed and carried out pre- and post-tests. The perceptions of the 9 students and 3 teachers were collected via students' interviews. For in-depth insights, even the perceptions of the instructor were recorded and reported.

Data Analysis

Descriptive Analysis

Mean and standard deviation were calculated to characterise the data and its tendencies. The data was also presented graphically for easier comprehension.

Inferential Analysis

An analysis of covariance, also known as an ANCOVA, was carried out with pre-test scores serving as a covariate in order to compare the levels of mathematical triarchic ability possessed by the control group with the experimental group. It handled the variation that occurred within the group by removing the inequalities in the baseline measures.

Thematic Analysis

The perceptions of the students were collected via students' interviews. In the flipped class, a total of 9 students were interviewed. The interviews took place in English and were transcribed in English. Each respondent was given a unique identification, with Student H, Student M, and Student L designating students from the clusters of (1) high achievers, (2) medium performers, and (3) low performers. The interview transcripts of students and teachers and reflective journal maintained by the instructor in the course of intervention were analysed through the technique of thematic analysis.

Findings

Results of Analyzing Quantitative Information

Mean scores on the Pre-Test Measure of Mathematical Practical Ability did not differ between the Experimental and Control Groups. The average mathematical practical ability of the experimental group improved by 17.33 points between the pre- and post-tests, while the control group improved by only 10.70 points. When controlling for Pre-Mathematical Practical Ability, the adjusted mean score of Mathematical Practical Ability for the Experimental Group is 42.71, which is considerably higher than that of the Control Group, which is 36.88. When students' pre-mathematical practical ability is considered as a covariate, the Flipped Learning Strategy was found to be much more effective than the Lecture Method in fostering students' mathematical practical ability.

Average pre-test scores on a measure of mathematical analytical ability show no significant difference between the experimental and control groups. In terms of gains in mathematical analytical ability, the experimental group demonstrated a respectable increase of 15.77 points from pre- to post-test, while the control group demonstrated a smaller gain of 9.42 points. When controlling for Pre-Mathematical Analytical Ability, the adjusted mean score of Mathematical Analytical Ability for the Experimental Group is 35.67, which is considerably higher than that of the Control Group, which is 29.03. Taking students' Pre-Mathematical Analytical Ability into account, it was discovered that the Flipped Learning Strategy is substantially more effective than the Lecture Method at fostering students' Mathematical Analytical Ability.

The average pre-test scores on a test of Mathematical Creative Ability between the Experimental and Control Groups are not statistically different. The average mathematical creative ability of the experimental group improved by 338.10 points between the pre- and post-tests, while the control group improved by only 27.42 points. When controlling for Pre-Mathematical Creative Ability, the adjusted mean score of Mathematical Creative Ability for the Experimental Group is 514.12, which is significantly greater than that of the Control Group, which is 203.61. When students' Pre-Mathematical Creative Ability was used as a covariate, it was shown that the Flipped Learning Strategy was much more effective than the Lecture Method at fostering students' Mathematical Creative Ability.

The mean Mathematical Triarchic Ability scores of the Experimental and Control Groups before treatment are not statistically different. Mean mathematical triarchic skill increased by 370.96 points in the experimental group from pre- to post-test, while it increased by only 47.12 points in the control group. Adjusting for Pre-Mathematical Triarchic Ability reveals that the Experimental Group had a considerably higher adjusted mean score of Mathematical Triarchic Ability, at 592.52, than the Control Group, at 269.50. When students' Pre-Mathematical Triarchic Ability is used as a covariate, the results show that the Flipped Learning Strategy is much more effective than the Lecture Method at fostering their Mathematical Triarchic Ability.

In the quantitative results, it was found that when students' Pre-Mathematical Triarchic Ability was used as a covariate, the Flipped Learning Strategy significantly outperformed the Lecture Method in fostering their Mathematical Triarchic Ability (Mathematical Practical Ability, Mathematical Analytical Ability, and Mathematical Creative Ability).

Figure 1

Mean Test Scores for Experimental and Control Groups on the Mathematical Triarchic Ability Test, Both Before and After Treatment

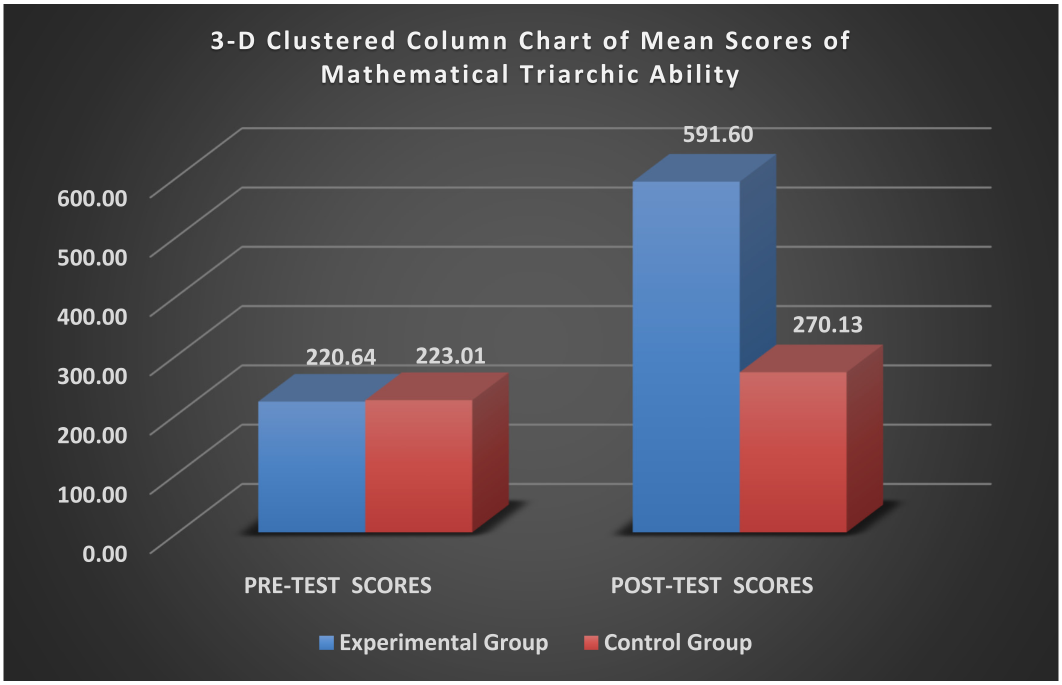
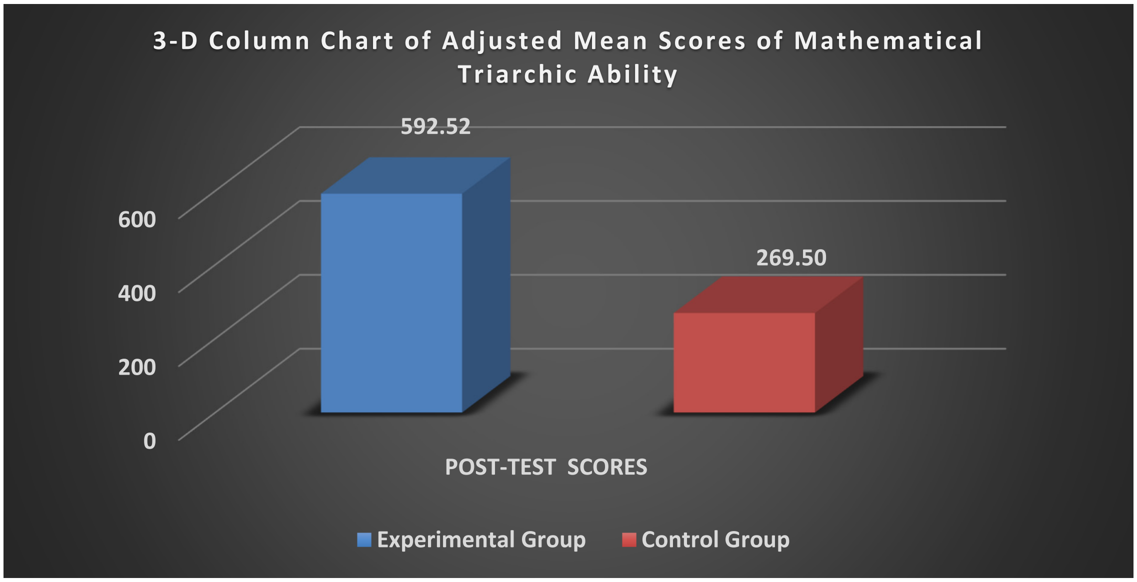


Figure 2

Mathematical Triarchic Abilities: The Mean Adjusted Post-Test Scores of the Experimental Group and the Control Group



Results of Analyzing Qualitative Information

The interview transcripts of the students, teachers and the instructor were analyzed to get their perception on flipped learning. It was divided into different themes – perception on flip sessions and practice sessions. The findings are: after class activities, seeing the video again helps, extra handouts that covered the same material as class notes helped in exam cramming, WSQ answered their internal inquiries well, the recapitulation of classmates helped students examine and apply new information to the text's exercise problems, the quiz gave them confidence, students shared ideas to find multiple solutions to the same problems, both pupils who helped their peers solve problems and explain concepts profited, students supported each other throughout class exercises, students solved analytical difficulties faster by working together. Some other findings were-the teacher helped kids quickly, questions built confidence, more practise station drill helpers would have been nice, analytical problems required extra class time, rearranging chairs was important for group work. Some of the other benefits emphasized in the interview were that -Flipped classrooms assist students by including parents, Rewatching instructional movies cut down on classroom repetition, WSQ improved student progress evaluation, class participation increased, Complex questions dominated class time, immediate feedback helped students, documenting student growth helped teachers evaluate student work and its effects on the classroom. Every child participated in the joint project and higher-level cognitive questions stimulated discussions. Student presentations enhanced self-esteem and performance and learning grids let teachers track student progress. Flipped learning relies on a good instructor-student relationship, which affects student retention.

Few suggestions offered by teachers and instructor were that the furniture configuration hindered their class. children may have used classroom objects to indicate their needs and obtained prompt assistance in the teacher's absence, the best educational films simplify complex topics. The WSQ approach should be used for assessing student development, quizzes should also be used as they are helpful for assessing student progress, during the flipped lesson, the instructor could aid each student individually

According to the qualitative analysis of the interview transcripts of the students, math teachers, and the reflective journal of the instructor, the primary reasons for the improved performances of the experimental group were the Formative Assessments, improved interactions between teacher and students, increased peer interactions, increased confidence in solving problems, increased in-class time for practising math problems, and individual attention to the students. Other reasons included increased in-class time for practising math problems and increased in-class time for completing formative assessments.

Educational Implications

Several areas of education can benefit from the findings of this study.
The research concluded that classroom interactions, both those between students and those between students and the teacher, significantly increased student learning. Therefore, it is important to facilitate as much student-teacher and student-peer interaction as feasible in the classroom. One reason for this uptick in achievement is that students have had more time in class to work on arithmetic problems. Therefore, pupils should increase their in-class math practise. When compared to more conventional methods of instruction, flipped classrooms were found to have a significant impact on students' development of transferable skills including problem solving, analysis, and innovation. Therefore, it is essential that educators be encouraged to incorporate this cutting-edge method into their classrooms. They can incorporate formative assessments into their lessons, such as quizzes or brief reviews of previously covered material. As the WSQ technique proved useful in gauging the students' progress, it may be implemented by educators. The teachers interviewed all agreed that parental participation in their children's education was crucial. Therefore, parents can also be informed about the significance of employing this flipped learning models based instructional material in order to improve their children's academic outcomes.

Based on the findings of this research, it is clear that access to computers and the internet is crucial for the widespread adoption of the flipped learning approach. Therefore, the school should have internet-connected computer laboratories so that teachings can be flipped during class time. It is the responsibility of educational institutions to support their faculty members as they pursue training in the flipped classroom approach. A section on Flipped Learning should be included in pre-service teacher education programmes so that future educators have exposure to and experience with this active learning technique. Policymakers need to be educated on the value of the flipped learning strategy as a cutting-edge method of instructing secondary school students. The federal government may try to fund the installation of computer networks in all public schools. If we are serious about improving education, we must provide teachers with opportunities to learn about and practise the flipped learning technique.

Conclusion

Mathematization of students' abilities is important but achieving this along with adhering to the curriculum can be a herculean task. Thus, the researcher carried out an explanatory sequential design of mixed method study to find out the effect of flipped learning on mathematical triarchic abilities among secondary school students. It was found that Flipped Learning technique has improvedTriarchic Abilities namely Mathematical Practical Ability, Mathematical Analytical Ability and Mathematical Creative Ability in secondary school students. As the innovative strategy is found effective, it has its implications for students, teachers, parents, educational institutes, teacher training institutes, policy maker and government for bringing quality of students' learning in mathematics. In view of this, all in all it can be said that Flipped Learning strategy has its worth to be implemented in the teaching-learning process in the school stage.

Limitation and Recommendation

The research does come with a few important limitations. To begin, given that the study was carried out in the field of mathematics, it is unreasonable to presume that the findings will be applicable to other disciplines. One of the disadvantages of the study is that it only targeted students in grades K-12. If the research project were carried out at a more advanced level of mathematics, it would be possible to collect and compare the points of view of students in both settings. If additional questions were asked, it would be easier to understand both the possible advantages and disadvantages of using the flipped classroom strategy for teaching mathematics. Only nine students were chosen to participate in the interview process for the flipped class. The percentage of volunteers who agreed to take part in the semi-structured interviews was considerably lower than what was anticipated. As a consequence of this, it's possible that the perspectives of a few of the students were ignored in this research. In this study, students mostly used desktop computers to view instructional videos. As smartphones decrease in price and increase in availability, more and more students are opting to watch films on their mobile devices instead of their computers. Very little investigation has been made into the effects of mobile education. Examining students' perspectives and sentiments on using mobile phones to watch flipped classroom videos would widen the scope of flipped pedagogy research. Educational research has shown that students' individual learning styles affect their academic performance. More studies on the flipped classroom are required to better understand the role that learning style plays in students' achievement, motivation, and confidence. Researchers who are interested in implementing the flipped classroom should also look to the latest findings in cognitive science and education while planning and executing in-class activities. Academics should examine whether or not a specific field is more open to flipped learning studies than others. Students from both rural and urban settings were excluded from the analysis. Therefore, a large-scale study can be done to compare the results of the study with those of students in both urban and rural settings.

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Physical Characteristics and Gender of Avatars in Minecraft Education Edition

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Abstract

A visual content analysis of available avatars in Minecraft Education Edition was performed to identify how gender was presented in the limited and pixelated graphical form of Minecraft. Data analysis was performed to determine which physical characteristics were most common among genders. Implications are discussed.

Physical Characteristics and Gender of Avatars in Minecraft Education Edition

The primary reason given for the over abundance of male avatars in games has been the perception that gaming is a male dominated activity with designers claiming market forces are to blame (Tran, 2013; Vermeulen et al., 2017). However, it is possible that this imbalance may persist in educational games where such market forces are not present. Previous research examining traits of avatars such as gender have focused on commercial games not educational games (Fron et al., 2007; Tran, 2013; Vermeulen et al., 2017). This study focuses on the physical characteristics and genders of avatars available in *Minecraft Education Edition* (MEE), an educational version of a popular mass market game designed to be utilized in educational settings.

The popular game *Minecraft*, currently a distinct product offering from MEE, originally launched in late 2011 by Mojang Studios to great success. At this point only a single avatar named "Steve" was available for use. As the game grew in popularity, people began to create alternate appearances for their characters that could be downloaded from the internet. In response the company began to offer purchasable bundles of avatars called skin packs. In 2015, a new official default character named "Alex" was added citing the need to match the growing diversity of players of the game (Mcwertor, 2015). Alex was specifically described by Mojang as having thinner arms, redder hair, and a ponytail as well as looking a bit like lead *Minecraft* developer Jens Bergensen. Players also noticed that Alex had pinker lips and pale skin. While *Minecraft* creator Notch described the game as genderless and refuted the idea that Alex represented a female human instead of a just a human (Rundle, 2015), Alex was immediately heralded as the default feminine option (Harwell, 2015).

MEE is widely used in schools with over 35 million users in 113 countries (Snider, 2020). As of version 1.17.30 MEE offers 116 unique default avatars (called skins) for players to choose from. Like its predecessor it uses highly pixelated forms to accentuate certain physical characteristics from which each avatar brings with it a natural assumed gender. Examining how assumed gender is represented through avatar traits is necessary to understand the accepted representations of gender in MME and may be transferable to other educational games.

Prevalence of certain physical characteristics and gendered options may limit students' ability to connect with their avatar during in school play as well as reinforcing certain stereotyped expectations of gender (Cohen, 2001).

The purpose of this content analysis is to examine the gender availability of avatars and how avatar gender predicts the presence of physical characteristics of avatars in an educational version of a mass-market game. Each of the 116 avatars available in the game were examined and coded according to their physical characteristics displayed in the game. The independent variable will be defined as each avatar's assumed gender as determined by the coders. Each avatar will be coded based on the following characteristics as dependent variables: arm width, nose width, hair length, mouth color, eye color, eye shape, brow shape, facial hair, and presence of eyebrows. Results will be compared to identify if there is an imbalance of gender options in avatars and to identify which physical characteristics are more common among each gender.

Research Question

RQ1- Which genders are more or less represented in MEE avatars and is this result statistically significant?

RQ2- Which physical characteristics are associated with assumed genders in MEE avatars?

Research Hypothesis

$\boldsymbol{H_1}$**-** There are significantly more male avatars than female avatars.

$\boldsymbol{H_0}$**-** Assumed genders are represented equally across avatars.

$\boldsymbol{H_2}$- The prevalence of physical characteristics are moderated by the assumed gender of the avatar.

$\boldsymbol{H_0}$**-** There is no difference in prevalence of physical characteristics between avatars of different assumed genders.

Literature Review

One of the major connection points between a user and a game is self-identification through the avatar they choose (Cohen, 2001). Users predominately select avatars that reflect their own traits with some minor alterations (Dunn & Guadagno, 2019). There is a positive impact reported by users when they are able to choose an avatar that reflects themselves in meaningful ways (Dong et al., 2013; Morgan et al., 2020). Research has shown no significant differences in how genders approach selecting or creating avatars (Young, 2018) other than predominantly selecting or creating avatars that match their gender (Guadagno et al., 2011).

The field of game design is heavily populated with white males making it common for this group to be overrepresented in avatar selection in commercial games (Fron et al., 2007). Having limited options for avatars is problematic as it can make it more difficult for a player to identify with their character (Dunn & Guadagno, 2019; Morgan et al., 2020). Additionally, the brunt of hostility in online games tends to come from male players against female and LGTBQ players reinforcing the belief that gaming should be a male dominated space (Ballard & Welch, 2015). The overrepresentation of white male avatars is often claimed as being due to market forces as the majority of gamers are thought to be white males (Tran, 2013; Vermeulen et al., 2017), however market reports show a far more balanced interest in video games in general (Newzoo, 2019). Minecraft has been extensively studied for its uses in educational settings (Nebel, 2016; Baek et al., 2020). It is a favored tool for education for simulated 3D environments. As an exclusively educational software, MEE is intended for classroom use. In this environment it can be assumed that no such market forces exist, as educational classrooms are approximately equally balanced according to gender as opposed to any disparity that may or may not exist in the public marketplace.

Method

A quantitative visual content analysis of specific elements of the 116 avatars was performed with regards to how gender is represented. Visual content analysis is used to examine relative frequencies of visual representations taken from images through classification quantification of content (Bell, 2001). The primary researcher performed three rounds of first cycle coding (Miles et al., 2020) to ensure accuracy of coding physical characteristics documenting each avatar's traits in Google Sheets. During the first cycle descriptive coding traits (Miles et al., 2020) were identified and labeled for each avatar with initial variables of name, assumed gender, arm width, nose width, hair length, eye color, mouth color, and eye shape. During a second pass of the initial coding, labels for each trait were adjusted for consistency and the eyelashes, facial hair, and brow shape were added as additional variables. During the third pass, coding was verified for accuracy and a codebook was created. This strategy allowed for the physical characteristics found in each avatar to be quantified to be compared with their assumed gender as determined by the researchers. Each characteristic was coded as described below.

Assumed Gender

Assumed gender is commonly described as the gender that others assume an individual to be based on apparent gender markers such as physical characteristics, voice, clothes, and hair (Portland, n.d.). Research has shown that there is little difference in the impact of a players gender on their need to identify with their avatar (Dong et al., 2013) and that the gender of avatars is important for empathizing with one's avatar (Morgan et al., 2020). Because MEE lacks any determination of gender within gameplay, assumed gender will be referred to as gender of the avatar and will be assessed by coders as either male, female, or indeterminate using visual cues for each avatar.

Arm and Nose Width

Due to the pixelated nature of MEE's avatars it is easy to determine the specific width of specific parts of the avatar model. Each avatar's arms are either four pixels wide, like Steve, or three pixels wide, like Alex. The majority of avatars have only two pixels between their eyes but there are a small number of avatars with a wider nose space between the eyes. Arm and nose width are dichotomous interval variables.

Hair Length

Hair length is difficult to quantify on a number of models due to hats, hoods, or other head covering. Hair length was generally determined to be easiest to quantify into three groups with short hair presenting visible skin below the hairline on the back and sides of the head, medium length hair showing no visible skin below the hairline on the back and sides of the head, and long hair showing visible hair on the body section of the avatar.

Eye and Lip Color

Due to the massive variability of color options available among both lips and eyes in MEE basic color categories were established for coding eye and lip color. A number of avatars lacked specifically colored lips or visible eyes due to eyewear, hoods, or hair. Eye and lip color were assessed as nominal variables.

Eye and Eyebrow Shape

MEE uses a variety of shapes to represent eyes and eyebrows. Several characters have no visible eyes and most have no visible eyebrows. However, each shape of eye and eyebrow was categorized based on the number and position of pixels used to represent them. In some cases eyebrow shape had to be assumed because the eyebrows were only partially visible due to head coverings or hair. Eye and Eyebrow shape were assessed as nominal variables.

Eyelashes and Facial Hair

The last variables after round one coding were the presence of eyelashes and facial hair. Eyelashes were usually seen in avatars as a one or two pixel black dot on the outside of the avatar's eyes. Differences between beards and mustaches were initially noted but combined in the final pass of coding. Both eyelashes and facial hair were coded as either present or absent without regard to the number of pixels used to represent them. As such, they are nominal dichotomous variables.

Data Analysis

Chi-square test for goodness of fit was used to test if an expected ratio, 50/50, of male and female avatars based on assumed gender. Chi-square test for goodness of fit is used to see if there is a difference between expected and observed frequencies in a known population (Frankie, 2012). An independent variable t-test was used to determine significant prevalence of interval characteristics (arm width and nose width) based on assumed gender. Chi square tests were used to determine significant prevalence of nominal characteristics based on assumed gender. Independent variable t-tests are used when comparing means of interval data between two groups (Levin & Fox, 2011). Chi square tests are used to compare expected frequencies with observed frequencies in ordinal and nominal data (Levin & Fox, 2011). Independent variable t-tests are preferred due to greater accuracy however they can only be used for interval data (Levin & Fox, 2011) which was not available for some variables. The null hypothesis proposes equivalent means and equivalent frequencies of physical characteristics between genders; therefore, these two tests should be sufficient to retain or reject the null hypothesis.

Results

Data were entered in Google Sheets and analyzed using SPSS 27. 65 avatars were assumed to be male, 50 assumed to be female with 1 avatar's gender being cited as unclear by coders. The avatar with an unclear gender was not included in further analysis. Using a Chi-Square for goodness of fit with assumed equal frequencies of the remaining 115 gendered avatars the results were determined to not be significant ($X^2 = 1.957,\ p = .16189$, therefore the null hypothesis for H_1 is retained. A second additional test using a 51% female and 49% female frequency did not substantially alter the results.

It was determined that male avatars had a wider arms (μ=3.9231, sd=.26854) and thinner noses (μ=2.0923, sd=.4229) than female arms (μ=3.42, sd=.49857) and noses (μ=2.2, sd=.60609). Independent t-tests showed this difference to be significant for arm width (t=6.937, *p*=<.001) but not for nose width (t=-1.122, *p*=.264).

Chi-square tests showed hair length (X^2=81.313, df=6, *p*=<.001) and eye shape (X^2=40.223, df=12, *p*=<.001) significantly moderated by gender with female avatars having longer hair and wider taller eyes, though the most female avatars eye shape was the same as the most common male avatar eye shape. Chi-square tests did not show significant moderation by gender for mouth color (X^2=25.839, df=18, *p*=.103), eye color (X^2=32.623, df=26, *p*=.173) or brow shape (X^2=38.197, df=36, *p*=.370) though the high number of confounding variables for each of these attributes likely decreased the accuracy of results. Additionally, facial hair was only found on male avatars (X^2=14.562, df=2, *p*=<.001) and eyelashes were almost exclusively found on female avatars (X^2=12.849, df=1, p=<.001) even though the majority of male avatars lacked facial hair and the majority of female avatars lacked eyelashes. The null hypothesis for H_2 is rejected specifically with regards to arm width, hair length, eye shape, eyebrows, and facial hair.

Discussion

With regards to RQ1 the majority of available avatar skins in MEE are male, but not so much so that it is deemed to be a statistically different number. However, a lack of statistical significance does not mean that there is no significance in the lower number of female avatars. While it is possible that trends in gaming are moving towards a more equitable gender balance or that the presumed market forces in educational gaming lead to more balanced gender representation, it is also possible that the presence of more male than female avatars is a sign of bias within game the population of developers (Tran, 2013; Vermeulen et al., 2017).

The results for RQ2 indicate that the most common female avatars have thinner arms and longer hair than male avatars which matches with Dunn and Guadagno's (2012) determination that female players tend to prefer thinner avatars. Significance was found indicating female avatars were more likely to have eyelashes, no facial hair, and larger eyes indicating that these characteristics were generally considered to be more femenine. However, while eyelashes and large sized eyes were common among female avatars, the majority of female avatars had no eyelashes and standard sized eyes. The only characteristics that were both statistically higher frequency and most common on female avatars were thinner arms and longer hair. The common use of these physical characteristics to imply gender is not necessarily problematic but it does continue to place an emphasis on stereotypical aspects of female beauty: thin, long hair, eyelashes, no facial hair, and big eyes. Additionally, the inclusion of only one avatar that did not have an assumed gender coded as either male or female shows a lack of options for trans or non-binary players common in many video games (Morgan et al., 2020).

Limitations

Content was analyzed based on current expectations of assumed gender. Gender definitions are fluid over time (Martin, 2004) and traits ascribed to one gender in this research may change in the future. There is also an inherent difficulty in portraying gender with the limited graphical representations available in Minecraft. One could ponder what possible characteristics avatars could be given to portray gender that are not based on stereotypes. It may not be possible to portray assumed gender without exaggerating stereotypical gender traits. Because assumed gender is based on physical characteristics, it is likely that assumed gender is a self-referential characteristic.

The high number of possible determinations while coding eye color, mouth color, and brow shape likely contributed to difficulties in accurate coding as well as smaller group sizes leading to these determinations being less accurate overall. It is possible that with additional skins to examine, significant trends may have been found. While questions of skin color and race of avatars in Minecraft Education Edition is an important topic to consider, it is outside of the bounds of this particular study due to the inherent challenges of picking an assumed race for a highly pixelated avatar based on anything other than skin tone. Future research may wish to consider racial representation as an additional variable to examine.

This analysis was performed on MEE version 1.17.30 by a single researcher. Between when the research was performed and when it was published, Microsoft has released additional skins including a number of non-binary skins and gender fluid skins in the *Friends!* skin pack. Ideally, multiple coders would have been used to verify coding accuracy (Krippendorff, 2004). As such this research should be considered as an artifact of the time the research was performed in late 2021.

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A Review of Available Literature for Use in Development of an Undergraduate Esports Certificate Program

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Abstract

Esports are growing as a viable academic endeavor. As part of an undergraduate credential, literature was collected and reviewed for use as part of a new certificate program in esports at Boise State University. This review focuses on topics of research available for reading assignments in an online program based on the esports ecosystem as defined by Anderson et al. (2018). It contains an examination of current major trends in research as considered for inclusion in an undergraduate esports program. Gaps in literature and directions for future study are discussed as well as adding a new category to the esports ecosystem titled *scholars*.

A Review of Available Literature for Use in Development of an Undergraduate Esports Certificate Program

With growing interest and legitimacy of competitive video gaming at the collegiate level, there has been an increased desire for colleges to provide programs preparing students for careers and study within the field of esports. Esports has long been considered a valid topic of academic study (Wagner, 2006) and existing research has argued that the relevance of esports is increasing as its popularity grows (Jenny et al, 2017; Kauwelona, 2019; Keiper et al., 2017). Existing literature reviews in esports have focused on sources of esports research (Reitman et al., 2020), psychology (Bányai et al., 2019; Pedraza-Ramirez et al., 2020), gender (Rogstad, 2021), and business opportunities (Gawrysiak et al., 2020). No single review has focused on available literature for the purposes of developing esports professionals across the numerous areas of involvement in the field of esports. This review seeks to address the need by examining literature from the perspective of suitability for educating and training new professionals and scholars in the field of esports.

Literature corpus was curated from available journal articles, conference papers, dissertations, books, and internet articles for the purposes of creating a ten credit undergraduate certification program in esports at a major public university in the Pacific Northwest. The program is intended to focus on developing an understanding of the vast field of esports including varsity programs, content creation, business, analytics, and social analysis. The intent of the program is to offer a series of one-credit online courses, each focusing on a specific element of the wider field of esports. These courses, as well as the specific topics of them, are in continued development at this time.

Much of the existing research in esports has been developed from a sports management, business, and media studies perspective (Reitman et al., 2020). Regular esports publications are made in the journals historically focused on field sports: *Sports Management*, *Sports Management Review,* and the *Journal of Applied Sport Management*. The other dominant strain of research examines sociological perspectives of esports like the definition (Jenny et al., 2017; Kane & Spradley, 2017), impact of esports on society (Holden et al., 2017; Lee & Schoenstedt, 2011), and the psychology of players and viewers (Hamari & Sjoblom, 2017). Additionally, articles proposing esports as a potential business opportunity in an era of significant growth are frequent (Gawrysiak et al., 2020; Jenny et al., 2018). However, fewer articles are found that examine the impact of esports programs on participants' academic performance (Reitman, 2018; Schaeperkoetter et al, 2017); team and league management (Cho et al., 2019); and content creation or broadcasting best practices (Anderson et al., 2018; Lee & Steinkuehler, 2019). This emphasis has led to literature that primarily focuses on the cultural impact of esports while leaving gaps regarding the training of professionals within the esports ecosystem and the development of successful esports programs.

Books published in the esports field tend to track individual players' stories documenting their rise--and sometimes fall--as a top player in a particular sport. Most of these books are aimed to fuel interest in eager individuals seeking to become superstar players rather than involving them in the many non-player roles within esports. Those that include the history of esports have done so in a disjointed manner (Li, 2017; Collis, 2020). Other books are largely designed for the promotion and legitimacy of esports (Shelton & Haskell, 2018). There is a clear need for established academic resources that focus on the origins of esports and roles beyond players and coaches.

This literature review uses the esports ecosystem as described by Anderson et al. (2018) as a framework for understanding the topics of available literature (see Figure 1). The undergraduate esports courses created at Boise State University aim to build necessary skills for future strategists, organizers, content creators, and entrepreneurs for careers in esports and this review examines the presence or absence of literature that specifically relates to these roles. Universities offering degrees and certifications need access to quality training material to prepare the next generation of esports players, coaches, broadcasters, content creators, journalists, community managers, designers, analysts, and tournament officials. Available literature is examined for suitability in undergraduate courses and organized according to potential roles in the esports ecosystem. Gaps in available literature and potential needed texts can subsequently be addressed.

Figure 1. The Esports Ecosystem

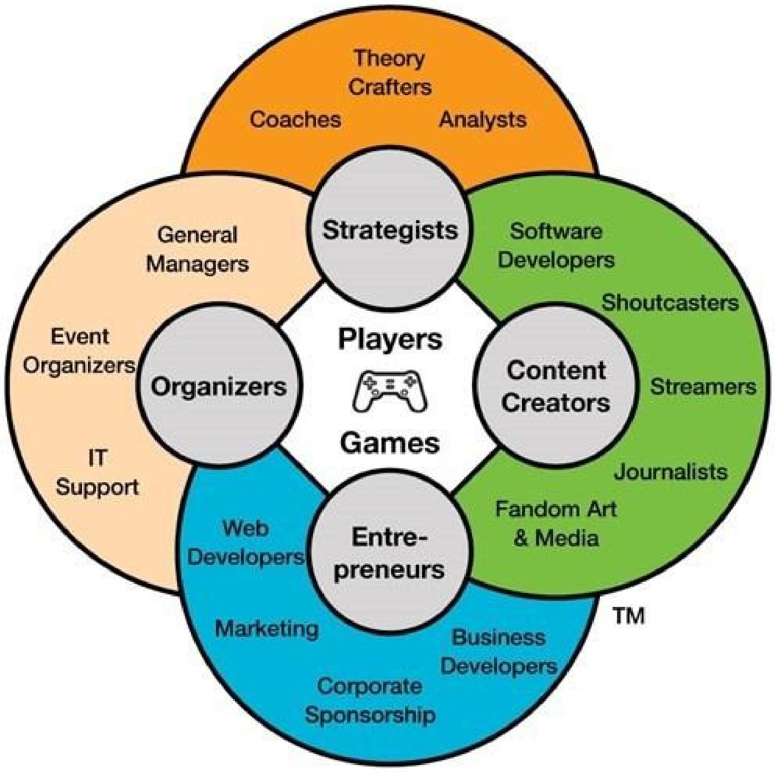


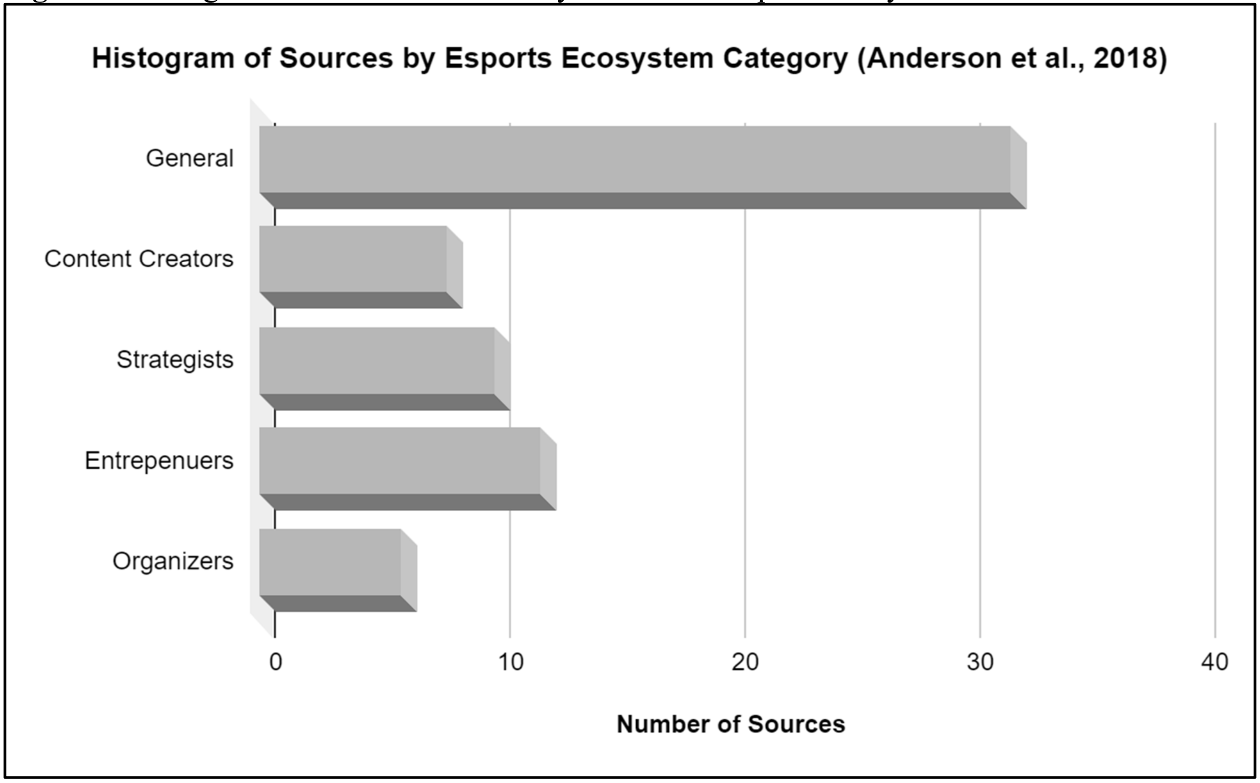
Diagram Citation: Anderson, Tsaasan, Reitman, Lee, Wu, Steele, Turner & Steinkuehler (2018)

Methods

A descriptive review (Pare et al., 2015) was chosen to examine literature in order to represent the state of the art within esports research as it pertains to the roles described in the esports ecosystem (Anderson et al., 2018). Descriptive reviews aim to analyze any decipherable patterns or trends in order to reveal existing topics and any gaps within available literature (Pare et al., 2015). Because esports is a newer domain, sources beyond journal articles were considered for inclusion in this review of literature if they were deemed appropriate for use in the curriculum by the researcher. Sources were gathered between January of 2021 and October of 2022 as the curriculum was being designed, developed, and deployed for its first run during the summer semester of 2022. Copies of relevant sources were stored on a Google Drive to be examined for inclusion in the curriculum.

A total of 68 sources were stored for review. The majority of sources were journal articles or conference papers but a small number of books, website articles, and news articles were also included for review. The literature corpus is not intended to include all available esports literature but only those that were considered for inclusion in the curriculum being developed. Sources were then labeled using provisional coding (Miles et al, 2020) according to the particular role in the esports ecosystem (Anderson et al., 2018) that they worked to inform. Just under half, 32, of the sources did not fit neatly into one of the roles in the esports ecosystem and received a label of *general* (see figure 2).

Figure 2. Histogram of sources reviewed by roles in the esports ecosystem.



Esports Ecosystem Coding

Coding articles for roles in the esports ecosystem was done according to the four highest level roles: *organizers*, *entrepreneurs*, *content creators*, and *strategists*. The *player* role was not included as almost all of the literature was applicable to players and competitors in esports to one degree or another. Sources were defined as fitting a specific role if the article primarily focused on content useful to one or more of the sub-roles defined by Anderson et al. (2018). For example, sources that focused on podcasters or shoutcasters were coded under *content creators* while sources discussing marketing and business opportunities were coded as *entrepreneurs*.

Coding Additional Sources

The number of sources that fell into the *general* code resulted in the need for additional coding. Descriptive coding (Miles et al., 2020) was used to understand what topics were being covered that were not directly represented in the esports ecosystem. Descriptive coding is used for creating an inventory of topics for indexing and categorizing (Miles et al, 2020) and was first applied to sources labeled *general* but was expanded to cover all sources as there was sufficient cross-over to do so. These additional codes cover the topics of *toxicity, health, culture, research and education, spectator, legal and labor, strategy and skills*, *non-gaming,* and *definition.* Not all sources fit into one of these codes but other codes with only a single article were not examined further.

Results

The esports ecosystem (Anderson et al., 2018) was moderately effective at providing provisional codes as each of the categories within the esports ecosystem contained between six and twelve sources with *organizers* being the least numerous and *entrepreneurs* being the most numerous. However, a large number of sources fell outside of the categories in the esports ecosystem indicating a need for either additional categories to be added to the ecosystem or broader categorization. Descriptive coding provided for a more detailed breakdown that showed what topics were discussed in sources labeled *general*. A description of the sources coded in each category of the esports ecosystem is followed by an examination of several of the descriptive codes and commonalities between their content.

Content Creators

Suitable sources that focused on content creation were frequently not esports based or even rooted in gaming, indicating a significant lack of research in esports content creation. A number of sources coded as *spectator*, were not generally appropriate for content creators as they tended to look at consumption motives (Hamari & Sjoblom, 2017; Yu et al., 2022) for individuals watching high level esports competition and examining the impact from a mass media perspective. Articles about podcasting in esports were largely absent from searches and available information about podcasting tended to come from non-gaming perspectives (Fernandez et al., 2015; Kuklo, 2018; Wolpaw & Harvey, 2020). Only one article gave a perspective on the role of shoutcasting, comementating an esports event, with insight on the complexities of the role (Kempe-Cook et al., 2019) but articles covering topics surrounding written content for esports were extremely limited. In place of esports specific literature, information on creating written content were generally taken from the field of game studies such as Zagal et al. (2009) which prescribes how to write high quality game reviews.

The overall lack of focus on the huge market of esports content creators is one of the most significant gaps in literature. Anderson et al. (2018) mentions broadcasters, streamers, independent app developers, fan art creators, and journalists, all of whom have been largely ignored by esports researchers save for a few focusing on streamers (Taylor, 2015; Wohn & Freeman, 2019). Even as universities scramble to put together broadcasting programming for their esports team, there is little research available for individuals pursuing this broad field that is creating a large need for creative and technically skilled workers.

Strategists

Strategists as described by Anderson et al. (2018) include roles such as coaches, analysts, and a unique form of data statisticians called theory-crafters. A quick search on hiring sites shows that esports teams are hiring for analysts and theory-crafters in attempts to calculate ideal builds, plays, and strategies for their teams. However, many of the best resources for understanding the skills and strategies of esports games are found, not in academic researcher, but on public forums such as Reddit, such as the Rocket League's Skill Book (MiracleWiff & Tomdovodo, 2019) or are available as strategy guides and videos produced by content creators found on game specific websites. Reitman & Steinkuehler (2021) specifically discuss the lack of theoretical taxonomies and practical intervention methods to train esports players for high level play. Some basic attempts have been made to create a framework for esports training (Nagorsky & Weimeyer, 2020), examine strategy at high level tournaments (Castellanos & Corps, 2021), and use behavioral pattern mining to examine player skills (Monthonat et al., 2020) but models for analyzing data for esports, effective coaching methods, and the actual process of theory-crafting are more likely to be found among players and enthusiasts than academic researchers.

One important point brought up by Hanghol & Nielson (2019) is that communication is a core mechanic in team based esports. From coaches to players, being able to effectively communicate with one’s team is vital in an environment where the entire field of play is not necessarily visible to each player as is found in traditional sports. While in traditional sports, each player is capable of surveying the entire landscape of the game in a quick glance, team based esports requires players share more information about the game as it develops. Additional research into developing effective teams, both on a technical play and strategic level, as well as developing clear communication and teamwork systems, is sorely needed.

Entrepreneurs

The most prolific part of the ecosystem discussed in articles was the role of the entrepreneur as many articles have focused on esports as a business opportunity (Jenny et al., 2018; Seo, 2013). Considerable time and effort in sources was spent discussing the potential growth in esports, especially during the mid-2010s as esports began its rise in prominence (Reitman et al., 2020). While numerous sources attempted to justify esports as a legitimate enterprise or compare it to traditional sports, few of these did so from the lens of entrepreneurs. Anderson et al. (2018) labeled the group as entrepreneurs, however, the actual roles he defines sync more with positions at large gaming companies such as Riot or Blizzard than those of scrappy startups or industry disruptors. Even as late as 2021 researchers were still defining and redefining esports from a business perspective (Bosquet & Ertz, 2021; Scholz, 2020). There are sources which provide meaningful contributions to esports businesses discussing the role of gender in spectatorship (Yu et al., 2022), using esports to improve brand perceptions (Gawrysiak et al., 2020), discussing sponsorship benefits (Freitas et al, 2020), and discussing the specific skills needed among esports specialists (Shunkaruk, 2021).

While the role of esports in culture continues to grow and it becomes more of a mainstream activity, a greater understanding of the role gaming companies play will be required. Already, discussions about potential litigation (Holden & Kaburakis, 2017), issues and inequalities among the esports labor system (Johnson & Woodcock, 2021), antitrust concerns and the role of publishers and team owners (Miroff, 2019) have been introduced by legal scholars. Unlike traditional sports in which no one owns the rules, competitive video games are owned and controlled by a single publisher. There have already been crackdowns on teams, players, and content creators that go against the corporate image a publisher is projecting. Numerous issues in the labor economy, league ownership, international relations, and team relations have not yet been explored but are likely to be important in the future of esports.

Organizers

The role of organizers in research has largely been monopolized by those focusing on organizing teams at the secondary and collegiate levels. While only six sources were identified as targeted towards organizers, four of them focused on high school or college leagues and teams (Cho et al., 2019; Pizzo et al., 2019; Reitman et al., 2019; Shelton & Haskell, 2019). These sources were primarily focused on overcoming the challenges of legitimizing esports as an activity beneficial for students and establishing funding for a program. Other sources that discussed the impact of prize structure (Coates & Parshakav, 2016) and social perspectives on doping in esports (Jansy, 2020) provided very specific information on running teams, tournaments and leagues but do not provide a clear picture of the skillbase required of esports organizers.

Sources that discussed the wide skillbase required of esports directors and general managers, as well as the technical requirements of running an esports program were absent from available research. Even as hundreds–if not thousands–of esports tournaments of various sizes are being run every week in the US alone, there is little research on how these are being managed and virtually no best practices for creating a stable, fair, and fun tournament for competitors. If esports are to continue to grow at the expected pace, considerable guidance will need to be available for already overworked and overstressed IT professionals, directors, and organizers who are scrambling to set up their own esports arena, tournaments, play schedules, and broadcasts.

Beyond the Esports Ecosystem

As nearly a half of the total sources reviewed fell outside of the roles defined in the esports ecosystem, a further understanding of additional roles within the esports ecosystem may need to be considered for inclusion. The following are the results of identifying themes found within the sources that fell outside of the four primary categories in the esports ecosystem.

Definitions

Sources defining esports were frequently too broad to fall into a specific category in the esports ecosystem unless they were looking at definitions from a business point of view in which case they were coded under the *entrepreneur* category. Even sources that were not focused on the definition of esports spent considerable time attempting to define esports, or to either include or disclude it from accepted athletic sports sometimes referred to as "traditional sports", or more pejoratively as "real sports" or "professional sports". Traditional sports have generally required a significant degree of gross motor skill, something that many esports currently lack (Hilvoorde & Pot, 2016; Kane & Spradley, 2017; Jenny et al., 2017; Marelić & Vukušić, 2019). However, there is little argument that physical skill is highly necessary for success in esports. Yet, there continues to be resistance to accepting esports as a sport which, in turn, has specific legal and labor implications (Bousquet & Ertz, 2021; Holden & Kaburakis, 2017; Scholz, 2020). One common feeling held in common by esports enthusiasts is that esports resembles traditional sports in most ways, yet the contestants hardly move (Segal, 2016).

Along with the discussion of definition comes a dizzying array of spelling options for esports including "e-sports", "eSports", "Esports" and "esports" with some authors swapping between spelling during the same article. This paper has chosen to use "esports" as that became its designated spelling according to the Associated Press in 2017 (Pacetti-Donnelson, 2019), however, many researchers have yet to accept this with publications as late as 2021 still using alternative spellings. Similarly, no consensus seems to have formed regarding what to call players with options such as "e-athletes", "competitive gamers", "esports athletes", "competitors", or just "athletes" while individual games tend to provide alternate terms such as "summoners", "agents", "champions", or "operatives". Standardized language for many elements of esports seem to still be in flux as the exact place of esports in academia is still being explored.

Research and Education

Perhaps the largest gap in the esports ecosystem deals with those either extolling the potential virtues of esports or warning of its inherent dangers, as well as a few cautious commentators who are simply aiming to understand the impact of esports on society. While it may be possible to lump academia in with other the existing categories, many researchers would likely chafe at their role being defined as a *content creator*. Almost half (14), of the sources outside the esports ecosystem received *research and education* code, as well as the majority of the sources coded for *organizers* and a few coded for *entrepreneurs*.

Several of the sources were literature reviews covering topics such as business (Frietas et al., 2020; Gawrysiak et al., 2020); specific game genres (Mora-Cantallops & Sicilia, 2018), esports psychology (Bányai et al., 2019), gender (Rogstad, 2021) or esports in general (Reitman et al, 2020). These provide important foundational information on the development of research of specific aspects of esports but other than the business topics are generally not applicable to a specific role within the esports ecosystem. Other sources, like Anderson et al. (2018), investigate potential positive impact of esports on students (Cho et al., 2019; Lee & Steinkuehler, 2019; Sauce et al., 2022; Schaeperkoetter et al., 2017) and schools (Funk et al., 2018; Keiper et al., 2017; Kauweloa & Winter, 2019; Wagner, 2006). Other sources took approaches borrowed from game studies to define esports genres (Choi & Kim, 2018; Crawford, 2015; Mora-Cantallops & Sicilia, 2018).

The number and depth of sources that clearly fell into this category yet failed to fit into the existing roles within the esports ecosystem indicates a need for an expanded picture of what the esports ecosystem includes. There is a clear need to add space for educators and academic researchers from fields such as sports management, psychology, sociology, game studies, and media studies. This need could be expanded to include some of the research that was not specifically coded as belonging to research and education but that examines esports from health and cultural perspectives.

Health

Concerns about esports player's health is often mirrored with concerns regarding the nature of video games in general. Beyond discussion about video game addiction (Turner, 2008; Wood, 2008) or video game violence in general (Ferguson, 2018), esports tends to include a very high amount of sedentary activity. Regardless of these concerns, esports athletes do not tend to become obese (Gaikoni-Ramirez, 2021). In fact, esports athletes tend to display healthy overall living habits even while health management remains an important concern (DiFrancisco-Donoghue et al., 2019). Competitors still need to monitor their health as long competitions with continual mental engagement can be quite draining indicating a need for some basic health considerations for esports players (Jansy & Sodomirski, 2021).

Even with limited movement, there are still concerns about injury as well as competitor mental health that need to be considered. DiFrancisco-Donoghue et al. (2018) recommended regular involvement of an assigned health professional, however there are few established protocols for dealing with issues that may arise among competitors. Research on potential injuries including retinal damage, musculoskeletal issues, and ideal ergonomic positions is recommended and could help esports teams take better care of their athletes. Also it is suggested that leagues begin to require certain physical and mental health screenings for players.

Toxicity

Toxicity is a major topic in gaming in general but the online nature of esports games bring it consistently to the forefront in many research articles. The interactive nature of online gaming and a history of accepting toxic behavior (Irwin et al., 2021; Irwin & Naweed, 2020) is a continued struggle for companies as they try to manage their communities through roles like community managers (Robles, 2017). Additionally, the false meritocracy of video games has prompted a number of studies examining uneven treatment of minority groups in online gaming (Davin et al., 2020; Fletcher, 2020; Paul, 2018). Studies have shown that heterosexuals and males perpetrated the majority of the bullying in online games while female and LGTBQ participants received the majority of the attacks (Ballard & Welch, 2015). A number of attempts have been made by gaming companies to mitigate issues of toxicity but these have generally been met with limited success (Blackburn & Kwak, 2014).

While study of toxicity has been a large part of esports culture, few prescriptions exist to combat it. Ongoing research indicates that the presence of female leadership in esports positions may help curb toxicity targeting female players but the majority of research appears to be focused on bringing awareness to the problems. Future research looking at effective policies, procedures, and best practices to create inclusive gaming spaces and inclusive teams is necessary as esports tends to be a very white and asian male dominated space (Fletcher, 2020). Research is needed to understand how we can promote more marginalized populations taking a larger role in esports as well as decrease the general toxicity of esports communities.

Culture

Differing cultural norms surrounding esports has been an area of discussion and study as several asian countries have risen to prominence as a dominant force in esports. Since the time of Starcraft, Korea's role as a major player in esports has been undisputed (Li, 2017), though different games tend to see a higher level of performance from different countries. Unlike in the US, esports in Korea is thought to be a pathway to excel as a player rather than a pathway to engage students with a general or STEM education (DeArmond et al., 2020). In China, representing the world's largest esports market (Yu, 2018), playing games has been marginalized in favor of high level esports creating a divide between competitive and casual players (Zhang & Recktenwald, 2016). Cultural understanding of esports, especially in underrepresented areas like Latin America, is an area where empirical research is needed.

Spectator

A small group of sources focused on the growing number of spectators of esports in an attempt to understand viewer motivations. Hamari & Sjoblom (2017) described how viewers are more likely to be active players of games and that viewer motivations tend to include improving one's own play of an esports game by watching professional level matches. Differences were seen in viewer behavior based on the types of live streaming formats impacting viewers, donations, and subscribers. However, the impact was varied across different genres of esports (Ma et al., 2021). The way in which a streamer interacted with the camera was an important factor in streaming success (Taylor, 2015). Gender differences were also found in viewer behavior with males preferring higher levels of aggression and women being more likely to follow specific attractive players (Yu et al., 2022).

Unlike traditional sports, the majority of esports fans are recent players of the game leading to different consumption motives. However, the viewership of esports is very broad and little research has been done to delineate between esports viewers of large tournament leagues and those who prefer to watch individual streamers. Also, comparisons across various broadcasting formats are largely unexplored as most viewer studies tend to focus on one title, or in some cases, fans of a single team. As esports continue to grow in popularity, production teams will continue to expand their repertoire of best practices. Little is published to inform those seeking to develop a broadcasting channel for their team or even a personal esports stream.

Labor and Legal

There are many concerns about the developing legal quagmire of esports as it differentiates from traditional sports models. Many issues similar to traditional sports are present such as the young age of professional players and questions about collegiate versus professional play. Johnson and Woodcock (2021) describe esports as defined by organizing game competitions yet note the significant role that third parties play in providing services, sponsorship, and commentary. They state that the many professional player positions are in a precarious balance requiring complete commitment to the game. This commitment presents a number of legal issues considering the power in the hands of game publishers to control potential business partners, players and teams from even accessing their game (Holden & Kaburakis, 2017; Miroff, 2017). Esports' unclear definition as a sport has led to a loss of protections in some countries and is likely to lead to inevitable litigation, returning back to the question seen under the *definitions* section of whether esports are a sport or an entertainment activity. It may be that this question will be answered by the courts over the coming years.

Discussion

One of the clearest outcomes from the literature reviewed in this article is that the overall ecosystem described by Anderson et al. (2018) may be too limited. With almost half of the overall sources being ascribed to the general category, it seems necessary to either expand the categories within the existing esports ecosystem or add new ones. The additional coding indicated that the topics of education, research, health, and psychology were all important topics to be included in the esports ecosystem, yet they currently lack a fitting category. Rather than attempting to force these roles into the existing ecosystem categories, we advise the addition of a new esports category to the ecosystem labeled "scholars" (see figure 3).

The esports scholars category is intended to include the many roles presently existing outside of the esports ecosystem yet playing an important role in shaping the landscape of esports and the world's perceptions of it. Within the scholars category we suggest the following roles: researchers, educators, psychologists, and clinicians. Researchers include those examining esports from a sociological, economic, behavioral, health, and game or media studies perspective. Educators include those teaching about esports, teaching digital citizenship in online gaming, or educating new esports developers. Psychologists include both those examining broad impacts of gaming on society as well as working with the mental health of players, coaches, and other professionals. Finally, clinicians at all levels attend to the physical health of esports players including doctors, nurses, and physical therapists. This new category would include a large section of available research as it accounts for approximately half of the sources included in this literature review.

As to the categories that are found within the existing esports ecosystem model, there is much work to be done. Content creation, specifically in esports, is one of the most under-researched category. While not entirely surprising, as content creation as an individual enterprise is fairly new, the ability for pro players and amateur players to create their own career in content creation differentiates it significantly from traditional sports. Many top earning content creators in esports are retired professional players or individuals who never reached the top levels of play. Additionally, research on how to recruit, train, and develop a successful esports team is absent from available research.

Specific to the needs for undergraduate education, a textbook including a clearly written history of esports is very much needed. Existing books tend to take a sporadic approach to esports history (Li, 2017; Collis, 2020), are designed to promote the legitimacy of esports (Shelton & Haskell, 2018), or are written as self help style books for kids interested in esports. As the language and culture around esports settles out, common language–and spelling–is needed that bridges the gap between academic sources and internet guides.

Figure 3. Updated Esports Ecosystem

Limitations

The selection of literature from this review is not considered to be inclusive of all available esports research. Literature selected was primarily chosen for suitability in the first six topics of undergraduate esports courses that were created, therefore topics such as esports technology, analytics, and event management may be under represented. Additionally, the esports ecosystem lists software developers as a sub-category under content creators. At Boise State University there are already separate programs that support software development, so this area was not included in the research gathered.

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Preliminary Results from a Case Study Dissertation Project: Using Science Fiction to Generate Interest in STEM Careers for Fifth-Graders

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Abstract

The pandemic changed education in too many ways to describe here. Based upon ACT scores at their lowest in 30 years, and higher levels of student anxiety and mental health issues, it is clear that our students are at risk of falling behind in their age-appropriate knowledge and skills. It can be asserted that one of the areas of casualty inflicted by mandatory home instruction is lack of collaboration, social construction, and focused activity, leading to lower skills and reduced schema due to lack of experience with knowledge building.

This project, a small excerpt from a full dissertation, seeks to explore the new paradigm of education after the pandemic through the lens of part of a case study from 2021-22. Although my particular focus is interest development (Hidi & Renninger, 2006; Renninger & Hidi, 2016), a slice of pandemic life is presented as well to help inform future instruction.

Introduction

I feature three pandemic-era case studies in this excerpt from my larger dissertation study, in which I explore the inter-relationships among the theoretical constructs of interest development (e.g. Hidi & Renninger, 2006), flow (e.g., Shernoff et al, 2014), and Kuhlthau's Information Search Process (ISP) model (Kuhlthau, 1991) in the context of an in-person Guided Inquiry Design instructional innovation, involving middle grade students in New Jersey. The Framework for K-12 Science Education (2012), an influential and formative document to the NGSS, predicts that interest leads to educational and career choices. The learning objectives include students' increases in situational and/or individual interest in STEM via participation in assigned inquiry-based SF-related curriculum and activities. The inquiry learning environment, specifically GID, coupled with the SF content focus, has potential to cultivate interest development due to its recognition and fostering of the Affective domain, where interest resides. It is my conjecture that SF is a particularly engaging instructional design feature and the addition of SF is the main "innovation" I add in my study that offers a new contribution to the literature. Other primary innovations, to which the research questions below are mapped, are the effects of an information literacy component on situational and individual interest, and the synthesis of the theories of Flow, interest development, Kuhlthau's ISP, and social constructivism as viewed within the use of Guided Inquiry and the incorporation of the GID in an online learning environment.

Overall, this study contributes to the continuing development of links and associations between the arc of the GID and the arcs of the interest development process and the Flow experience. Their similarities and parallels indicate that they should be used in tandem when designing STEM curriculum, particularly in conjunction with the highly popular SF stories and series with which the students are often familiar and comfortable. Their use provides a platform upon which to build curricula that stimulates young scientists even in an emergency remote teaching (ERT) environment. The primary research questions this dissertation excerpt will address are:

1. SFF. In what ways(s) does student progression through a multi-session learning intervention based on Kuhlthau et al's guided inquiry design (GID) instructional theory, adding in a component on Science Fiction and Fantasy texts, contribute to students' situational and individual interest development in STEM subjects covered in those texts?
2. Integrated model. In what ways does student progression through a multi-session learning intervention based on Kuhlthau et al's guided inquiry design (GID) instructional theory, reveal inter-relationships among the theoretical constructs of interest development (e.g. Hidi & Renninger, 2006), flow (e.g., Shernoff et al, 2014), and the ISP (e.g. Kuhlthau, et al., 2012)?

Methods

Pandemic-era Teaching in New Jersey. Executive orders issued by New Jersey Governor Phil Murphy, effective on March 18, 2020, in conjunction with the actions of many other governors, mandated remote instruction for all K-12 public, private, and parochial schools (Reynolds, Aromi, McGowan, & Paris, 2022). While public schools were required to provide to the state ". . . ERT transition guidelines, including prompts for instructional technology integration and plans for securing digital equity" (Reynolds, et al., 2022, p. 7), private schools like the Jewish after-school religious program in which this study was conducted were subject to less official guidance. Educational Director Rabbi NM was both blessed and cursed by this low level of oversight. She could make her own decisions about how to proceed technologically, e.g. choices of online program, curricula, overall vision. However, she did not have a strong pool of employees and administrators with whom to make and guide those decisions. The result is that students and parents experienced uneven instruction that improved as the pandemic wore on. Fifth-grade student Rachel (no real names are used per IRB) confirmed this pattern: "Um, I think the pandemic, like kind of, like ruined my experience here, because like, last year, it was like, really bad. I hated being remote and stuff. But like, this year, it's not as bad because like, I've good teachers, and like, they're kind of like making it fun and stuff. So last year was definitely really bad. But this year is not so bad" (Rachel, Pandemic Learning Code). Student Greg described the progression in quality of instruction in the pragmatic way he often approaches problems: "Because it's like, because you like, you can hear like the teacher like way better without the mask."

Instruction delivery changed from the Pilot study, conducted the previous year at the same site, to the second iteration of the study, beginning in early September, 2021. Classes were conducted in-person but with many restrictions listed in Table 1 (below).

Table 1.

Instruction Limitations during September, 2021, to December, 2022.

Limitation Imposed upon Student Activity	Impact upon Instruction and Learning

Mandatory masking	As Greg points out above, students (and instructors) can hear better without masks. As a result, instruction was impeded by many interruptions because students did not understand me or each other during reading and discussion.
Outdoor instruction whenever possible	Ten minutes of instruction were lost during each lesson that was held outside. Additionally, distractions such as the weather, traffic, and other student groups close-by played a factor in how students responded to outside as a learning space. Finally, I could not record classes outside.
Windows and doors open at all times	This was only a distraction if the weather was cold or the class was too loud due to an activity. Also, I have a loud, strong voice that carries outside of the room if the door is open.
No sharing of materials, such as textbooks, notebooks, and writing supplies	This policy made it extremely difficult to plan group activities involving physical or digital artifacts since such things are routinely shared.
No mingling of classes or full group meetings	This did not impact the STEAM Academy class.
Limited use of bathrooms and water fountains	This was an inconvenience but it did not affect learning in any discernible way.
No student traveling from classroom to classroom	This was an inconvenience but it did not affect learning in any discernible way.
Limited use of video recording	This was a problem when the ability to record was removed without previous knowledge. I often had to make a quick lesson adjustment when told at the last minute that class must be held outside.

Case Study and Thick Description. Observing students over a period of time, in this case five months, produces a potential narrative that can be used to focus on a learning process closely over time (DeWalt & DeWalt, 2011). Geertz (2017) popularized the term "thick description" to describe the intimate details, perceptions, and perspectives collected and analyzed during case study. There is a tradition of thick description in science fiction. Ursula LeGuin is a prime example of an author who successfully builds new worlds and historicities employing ethnographic methods reminiscent of Geertz (Davison-Vecchione & Seeger, 2021). LeGuin's worlds explore socio-sexual potentials, political possibilities, and ethical anthropologies; these explorations require the type of rich, detailed, sensual descriptions employed in this case study. LeGuin's intensely-drawn characters and worlds paint a rich portrait of an alternate Universe of possibilities, and the goal is to bring that sense of wonder and possibility to the curriculum.

Case Study and Contextuality. This project is profoundly affected by the pandemic, and the content, delivery, and available data are all affected by this unavoidable situation. However, this is an excellent time to incorporate the idea of contextuality into the case studies' formation (Mabry, 2008). How was the content of the project affected by the pandemic? What would have gone differently if not for the pandemic? How were the topics we discussed affected by the pandemic? Were the natures of the artifacts affected by the pandemic? Case studies demonstrate a wide respect for the complexity of life (Mabry, 2008). Many slices of life are needed to construct a picture of an experience, and case studies are one method within which to offer those finely-detailed portraits.

Design-Based Research as Methodology. Design-based research (DBR) has informed this project well, providing both a methodology and a method (Barab, 2014). Design-based research's (DBR) goals are to dynamically reflect and adapt during research and intervention (Barab, 2014). DBR also supports observing naturalistic settings and integrating theory and practice through a cycle of reflection and iteration (Barab, 2014; Glaser & Strauss, 2017). Those naturalistic settings, students in a STEM classroom, school library, and/or school research/writing lab, are collaborative and active, and should remain iterative until the end of the intervention (and possibly beyond). Fortunately, a common result of DBR is the ability to conduct an assessment of whether it and the other theories/methods that comprise the study's design were effective (Barab, 2014). This valuable information will be used to make decisions concerning future iterations in the study.

The Students. The n of the class started at 10 and ended at 12; after adjusting the IRB, the 2 additional students were allowed in by their request. All students and parents signed consent forms and the Educational Director Rabbi NM was very supportive of the study. From the 12 students, I selected 3 who represented different slices of learning style, attitude, personality, and self-efficacy. However, I must concede that all 3 of the selected students produced artifacts and experiences in class on a regular basis, thereby providing more data and richness to the case studies. The 3 students selected for additional study are listed below (Table 2)

Table 2

Featured Participants during the Second Iteration.

Student Pseudonym	Gender and Ethnicity	Brief Description
Greg	Male, White, Jewish	Greg is full of energy and he stays focused if others do not distract him. Greg likes to do well and receive acknowledgment. He also enjoys being proud of what he does. Other teachers reported to me that he was a behavior problem, but all he wants is respect and a little space to be fidgety.
Rebekah	Female, White, Jewish	Rebekah is a very assertive person. She knows what she likes and likes what she knows. Her final project eclipsed all others in that she created an actual working robot while everyone else created imagined artifacts.

Mindy	Female, White, Jewish	Mindy likes working with others. She claims to like fantasy. Interested in creating things. Creation seemed most important to her. Her interest in Science has increased due to this class.

Results

Approach to the Data. The data sources from which the following vignettes are taken, a compact version of a larger dissertation project, are student pre-interviews, activities during the 9 classes conducted, artifacts produced during the 9 classes, and post-interviews. The goals of the use of each data source are featured in Table 3 (below). The case study data will be presented in the order of Table 3. Due to the space limitations here, one of the three students, Greg, will be featured. The others, along with Greg, will be fully presented in the dissertation.

Table 3.

Goals of the Use of Each Data Source.

Data Source	Format	Goals of the Use of this Data Type
Pre-Interview	Transcribed and filmed interview before the intervention	The Pre-interview is an important tool to become assimilated into the culture of the students. Learning about the students' interests, likes and dislikes, and general attitude towards STEM and science fiction, informs the design-based research process and the considerations involved in adapting instruction.
Class Activities	Videographed and transcribed using Otter AI.	Capturing of class activities will be used to chronicle development of the students' interests through comments, collaborations, and experiments and activities related to them. Captured single frames from 45-to-50 minute videos are the data that will be used to demonstrate student learning and interest development.
Student-created Artifacts	Experiments, Research Materials, and Final Projects	Artifacts are the only truly physical evidence of student activity. They greatly inform instructors' instructional design for future iterations. In many learning environments, ". . . analysis of an artifact be carried out as a means to interrogate the intentions and actions of the designer(s) creating the artifact" (Boling & Gray, 2020, p. 94). That is the purpose of case study, making artifact analysis a key component of the data set.
Post-interview	Transcribed and filmed interview after the intervention	Interviews can provide a wealth of knowledge about not only students but also their experiences, skill sets, and approaches to problem solving, especially in STEM learning (Civil, 2014). The post-interview is one of the primary data sources that demonstrates changes in interest and the efficacy of the new theoretical model. It also informs changes in the model using DBR as a guide.

Case Study: Greg. In his pre-interview, Greg indicated, “I like a lot of, like, Science projects.” Like many students in the class, Greg chose to read on his own the stories “A Gun for Dinosaur” by L. Sprague deCamp and “Cookie Cutter Superhero” by Tansy Rayner Roberts. He explained that “Um, so I like superheroes and stuff. And I'm really interested in animals.” Moreover, he states that, “I like studying like the planets and like the solar system.” This data suggests to me that Greg is open to both science fiction and to STEM learning. Superheroes are already fantasy or science fiction, depending upon the specific Universe in which they exist: A futuristic Batman-like superhero could be science fiction, since Batman does not have any supernatural powers, but in any era or Universe, Superman or Green Lantern (for example) will always be fantasy due to their supernatural abilities. Greg’s interest in being a veterinarian and his fondness for animals, which he states several times during the pre-interview, mean that Caleb is beginning the class above the first phase of interest development (see Figure 1 below). Based upon Hidi & Renninger’s 2006 model, Greg is in Phase 2 or Phase 3, which should make him quite receptive to the class (Renninger & Hidi, 2016; Hidi & Renninger, 2006). The following give-and-take highlights Greg’s desire to collaborate and experiment in-person, mask-free, something he missed greatly during the Pandemic and that he is excited to do in this class:

> Greg: So, I think that learning is a lot harder [during the pandemic]. Because it's like, because you like, you can hear like the teacher like way better without the mask.
>
> B. DuBoff: No kidding!
>
> Greg: You can do more partner work with like your friends, and they can help you understand stuff better.
>
> B. DuBoff: I agree. And then how about specifically science subjects?
>
> Greg: Um, I think that it affected learning about science by like because people like can't be close to each other trying to figure out something together, because most things are figured out with a group of people.

Without realizing it, Greg argues in favor of social constructivism and laments that he cannot do more of it.

Figure 1.

Four Phases of Interest Development (Hidi & Renninger, 2006).

	Less-Developed (Earlier)		More-Developed (Later)	
	Phase 1: Triggered Situational Interest	*Phase 2: Maintained Situational Interest*	*Phase 3: Emerging Individual Interest*	*Phase 4: Well-Developed Individual Interest*
Definition	• Psychological state resulting from short-term changes in cognitive and affective processing associated with a particular class of content	• Psychological state that involves focused attention to a particular class of content that reoccurs and/or persists over time	• Psychological state and the beginning of relatively enduring predisposition to seek reengagement with a particular class of content over time	• Psychological state and a relatively enduring predisposition to reengage a particular class of content over time
Learner Characteristics	• Attends to content, if only fleetingly • May or may not be reflectively aware of the experience • May need support to engage from others and through instructional design • May experience either positive or negative feelings	• Reengages content that previously triggered attention • Is developing knowledge of the content • Is developing a sense of the content's value • Is likely to be supported by others to find connections to content based on existing skills, knowledge, and/or prior experience • Is likely to have positive feelings	• Is likely to independently reengage content • Has stored knowledge and stored value • Is reflective about the content • Is focused on their own questions • Has positive feelings	• Independently reengages content • Has stored knowledge and value • Is reflective about the content • Is likely to recognize others' contributions to the discipline • Self-regulates easily to reframe questions and seek answers • Appreciates and may actively seek feedback • Can persevere through frustration and challenge in order to meet goals • Has positive feelings

Greg: Class activities. Greg excelled during kinesthetic, physical experiments. Although other teachers complained that Greg was too "hyper," I was informed by his pre-interview and his stated desire to work with others in-person, so I knew before the class began that including more team-based, STEM experiments requiring collaboration, creativity, and problem solving, and additionally creating the potential for Flow (Csikszentmihalyi, 2008).

Ecology and humanitarian themes emerged early in the program, and many students expressed an interest in and wondered about themes such as fossil fuel versus solar power, caring for sick and needy people and animals, and cleaning up the environment. Caleb began the exploration of these topics in class one when he asked, "What would happen if oil slowed down?" That is the exact theme of the excerpted book *Empty* by Suzanne Weyn that we had just read aloud. He also asks, "If we ran out of oil, would everyone drive a Tesla? . . . Couldn't we have a solar panel car?" Greg is often the first to dive into a topic and ask questions, especially if he feels as if he has a little expertise or can make an entertaining, clever comment. He is naturally outgoing and gregarious except if he feels overwhelmed or has reached cognitive load, when he can suddenly turn sullen and detached.

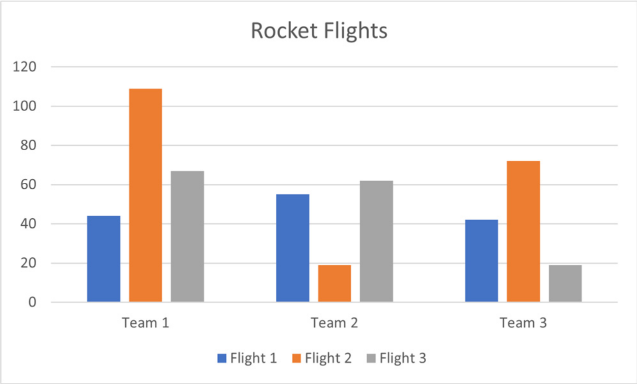
Greg's need for movement is obvious. During Class Three, I became aware that he was organizing and re-organizing something at his desk, just so he could be moving somehow. He is also slumped in his chair; listening is not his strongest skill. At 8:00, during discussion and modeling of the K-W-L as a a charting tool, Greg was facing the other way and playing with something manually. He had trouble staying focused on the lesson, but from previous experience, I know that Greg is clever enough to retain part of what was said so he will not look foolish if approached or asked. Later in the class, during brainstorming for a cluster map about potential topics for exploration, Greg makes a great point about what other spokes could go in our cluster about eliminating oil and gas use, right out of *Back to the Future*: "I don't know if this answers the question, but one of the material sources could be trash, since there's so much trash on the earth and we could use trash for everything, instead of oil and gas." His friend Rebekah cynically asks, "So how are you going to fill your car [tank] with trash?" However, Greg follows up with a comment about collecting trash, and that sparks the class to design their projects around cleaning and helping the environment for their *tikkun olam* (heal or save the world) projects.

Greg: Artifacts. Greg's proudest moment during the 9-class unit occurred during the "paper rocket" exercise. Student teams are given paper, masking tape, and a plastic straw and asked to create a rocket from the paper and tape and propel the rocket with the straw. Each team gets 3 launches, and each is measured in inches and recorded as data. This is a valuable research and experiment experience, especially for fifth-graders who had not been together for two years due to the Pandemic. Greg's team, Team 1, designed the best rocket and propelled it the farthest. He was very proud of this accomplishment and was happy to record and make a chart with the data that showed his team winning (see Figure 2 below).

Figure 2.

Rocket Flight Data for Experiment.

Rocket Flight Data			
	Team 1	Team 2	Team 3
Flight 1	44	55	42
Flight 2	109	19	72
Flight 3	67	62	19



Greg is at his best while moving and performing, so this experiment was ideal for him. The action shot of Greg and Rebekah creating and launching the rocket show the focus and concentration Greg can attain when appropriately engaged (see Figure 3 below; Rebekah is left, Greg is right, the rocket is circled in red).

Figure 3.

Greg Launches his Team's Rocket.

The other major artifact Greg produced with Rebekah was the emo 2000, a trash-collecting robot. Although Rebekah admitted that the working robot was created “with a little help from her Dad” the engineer, Greg worked on the “front” of the robot, created with foamboard, corrugated boxes, and many artistic supplies and chachkes such as crayons, markers, glitter, stickers, and other objects created from corrugated cardboard (see Figure 4 below).

Figure 4.

The emo 2000 Trash-Collecting Robot in Operation and on Foamboard.

Greg: Post-interview. In all interviews, both pre- and post-, I gave parents the option to sit in on the interview as a passive participant. Although most students appeared alone, 3 of the 12 students' mothers sat in. Greg's mother sat in during both interviews. My approach is to achieve the maximum amount of comfort for the interviewee and his/her family so I can get the most relaxed, easygoing interview possible. Parents generally respect the lines they should not cross to achieve genuine authentic, student-generated data, but sometimes a parent is helpful to make a fifth-grader more comfortable speaking to an adult in what some students may consider to be a high-pressure situation. It was clear to me throughout his interviews that his mother's presence was a benefit, not a problem, as she gently prodded Greg when he had trouble answering but did not plant any ideas.

In his post-interview, right out of the gate, less than a minute into the interview, Greg wanted to demonstrate his pride to his Mom over the rocket experiment and his collaboration with Rebekah on the emo 2000:

> Greg: So we did this project, when you make a rocket out of paper?
>
> Greg's Mom: Uh huh.
>
> Greg: And see if it which one would fly the farthest. And mine did.
>
> Greg's Mom: Oh, awesome.
>
> B. DuBoff: I mean, it was really a superior design, I must say. Let's talk. Alright, so what did you like best about the class? And what interested you the most?
>
> Greg: What interests me the most is probably like, making and come up coming up with a, like the robots and stuff. And I like best of all the class was working with my partner to make the design for the robot [the emo 2000].

This expressed interest in robots did not appear in Greg's pre-interview, except possibly his interest in superheroes. He spoke frequently about wanting to be a veterinarian and stated that he likes animals a great deal, but he did not address technology. In fact, the words "robot" and "design" do not appear in the pre-interview, but are first out of the chute in his post-interview. This demonstrates a change in his attitude and approach. The project has created a new interest for Greg. He is still in the beginning of his interest in technology and robots, and it may fade in time if not reinforced frequently, but for Greg in this place, at this time, a new potential career STEM interest has sprouted. If properly nourished, it will grow into one of the 3 or 4 main interests people normally have at one time (Renninger & Hidi, 2016).

The rest of Greg's post-interview was highlighted by his discussion of astronomy, the planets, and the solar system, another new interest. Coincidentally, and fortunately for Greg, I had changed my bulletin board halfway through the unit to the planets and solar system. Without data to propose it, I can only surmise that it aided Greg in developing his interest through frequent exposure. However, the following excerpt does demonstrate the effect of activating students' schema:

> Greg: So, me and Lea were like, Lea and I were thinking about how we're thinking of a project that could help people in need. So we came up with a

portable trash can that can, like pick up trash for people, and help people like who they can't walk as well as other people. And they can like, I can, like pick up the trash, move it around. So that's like, so their home is like not a mess.

B. DuBoff: And what made you think of that? Was it anything in our discussion or conversation that kind of got you the, you know, gave you the idea?

Greg: So mainly, the conversation, like we heard it, like, once, and we thought it was a good idea. So that's why we chose it.

Just hearing about something can be the hook that begins interest (Renninger & Hidi, 2016). An intentional or casual thought can become a great invention, innovation, or career.

Finally, Greg seemed positively influenced by the science fiction as predicted by the theoretical model that accompanies the full dissertation: “I like the part where it was talking about how there was an old book found in there in the shelf, because they never like it because it was in the future. And they had books on like, electronics.” The story we read was “The Fun they Had” by Isaac Asimov. Then he recalls another excerpt, this one from *Empty* by Suzanne Weyn: “Um, your talking about the pipes that would clean the water and filter them. So that wouldn't be like having trash in it. That seems cool, because it would start it would like stop pollution in the water.” This comment is in response to a class discussion about global water shortages and the “purple pipe” system that many countries and areas of the U.S. use to conserve potable water and energy. When Greg remembers these issues and scaffolds this information onto existing schema, interest can begin (Reiser & Tabak, 2014). Greg appears to be well on the way to interest in STEM careers and, to a lesser degree, in science fiction.

Conclusion

This small excerpt of a dissertation project demonstrates, through presentation of qualitative data refined through Design-based Research (Barab, 2014), change and enhancement of interest in one case study participant. Greg’s activities and comments also indicate that science fiction can be a successful hook to capture, and potentially hold, student interest. Also, Greg’s shift to new STEM interests by the end of the class suggests that a student already interested in STEM careers and activities may be as likely or more likely to be open to new STEM careers and activities. The full dissertation will present more evidence and more students, the three originally discussed in the beginning.

Although I cannot claim the evidence can be applied universally with such a limited viewpoint, I do believe that Greg is representative of many 10-year-old American boys, particularly living in the Northeast U.S., and that his experience can be seen as one more block of data supporting the use of science fiction and kinesthetic activities in STEM interest development. According to the findings, fifth-graders do better when they can do more.

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Appendix A: Pre-Intervention Interview Questions

These interviews will be in the Constructionist style (Brinkmann & Kvale, 2015). It is acknowledged that the interview process contextually affects the interview.

Pre-intervention

1. Tell me about your interest in SFF and STEM? (interest development)

2. Why did you choose your story or stories? What about it interested you? How did the cover and first couple of pages interest you? (general literacy and interest development)

3. What do you like or dislike about Science class in regular school? What are your favorite topics in Science? What makes you interested in those topics and not other topics? (Science literacy)

4. Are there Science topics you like more than others? If so, which ones? What makes them interesting to you? (Science interest)

5. If you could pick a Science-related job, what would it be and why? (Science interest)

6. Do you ever think about the future, both your future and the world's future? What do you imagine will be different about the future from now? (Science interest)

7. Tell me about the most interesting ways that Science or scientific things have changed the world. (Science interest)

8. What world problem would you solve if you had the power to do anything? (cite some examples so they know what I mean, like global climate change, cancer cure, feed the hungry, etc.). (Science literacy)

9. Do you think that after this class you will be better at Science or English? Why or why not? (Science literacy and general literacy)

10. Do you think this class will make you a better researcher? How? (information literacy)

11. What are your expectations for the class? What do you think we'll do? Do you think it will be interesting even though you do not know exactly what will happen? (general interest)

12. Does reading and thinking about the future help you with your projects at school? Please describe one. (information literacy)

13. Where do you normally research for your school projects? (information literacy)

14. Do you like learning about new words and phrases in Science or other subjects? (Science and information literacy)

15. Any questions or comments?

Appendix B: Post-Intervention Interview Questions

These interviews will be in the Constructionist style (Brinkmann & Kvale, 2015). It is acknowledged that the interview process contextually affects the interview.

Post-intervention

1. What originally interested you about Science Fiction and Fantasy and Judaism? What do you think has caused your interest to increase or decrease in STEM, SFF, or Judaism during the class? (interest development)

2. Why did you choose your book? What about it interested you? Did you learn any new words or concepts from the book? (general literacy)

3. What do you like or dislike about Science class in regular school? What are your favorite topics in Science? What makes you interested in those topics and not other topics? (Science literacy)

4. Are there Science topics you like now that you did not like or know about before? If so, which ones? What makes them interesting to you? (Science interest)

5. If you could pick a Science-related job, what would it be and why? (Science interest)

6. Do you ever think about the future, both your future and the world's future? What do you imagine will be different about the future from now? (Science interest)

7. Tell me about the most interesting ways that Science or scientific things have changed the world. (Science interest)

8. What world problem would you solve if you had the power to do anything? (cite some examples so they know what I mean, like global climate change, cancer cure, feed the hungry, etc.). (Science literacy)

9. Do you think that after this class you will be better at Science or English? Why or why not? (Science literacy and general literacy)

10. Has this class made you a better researcher? How? (information literacy)

11. What about the class has been fun and interesting? Please describe. Was anything boring about the class? Please describe. (general interest)

12. Tell me about your project. How did reading and thinking about Science Fiction and Fantasy (SFF) help you with your project? (information literacy)

13. How did the resources of the class like the websites, videos, etc. help you to research your project? (information literacy)

14. Please talk about some of the new words and vocabulary you have learned. What are some of the most interesting words and definitions? What makes them interesting? (Science and information literacy)

15. You probably had an idea of the types of things you would learn and do in this class. How did they match up with what really happened? How was it better, worse, or about the same as you expected? (interest development)

16. How would you describe the class to a new student who had never heard of it? Would you recommend it? (interest development)

17. Any final comments or observations?

Impacting Student Learning Using a Community-Building Discussion Platform Designed with Social Presence and Gameful Engagement

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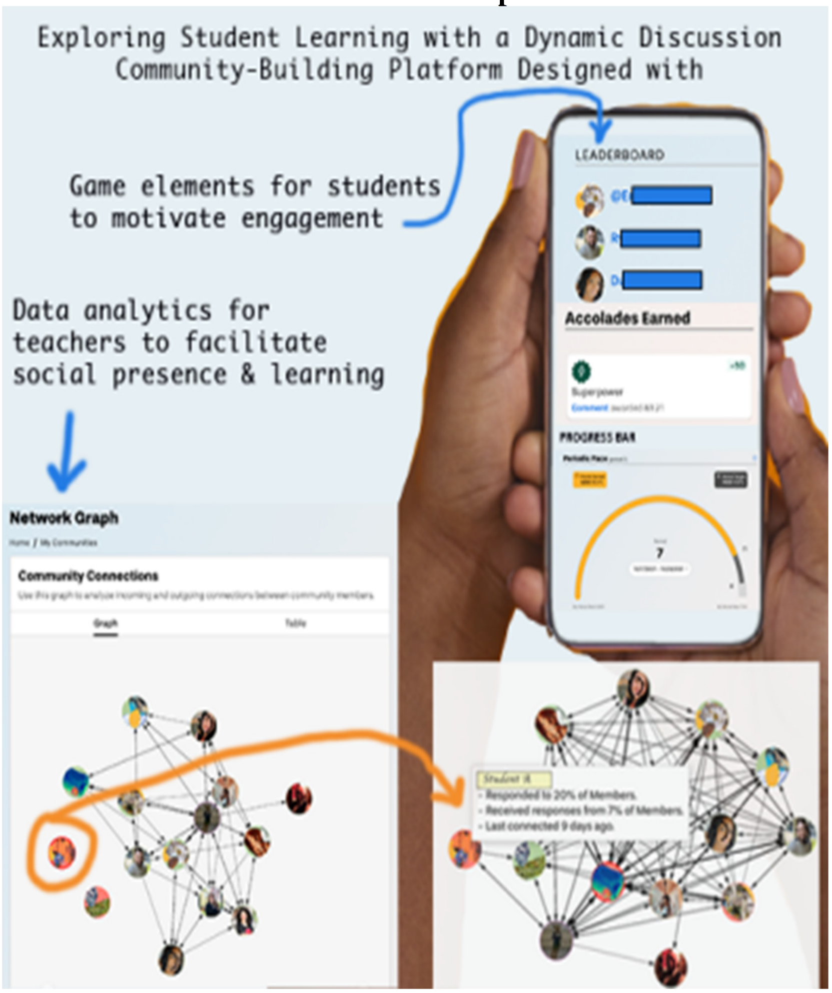
Abstract

How can instructors craft safe spaces for learning communities that seamlessly promote connectedness and course engagement outside the physical classroom? This one-year exploratory study completed at a mid-sized private university uses a social and gameful experiential (SAGE) approach to increase learner engagement and foster self-regulation. Interdisciplinary faculty explored the potential for a unique community-building discussion platform that uses a gamified social media-like platform to encourage self-regulation (Zimmerman, 2008) and motivate learners (n-103) to manage and master online scholarly discourse. Assessing how this technology impacts learner engagement, this study employs disruptive innovation theory (Christensen et al., 2011) and suggests that Yellowdig, one such disruptive technology, can foster positive changes, such as critical thinking and problem-solving skills. Researchers carefully and purposefully incorporated this technology into their courses to foster social constructivism (Vygotsky, 1997) to improve learners' self-regulation, cognition, and satisfaction.

Graphical Abstract



Keywords: SAGE, social and gameful experience, self-regulated learning, SRL, gamification, Yellowdig

Impacting Student Learning Using a Community-Building Discussion Platform Designed with Social Presence and Gameful Engagement

Researchers use the SAGE acronym for this social and gameful experience to improve learning as it aligns true to the essence of sage, building knowledge through reflections and experiencing the learning. Selecting Yellowdig as a platform that builds SAGE into the technology, this interdisciplinary team of researchers incorporated this into eighteen classes to inspire self-regulated learning through active engagement. Using this SAGE method, this study aimed to answer the following overarching question:

What is the learner experience when disruptive technology is purposefully incorporated into courses to foster engagement and a) improve learner satisfaction, b) self-regulation, and c) cognition?

This paper focuses on the results related to self-regulated learning from students' perspective and provides the second phase in a series of data analysis reports that examines and reports on the overall learning experience. While student satisfaction is important to the motivation and receptive frame of mind to build cognition, learning beyond the classroom takes more than just enjoyment and teacher-driven influence to improve cognition. Thus, researchers ground this study with a review of the literature regarding the need for SAGE learning and the necessity to foster self-regulated learning.

Literature Review

Surfacing up from the pandemic, an interdisciplinary team at a small private south-eastern university examined student experiences (n=507) during emergency remote learning (Ensmann et al., 2021). Findings from that study suggest a paradigm shift in education whereby disruptive technologies offer a means beyond traditional classrooms for interconnectedness and learning through social constructivism. The data revealed the depth of anxiety felt by students and suggests the need for increased empathy, communication, interaction, and flexibility from instructors and course communities to proceed with academic coursework, particularly for first-year college students. The findings elevate the importance of social presence as a literacy for learning in any modality, underscore the need to support the students' mental health, and stress the urgency for online and remote learning readiness for current and future public emergencies (Ensmann et al., 2021). Despite the unexpected nature of emergency remote learning, this study pinpoints lessons learned, including connections, professors, and self-regulation matters (Ensmann & Whiteside, 2021; Whiteside & Ensmann, 2021; Meyer, K. A., 2011; Ulrich & Karvonen, 2011).

Additionally, after the initial study, researchers explored student satisfaction with SAGE learning leveraging Yellowdig in a multi-phased research project. The first phase in 2021 offers results using the electronic Learning Satisfaction Survey (eLss) (Ritzhaupt, 2019) to measure learners' satisfaction (Ensmann & Whiteside, 2022). Participants (n=145) reacted with above-average satisfaction (nearly 80%) to questions regarding the learning experience. Initial findings suggest that instructors can leverage the gameful experience and social media-like engagement to foster critical connections and course satisfaction.

Next, in this next phase, researchers explored the concept of self-regulation and self-efficacy, which has been documented through the years by Pintrich (2000, 2004), Bandura, Rosenthal, and Schunk, and Zimmerman (Zimmerman, 2013), an educational psychologist in the 1960s, publishing the landmark work on self-regulated learning. Proposing social cognitive models, Zimmerman offered a cyclical phase model to compartmentalize the factors attributing to SRL (Zimmerman, 2008, 2013), examining three phases: performance, self-reflection, and forethought. This model revealed how proactive learners are distinguished by their performance and forethought through an adapted methodology called microanalysis.

This research suggested that those who set goals proactively, self-monitor with intention, use effective strategies, and are receptive to personal feedback attain mastery quicker and are motivated to learn.

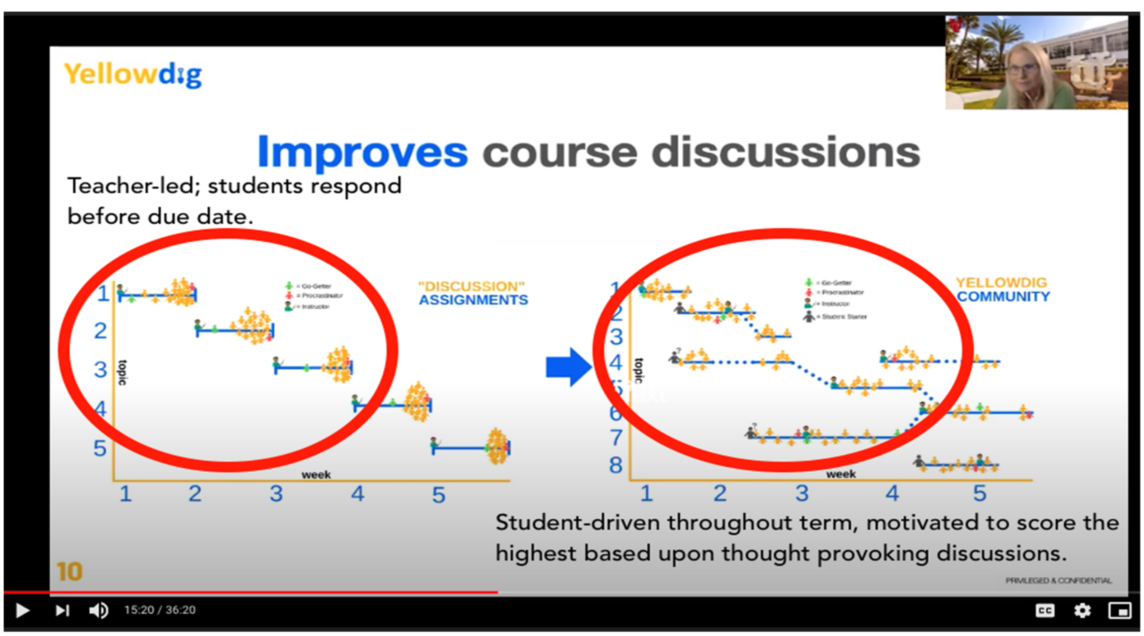
Methodology

Design of Social and Gameful Experience (SAGE)

Designing SAGE for learning with intentionality includes articulating the rules; using points and accolades (collectibles in gameplay) to actuate competition, collaboration, and accountability; modeling and using data analytics to prompt engagement and networking; offer a dashboard with progress bar/data analytics to facilitate accountability and SRL. Each step is accomplished by modeling the behavior we want our learners to exhibit. Thus, instructors begin by posting the expectations that learners must post reflections and offer fresh ideas about the course content, clarify how many points they will earn for each post, and move into the benefits of using SAGE. For example, each time learners incite another to comment or provide a social media reaction (like a thumbs up, a heart, or a lightbulb), they achieve points and can win collectibles. When they provide reflections that offer insightfulness, help, community building, or superpowers, instructors can reward learners with collectibles that add to their points. Superpowers are awarded when learners demonstrate an air of creativity in posts and innovative applications of concepts or ideas. Finally, learners can use their progress bar to help them stay on track and manage their learning. In this respect, the paradigm shifts from cramming homework and discussion board posts into the night before something is due to engaging in learning as they already do daily through social media, motivated to connect to achieve recognition and knowledge just as they do with any other social media platform. Learners and instructors can flag posts that stray from the learning, and learners can even lose points if posting for points without merit of academic achievement. Ultimately, this SAGE design flips the experience to the learners leading the learning and the instructors facilitating the direction and deepening the connections. (See Figure 1.)

Figure 1

Yellowdig's Illustration of Dynamic Changes in Course Discussions



Note: *Yellowdig's Illustration was provided with permission from Yellowdig.*

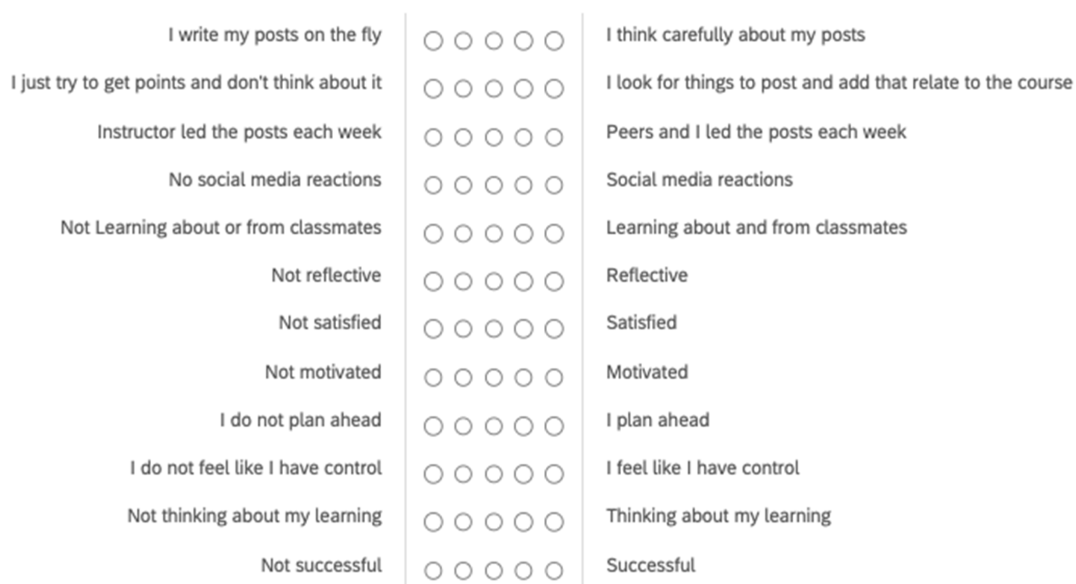
Data Sample, Collection Instrument, and Analysis

To explore the SAGE experience related to SRL, two faculty members integrated Yellowdig into their instructional approach for graduate and undergraduate courses (n=12), and participants (n=103) were asked to complete a post-survey including SRL questions from fall 2021 through spring 2022. Participants were university students at both the graduate and undergraduate levels.

Since the literature points to the value of survey methods (Babbie, 1973; Fowler, 2009; Creswell, 2014), the researchers selected the Electronic Learning Satisfaction Survey (eLSS) to measure electronic learning satisfaction (Ritzhaupt, 2019) of e-Learning environments. Designed to be comfortable for the user experience, the instrument uses bipolar adjectives at opposite ends of a five-point Likert scale regarding satisfaction.

In this phase of the study, researchers developed a similar model to test for SRL. Using the same scale, where one was the negative sentiment and five the positive, researchers included bipolar phrases to address Zimmerman's SRL dimensions (2008) for learners to rate their self-regulation during SAGE learning. (See Figure 2.) Interrater reliability testing by three university research assistants familiar with the platform tested the questions and found 8 out of 12 questions 100% in agreement. Discussion ensued, and revisions were made for clarity until a consensus agreement of 100% was reached by all research assistants for the final questions (Creswell, 2014). Examples of questions requiring consensus include: I just try to get points and don't think about it (1): I look for things to post and add that relate to the course (5); instructor led the posts each week (1): peers, and I led the posts each week (5); and, not planning ahead: planning ahead (5). This instrument also included a short-answer question to complement the quantitative data with qualitative data and provide an opportunity for participants to further elaborate upon their SRL with this SAGE approach: How have the experiences you had with Yellowdig changed you or contributed to your growth this term? Researchers administered an informed consent approved by the university institutional review board at the beginning of each course and pinned the link to the survey invitation to the top of the Yellowdig platform at the end of each term for participants to complete.

Figure 2
SRL Scale



Results

Descriptive analysis revealed a 100% response rate for participants (n=103) who completed more than three questions to evaluate their self-regulation with an overall average of 3.92 on a scale of one to five. Learners identified themselves as higher than average (above 3) on all questions regarding SLR except *for posting habits* (2.99) which revealed learners more often create posts on the fly rather than taking the time to think carefully about a post.

Table 3

SRL Scale Results: Overall Learner SRL Levels (n=103)

Variable	Mean	Std. Deviation	Min	Max
1-I write my posts on the fly: 5-I think carefully about my posts	2.99	1.27	1	5
1-I just try to get points and don't think about it: 5-I look for things to post and add what relates to the course	3.41	1.28	1	5
1-The instructors led the posts each week: 5-Peers and I led the posts each week	3.85	1.12	1	5
1-No social media reactions: 5-Social media reactions	3.45	1.38	1	5
1-Not Learning about or from classmates: 5-Learning about and from classmates	4.24	1.06	1	5
1-Not reflective: 5-Reflective	4.34	0.92	1	5
1-Not satisfied: 5-Satisfied	3.96	1.14	1	5
1-Not motivated: 5-Motivated	3.64	1.23	1	5
1-I do not plan ahead: 5-I plan ahead	3.33	1.32	1	5
1-I do not feel like I have control: 5-I feel like I have control	4.13	1.09	1	5
1-Not thinking about my learning: 5-Thinking about my learning	4.06	1.01	1	5
1-Not successful: 5-Successful	4.11	1.09	1	5

Qualitatively, results were examined based on Zimmerman's three dimensions aligned to each question in the instrument. Figure 3 offers a sample of those findings.

Table 2

SRL Codes Aligned to SRL Questions with Sample Learner Quotes

SRL Codes Zimmerman (2008)	Description Item	Aligned to eLss instrument adapted to add a section on SRL	Example quote
Forethought	Thought given to posts Planning ahead Looking for content to post	Q1 Q9 Q2	"I work at Fairgrounds St. Pete as a creative technologist. We also have a small education component that is starting to pick up. For my final project, I'm thinking of creating a storyline project that teaches learners how to create "Glow Grass". It will also teach the basics of electricity and electrical circuits" "Looking forward to the next half and getting deeper into Articulate Storyline"
Performance Phase	Self-Created Posts Control Motivation	Q3 Q10 Q8	"Here is what I have accomplished in class today with my storyboard." "This is my first attempt to make a storyboard" "The course that I've be developing is on the subject of community paramedicine"
Self-Reflection Phase	Social media reactions Thinking about the learning Feeling Successful Reflective Satisfaction Learning about/from my classmates	Q4 Q11 Q12 Q6 Q7 Q5	"I spent a lot of time choosing music for audio editing, since when these music are added to your project, they must be logical!." "Although, the word count for making posts was hard to achieve at times, so I relied on commenting on others' posts." "I think it got a bit off track somewhere along the path. This is partly because I didn't do a storyboard. I felt like the book itself was enough to go on, but it turns out I may have benefited from some production notes" "This is a deliberate move in order to achieve the emotional / psychological impact that I want to achieve."

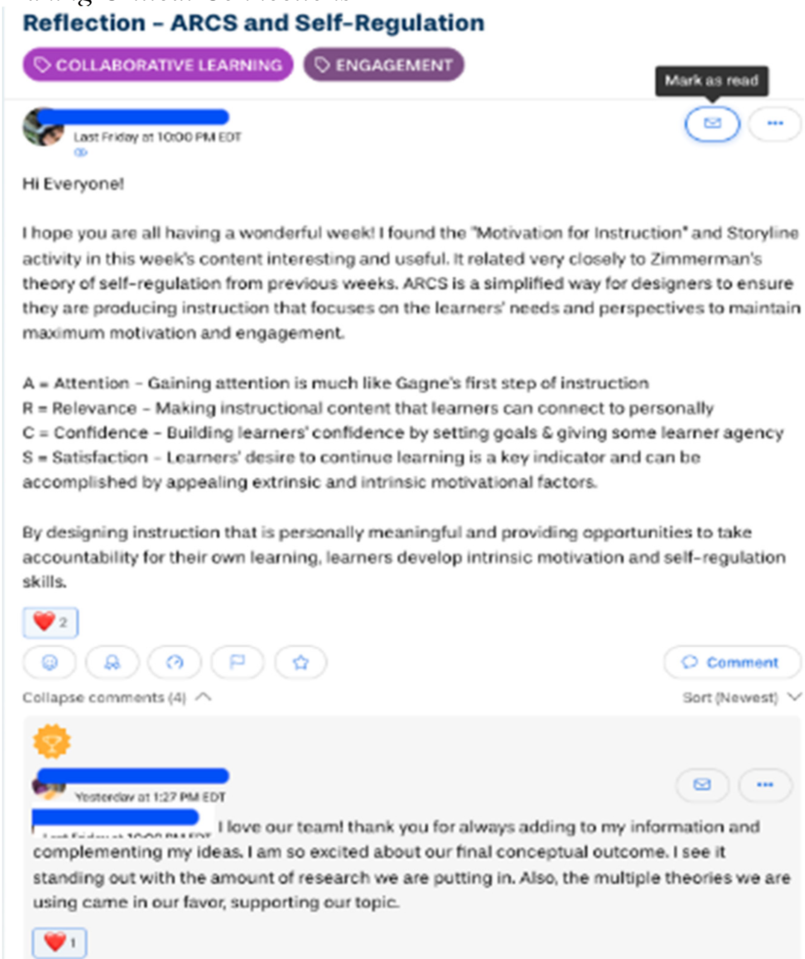
Discussion

In coupling the qualitative with the quantitative findings, researchers compiled the following lessons learned.

1. A review of the data suggests instructors may enhance learner self-regulation if the instructor reinforces the need to plan ahead, offers specific Yellowdig reminders along with other course assignments, and remind busy learners of the various options in Yellowdig to enhance their learning (such as authoring their own posts that extend the course content.
2. Those who advanced their learning from task-based to self-regulation offered sentiments such as "The format was very modern and fun; the gamification aspect of it made interactions more significant and required more critical thinking than most discussion boards." These learners reflect upon the peer-to-peer engagement and motivation of the gameful experience, recounting, "I liked how we could engage with other students and get to know each other a lot better with all the interactions." Another offered, "Easy collaborative efforts, the points earned are rewarding to see and encouraging." These

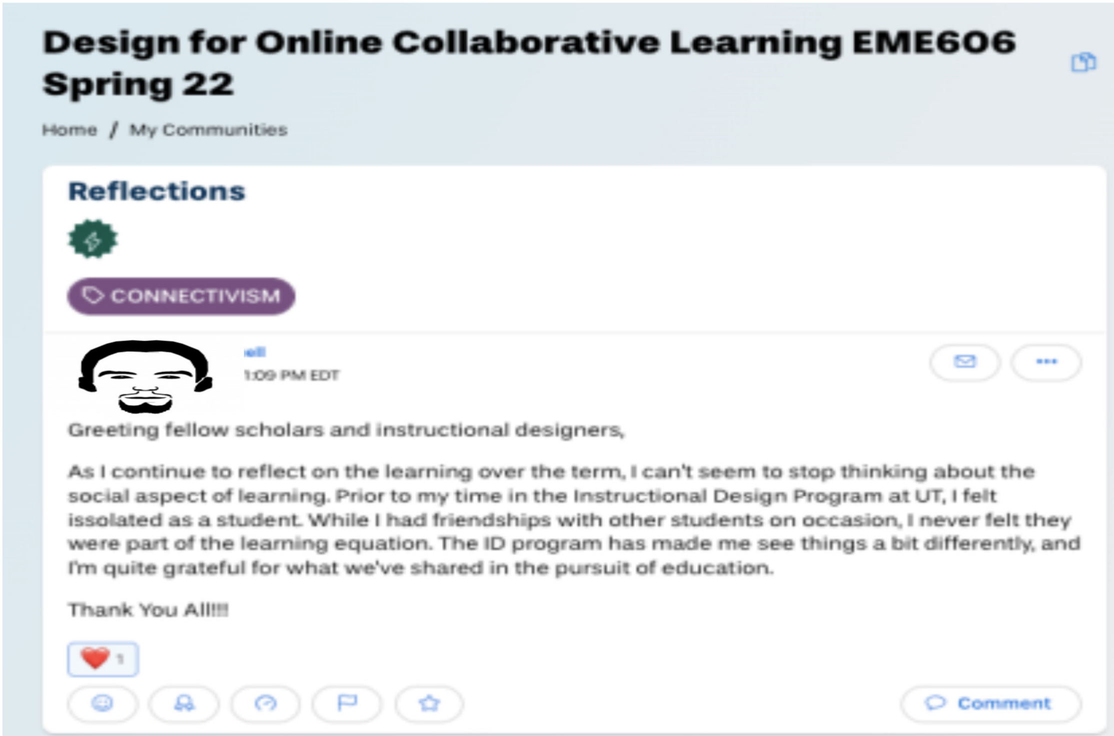
students found the discussion board helpful in offering options for them to advance their own learning. Ultimately, these learners make critical connections once they understand their part in the experience with SRL. (See Figure 3.)

Figure 3
Making Critical Connections



3. Learners need to be redirected to re-envision learning to mimic their everyday world of learning. Rather than wait for the professor to make a prompt at the beginning of the week and wait until the day before it was due to post their response, with a few posts to peers, the faculty redirected learners to engage as they do with other social media. Build the learning daily with a bit of the social media feed. In doing so, learners earned points passively when they prompted others to engage in their ideas, grow their knowledge, and create connections and community. (See Figure 4.)

Figure 4
Reflecting Upon the Learning



Overall, learners need to be redirected to re-envision learning to mimic their everyday world of learning. Rather than wait for the professor to make a prompt at the beginning of the week and wait until the day before it was due to post their response, with a few posts to peers, the faculty redirected learners to engage as they do with other social media and build the learning daily. In doing so, learners earned points passively when they prompted others to engage in their ideas, grow their knowledge, and create connections and community. This study found the SAGE approach using the Yellowdig platform to improve critical connections when instructors purposefully incorporate this disruptive technology to reinvent the student learning experience offers an effective platform to facilitate self-regulated learning. A further examination from the cognition perspective, examining if they truly achieved learning outcomes, could further advance understanding of this approach.

Conclusion and implication

Initial findings across multiple courses in this study suggest that instructors can leverage the SAGE approach to learning to foster SRL. Overall, this study explores the Yellowdig platform as one interactive solution for instructors to help motivate their learners to address difficult course content and advance problem-solving and critical thinking to better address complex societal issues. This study offers learning considerations for instructional designers, faculty, and supervisors of instruction in higher education. Findings across multiple courses suggest that instructors can leverage the gameful experience and social media-like reactions of community-building platforms to foster engagement, satisfaction, and SRL connections.

Ultimately, this SAGE design transfers the experience to the learners allowing them needed autonomy yet carefully scaffolding their learning and allowing them to slowly become more independent, self-regulated learners. In turn, instructors facilitate the discussion and deepen critical connections instead of counting posts and responses.

Declarations

In compliance with ethical standards at the University, researchers obtained informed consent from all individual participants.

All procedures performed in this study involving human participants followed ethical standards and the 1964 Helsinki declaration and its later amendments.

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A Thematic Analysis of Research Trends in MOOCs Dissertations and Theses (2008-2021)

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Abstract
This study examined the topical and methodological trends in 78 dissertations and master's theses about MOOCs published between 2008 and 2021 by ProQuest Dissertation and Theses Database to address the scarcity in existing literature reviews on young scholars' research efforts. Six major topical trends were identified from the perspectives of different stakeholders of MOOCs. Methodological trends described the research methods employed and how they related to research topics, data collection and data analysis methods.

Keywords: massive open online courses (MOOCs), dissertations and theses, thematic analysis, literature review, online education

Few of the previous reviews on MOOCs (e.g., Deng et al., 2019), if not any, targeted the MOOCs dissertation and thesis studies, an important body of literature reflecting the research interests of young scholars and their advisors (Davies et al., 2010; Drysdale et al., 2013). In this review, thesis studies were those written for the master's degree and dissertations for the doctoral degree. Specifically, it addressed two research gaps existing in the current reviews: (1) it offered an updated and a more comprehensive understanding of the research trends as reflected in MOOCs graduate research by covering the wide year range from 2008 to 2021; (2) it provided an important perspective which, if taken together with previous reviews, could help researchers develop a holistic understanding of the current state of the field.

To address the scarcity in existing literature reviews on young scholars' research efforts, this study aims to highlight the topical and methodological issues and make corresponding recommendations for future research endeavor. Four research questions that guided this inquiry were as follows:

1. What research topics have been explored in the MOOCs graduate research (2008-2021)?
2. What research methods have been employed by the MOOCs graduate research (2008-2021)?
3. What data collection methods have been used in the MOOCs graduate research (2008-2021)?

4. What data analysis methods have been used in the MOOCs graduate research (2008-2021)?

Methodology

Data Collection

The search for relevant literature was performed in the “ProQuest Dissertation and Theses Database (PQDT)”. A list of search terms and procedures were used during the search process:

- The keywords used for the search were “MOOC*” and “massive open online course*”.
- The search was limited to “abstract” only.
- The year range covered was from 2008 to 2021.
- The language was limited to English only.

A two-stage data screening process was followed to screen the 222 initially returned records. At the first stage, the title and abstract of each study were carefully read to determine that MOOCs were studied rather than simply mentioned, yielding 98 studies that were potentially eligible for the second-stage screening, excluding two studies not available in full-text.

At the second stage, the researcher read the full text of each manuscript, guided by two major purposes: (1) to determine whether the studies studied issues on MOOCs; (2) to determine whether the description of method section provides sufficient detail so that adequate information could be extracted to address the research questions.

After completing the two-stage screening process, 78 studies were identified as eligible for review in this paper.

Data Analysis

This study modified the five research strands of MOOC research identified in Veletsianos and Shepherdson (2016), and used the following six coding categories to address RQ1: (1) learner-focused, (2) instructor-focused, (3) institution-focused, (4) design-focused, (5) employer-focused, (6) provider-focused.

For RQ2, three widely accepted categories: quantitative, qualitative, and mixed-methods research (Creswell & Plano Clark, 2018) were adopted, and they have been used in several previous reviews (Almasi & Zhu, 2020; Zhu et al., 2018). Apart from the three general categories, the researcher also noticed the use of design-based research (DBR) (Brown, 1992) during the second-stage screening process. Given the increasing recognition and adoption of DBR by the research community (Anderson & Shattuck, 2012; Raffaghelli et al., 2015), and the need to reflect the methodological diversity in the reviewed studies, this study used DBR as the fourth category to describe the research methods adopted in the reviewed studies.

Regarding RQ3, this study employed some of the categories identified in Veletsianos and Shepherdson (2016) such as surveys, and added new categories like platform data, document review, artifacts, and physiological signals.

To address RQ4, the researcher categorized the methods into more general items, for instance, methods like regression and analysis of variance were coded under “inferential statistics”. The final identified data analysis methods were cross checked so that they were mutually exclusive.

Findings and Discussion

RQ1: What research topics have been explored in the MOOCs graduate research (2008-2021)?

Six major research topics were identified based on the examination of research purpose and research questions in each study. To reflect the diversity of topics, each major research topic was further categorized into certain number of sub-topics, which will be presented in more detail in the following sections.

More than half of the reviewed studies explored issues related to learners in MOOCs (65.4%), which was in line with previous review studies (e.g., Deng & Benckendorff, 2017; Raffaghelli et al., 2015). Other major research topics that followed the learner-related issues were instructor-focused (11.5%), institution-focused (11.5%), design-focused (6.4%), employer-focused (3.8%), and provider-focused topics (1.3%).

Learner-focused

Completion. There has been at least one MOOCs dissertation or thesis each year examining completion-related issues from 2014 to 2020. Much research effort investigated the factors correlated with MOOCs completion, including self-directed learning (Schulze, 2014), cultural indicators (Alabdullaziz, 2015), types of assessment (Papathoma, 2015), and the incorporation of a variety of multimedia materials and guided discussions (Montgomery, 2016), etc.

Learning experience. Studies in this category targeted learning experience issues from various perspectives, which included: the investigation of learners' general experience in MOOCs (Morris, 2014), the examination of learners' participation patterns (Stager, 2016), and the study of the barriers and challenges learners encountered in MOOCs (Cox, 2018), etc.

Motivation. Six out of ten studies in this category explored learners' motivation to enroll in MOOCs (e.g., Alabdullaziz, 2015). Other research topics included the investigation of the relationship between learners' motivation and learning outcomes (Wang, 2017) and participation in MOOCs (Haniya, 2019), and the drivers that motivated learners to complete MOOCs (Cox, 2018), etc.

Perceptions. Five of the seven studies in this category examined learners' perceptions of their experience in MOOCs (e.g., Kilgore, 2018), including the perceptions of peer interactions (Loizzo, 2015), and engagement and achievement in MOOCs (Morris, 2014).

Engagement. Studies in this category investigated the factors impacting learner engagement in MOOCs, including learners' trait complexes like personality and achievement goal orientations (Torres, 2016), the MOOC design features (Gore, 2018), and the integration of MOOCs into campus courses in Saudi women's higher education (Almutairi, 2018), etc.

Other trends. Studies coded under "learning outcomes" investigated the factors contributing to learner performance in MOOCs, including learners' motivation (Wang, 2017), pre-test (Janelli, 2019), self-regulatory strategies (Maldonado, 2019), and feedback (e.g., Kulkarni, 2015). "Peer interaction" studies mainly focused on learners' interaction pattern in MOOCs (Kellogg, 2014), the promotion of peer interaction (Hill, 2015), and how peer interaction related to learner performance in MOOCs (Huesman, 2019).

Instructor-focused

Compared with "learner-focused" topics, the number of studies that examined instructor-related issues was extremely low (*N* = 9). The results suggested that the majority of "instructor-focused" studies explored issues related to instructors' perceptions of MOOCs (33.3%), motivation to teach MOOCs (22.2%) and experience in teaching MOOCs (22.2%).

Institution-focused

Nine studies specifically focusing on issues related to higher education institutions covering three sub-topics: the impact of MOOCs on the landscape of higher education (66.7%), the integration of MOOCs into the existing instruction paradigm (44.4%), and the institution disposition (22.2%, e.g., decision-making process and expectations).

Design-focused

Five studies specifically addressed matters on the design of MOOCs. The identified sub-topics under this category included: the use of instructional design models and theories in MOOCs design, the design of MOOCs to improve accessibility for disabled learners, and the collaborative design process and experience of MOOCs.

Employer-focused

Three studies were coded for this major research topic. Only one sub-topic attending to the employers' perceptions of, and acceptance of MOOCs was identified. For instance, Outland (2014) addressed hiring managers' perceptions of courses offered in MOOCs, and the potential positive or negative impact of MOOC course-taking on candidates' employability.

Provider-focused

One last identified major research topic examined MOOC provider perceptions of assessment, accountability, and accreditation of MOOCs (May, 2015).

The findings suggested that (1) the assessment in MOOCs should be more learner-centered, (2) learners in MOOCs are the major stakeholders and (3) MOOCs could be institutionally accredited when offered as a part of degree program. Notably, "provider" is to be distinguished from "institution" reviewed above. Provider in this study refers specifically to the MOOC platforms hosting the MOOC courses produced by different higher education "institutions".

RQ2: What research methods have been employed by the MOOCs graduate research (2008-2021)?

Among the 78 eligible studies, nearly half of them were quantitative in nature, 29 studies were coded as qualitative, and 15 studies employed the mixed-methods approach. It was worth noting that one study specifically declared the use of DBR as its guiding approach (e.g., Li, 2015), in which both quantitative and qualitative data were collected. Qualitative methods were not the least used as indicated by previous reviews (e.g., Zhu et al., 2018, 2020), instead, they were only second to the quantitative methods, which were suggested in previous reviews as the most frequently used methods (e.g., Raffaghelli et al., 2015; Veletsianos & Shepherdson, 2016; Zhu et al., 2018, 2020).

Mixed-methods were the third most employed methods, which should be concerning as the small number of such studies may reflect the superficial magnitude of complexity of the research design in MOOC studies (Gašević et al., 2014; Greene et al., 1989). Future studies should balance the use of different research methods in order to achieve the methodological diversity advocated by Veletsianos and Shepherdson (2016) and to increase the validity of research findings (Greene et al., 1989).

DBR was the least adopted method in the reviewed studies. As an emerging research methodology that has the potential to guide better educational research, DBR has received considerable attention from researchers (Amiel & Reeves, 2008; Design-Based Research Collective, 2003). MOOCs offer a purely naturalistic setting in which learners are diverse in demographics and locations (Breslow et al., 2013). The successful implementation of DBR requires a naturalistic setting (Design-Based Research Collective, 2003; McKenney & Reeves, 2012), starts with the discussion of practical problems between practitioners and researchers (Amiel & Reeves, 2008), and usually involves multiple rounds of iterations (Amiel & Reeves, 2008; Anderson & Shattuck, 2012). The scarcity of DBR studies in MOOCs could possibly be attributed to the high demand of time and effort for the multiple iterations (Gašević et al., 2014). Moreover, given the large investment in developing and offering MOOCs, some MOOCs are not offered multiple times, which makes it more challenging for researchers to conducted DBR that requires several iterations in MOOCs (Gašević et al., 2014). However, it would be possible to implement several interventions in different subpopulations (Kizilcec et al., 2013) among the registered learners in MOOCs to make up for inadequate opportunities of multiple iterations (Gašević et al., 2014).

RQ3: What data collection methods have been used in the MOOCs graduate research (2008-2021)?

Survey was the most used data collection method which was employed in more than half of the reviewed studies. Survey was used in studies for collecting learners' demographic information (Martin, 2015); measuring learners' motivation (Li, 2015), self-directed learning readiness (Schulze, 2014), and self-efficacy (Branson, 2017); collecting stakeholders' perceptions of MOOCs (e.g., Stein, 2016), etc. Other identified data collection methods included semi-structured interviews (33 studies, 42%); platform data (24 studies, 30.8%), document review (18 studies, 23.1%), and observation (eight studies, 10.3%).

The researcher also examined the number of data collection methods employed by each study. About half of the reviewed studies (48.7%) used only one data collection method, including survey (42.1%), platform data (31.6%), and semi-structured interview (18.4%). About one third of the studies (29.5%) employed two data collection methods, in which survey was utilized in 16 of the 23 studies (69.6%), platform data in 11 studies (47.8%), semi-structured interview in 10 studies (43.5%), document review in 4 studies (17.4%), observation in 2 studies (8.7%), and focus groups in 2 studies (8.7%). Survey was the most frequently employed method in either one-method or two-method studies. The pattern was a bit different in studies employing three methods, in which semi-structured interview was used in 14 studies, followed by document review in 12 studies, survey in 10 studies, and observation in 4 studies. Only two of the 78 studies used four data collection methods.

Since all data collection methods are inherently biased and limited in scope, the use of only one method will inevitably bias the research findings, thus diminishing the validity of the research studies (Greene et al., 1989). It is, therefore, suggested in this study that two or more methods that have "offsetting biases" (Greene et al., 1989, p. 256) be used in the future research endeavors to enrich the methodological diversity.

RQ4: What data analysis methods have been used in the MOOCs graduate research (2008-2021)?

A total of 12 major data analysis methods were identified. Inferential statistics were the most frequently adopted data analysis methods (48.7%), followed by descriptive statistics (39.7%), coding (25.6%), thematic analysis (21.8%), and content analysis (9.0%). The findings suggested that the inferential instead of descriptive statistics were the most frequently adopted data analysis methods, which was in stark contrast with previous review effort (e.g., Zhu et al., 2018, 2020) and may reflect the complexity of research designs of the reviewed studies. Only seven studies adopted the more advanced and versatile methods like learning analytics and educational data mining (LA/EDM) (Gašević et al., 2014). LA/EDM methods could potentially enable the researchers to make full use of learners' trace data by analyzing their learning activities in MOOCs (Gašević et al., 2014), thus providing a more intricate profile of how learning takes place in MOOCs. Future studies may consider an increasing use of LA/EDM in alignment with sound educational theories to provide a more comprehensive and meaningful interpretation of learning and teaching in MOOCs (Gašević et al., 2014).

Regarding the number of data analysis methods adopted in each study, the results suggested that half of the 78 studies used one data analysis method, and about one third of studies employed two data analysis methods. Many one-method studies employed qualitative type of data analysis methods like coding and thematic analysis. Statistical analysis methods including descriptive and inferential statistics were more often adopted than qualitative data analysis methods in studies employing more than two data analysis methods. In effect, 37 of 39 (94.9%) studies using two or more data analysis methods adopted the statistical analysis methods. Veletsianos and Shepherdson (2016) warned that the heavy dependence on particular research methods could largely constrain our understanding of MOOCs, therefore, they called for "an expansion of the methodological approaches used in MOOC research" (p. 214). More importantly, the triangulation of multiple data sources would enhance the validity of research findings (Greene et al., 1989).

Limitations

Since this study reviewed MOOCs graduate research available in ProQuest Dissertation and Theses Database (PQDT), in which a large percentage of studies are from universities in the U.S. and Canada, this study may be "geographically limited" to some extent. Future studies are encouraged to expand this review by including MOOCs graduate research written in other languages such as Chinese as recent review effort demonstrated that China came only after the U.S. in generating empirical MOOC research (Zhu et al., 2020). Also, future studies may consult other databases dedicated to the collection of dissertations and theses within specific institutions.

Conclusion

This supplementary review was consistent with previous systematic review effort in that it also suggested that most graduate research studies targeted learner-focused issues (e.g., Raffaghelli et al., 2015; Zhu et al., 2018, 2020) adopting quantitative research methods (e.g., Raffaghelli et al., 2015). As opposed to previous reviews (e.g., Zhu et al., 2018, 2020), qualitative methods were the second most widely used methods rather than least used. When it comes to data analysis methods, this review contrasted with existing reviews (e.g., Zhu et al., 2018, 2020) in that inferential instead of descriptive statistics were most frequently adopted. Moreover, the findings also revealed that half of the studies employed only one data analysis method, and this would limit our comprehensive understanding of MOOCs (Veletsianos & Shepherdson, 2016).

What is unique about this review related to its identification of the scarcity of studies employing the design-based research method (Amiel & Reeves, 2008; Design-Based Research Collective, 2003), which has been increasingly accepted as an alternative research approach in addition to quantitative, qualitative, and mixed-methods approaches (Anderson & Shattuck, 2012; Raffaghelli et al., 2015). Given its deep focus in solving practical problems by working with practitioners as well fine-tuning theories (Amiel & Reeves, 2008; Anderson & Shattuck, 2012), DBR has great potential in solving some serious issues (i.e., how to engage learners in MOOCs) facing MOOCs that other research approaches fall short of. Therefore, future studies are encouraged to employ DBR approach to explore critical issues such as designing engaging courses, thus lowering the attrition rate in MOOCs. The paucity of graduate research studies adopting DBR approach should be alarming as it may signal that the young scholars are not prepared to conduct DBR studies. This study is timely and important as it points out this issue that has not been identified in other review efforts. Future studies may continue expanding the repertoire of methodological approaches in MOOCs research (i.e., more use of methods like educational data mining) and employing DBR approach, as well as focusing on topics that are critical for the sustainability and continuous growth of MOOCs.

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The Study of Adult Learners in Distance Education: A Scoping Review of the Literature

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Introduction

Distance education has been around in various forms for decades, from correspondence courses and radio-based learning to courses by satellite and CD-ROM to today's online and blended courses. Throughout this time, the target audience has generally been "adult learners" - individuals for whom the existing structure of post-secondary learning does not fit. Despite a growing robust literature around online learning in general and on adults as learners in workplace learning, research specifically around learning for adults over 24 through distance education has been spotty. We set out to conduct a scoping review of the literature in this space to see what is well established and what has been lightly examined or not at all. In this paper, we first present our scoping review study, and then we discuss the benefits, challenges and the lessons learned from working on such a large inter-institutional and international team.

Literature Review

Learning happens in many circumstances, whether within the structure of an educational institution, a community event, or personal direction. Learning environments are categorized as formal, informal, and nonformal (Coombs, 1989; La Belle, 1982; Mocker & Spear, 1982). While initially organized around physical locations of learning, the structure can and has been applied to distance learning (Lowenthal et al., 2009). This scoping review is limited to empirical research conducted on adult learning delivered at least partially from a distance and by a "formally constituted institution of education" (Hager, 2012, p. 1314).

The U.S. Department of Education records separate metrics for “nontraditional learners,” including those who are age 24 and older (Radford et al., 2015). Findings from the fields of neuroscience (Fjell et al., 2013) and psychology (Ackerman, 1996; Hagen & Park, 2016; Horn & Cattell, 1967; Salthouse, 2010) provide further evidence for classifying adults as a different type of learner.

Learning happens in many circumstances, whether within the structure of an educational institution, a community event, or personal direction. Learning environments are categorized as formal, informal, and nonformal. While initially organized around physical locations of learning, the structure can and has been applied to distance learning. This scoping review is bounded by research conducted on adult learning in formal learning settings defined as associated with an educational organization (non-credit or for credit).

Regular data collection by the US Department of Education does not capture enough about participation of adult learners in distance education for several reasons: 1) the primary focus is on first-time, first-year students, 2) population distinctions do not specify the modality of teaching/learning; indeed they assume an in-person learning environment, and 3) most data collected around distance learning per se focuses on traditional student populations (Advisory Committee on Student Financial Aid Assistance, 2012).

Several learning theories, models, and frameworks have been researched and found effective for online education. These include Community of Inquiry (Garrison et al., 2010), Connectivism (Siemens, 2017), and Online Collaborative Learning (Harasim, 2012). However, age is often not a variable studied.

We located eight existing systematic reviews of adult learning in distance education in a search of the literature. Three of these articles focused specifically on health-care education (Carroll et al., 2009; Peterson, 2009; Wu et al., 2018), and one each focused on communities of practice (Abedini et al., 2021), problem-based learning (Jurewitsch, 2012), heutagogy (Moore, 2020), computer games (Turner et al., 2018), and adventure learning (Veletsianos & Kleanthous, 2009). No systematic reviews looked specifically at the learning processes that adults experience in distance education.

Distance education is growing as a popular learning modality for adults though its presence in the literature is limited. Similarly, there is a gap in exploring the learning processes of adults, and a systematic review on this topic has not been conducted. A scoping review of the literature will lend the field of instructional design a holistic view of adult learners in distance education contexts and a baseline for identifying shortcomings and gaps in the literature. The research goals are to (1) map the current state of empirical and analytical research on adult learning in distance education; (2) identify gaps in the literature and directions for future research, (3) synthesize definitions, and (4) organize concepts and literature for other researchers and practitioners.

Research Questions and Definitions

The research question guiding this study is: How are researchers studying the ways adults learn in distance education? More specifically, we will explore:

1. What are the characteristics of studies on adult learning in distance education?
2. What research methods were employed to study adult learning in distance education?
3. What trends and gaps in research on adult learning in distance education emerge?

We defined "adults" as age 24 and older as reflected in the U.S. Department of Education definition of nontraditional learners. We explored "learning" as it relates to any actions directly connected to course content or skills, affect, or the self-regulation necessary for student academic success. Our context was "distance education," meaning not in the same location or a hybrid combination of traditional and remote learning, either synchronous or asynchronous instruction provided by an educational entity.

Methodology

This scoping project addresses the issue of current ambiguous terminology and lack of comprehensive review of the literature on adult learning in distance education (Peters et al., 2015). A scoping review methodology is appropriate for the anticipated diversity of studies to be included to address the broad questions under investigation (Peters et al., 2020). Given the nature of scoping reviews, articles included were not assessed for quality in terms of methodological limitations or risk of bias. Our study utilized the protocol outlined in the *JBI Manual for Evidence Synthesis* (Peters et al., 2020). The team developed a protocol and utilized similar keywords to search institutional access databases to identify potential articles based on inclusion criteria. Searches were conducted in July 2021 and were not limited by date. Studies after that date have not been included. The initial search yielded 20,241 potential articles for review. After removing duplicates, the total abstracts reviewed included 11,227.

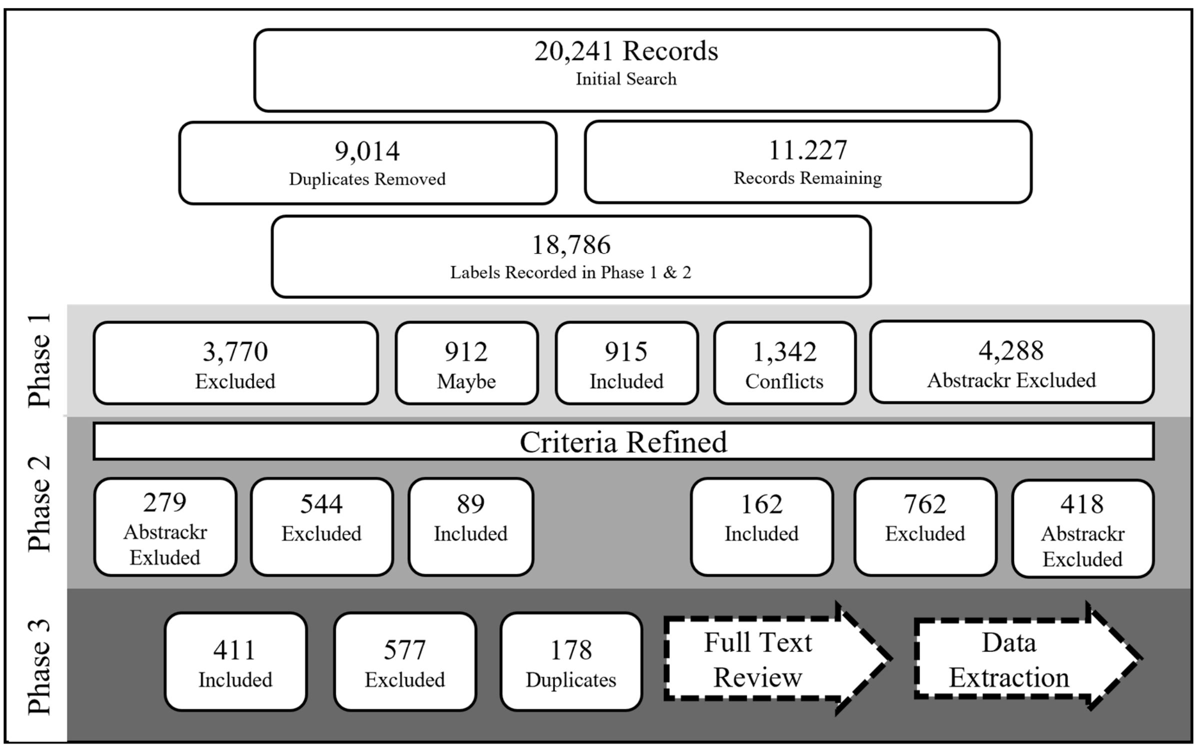


Fig 1. PRISMA diagram showing abstract screening results throughout the three phases of the project.

The research team utilized the Abstrackr platform from Brown University (Wallace et al., 2012) to screen the abstracts, where at least two researchers reviewed each abstract, and the team collaboratively resolved any conflicts. In the first round of abstract reviews, the team labeled 915 articles to be included, 912 as "maybe", 1,342 received conflicting ratings, and 3,770 were excluded (see Figure 1). The AI in Abstrackr marked 4,288 abstracts as irrelevant based on our coding patterns. We took a random sample of 100 abstracts to confirm that these were indeed irrelevant. At this point, the team worked to refine the criteria to be more specific in our definitions and developed a job aid to assist in evaluating the abstracts (see Figure 2). The team conducted a second round of reviews of the abstracts marked "maybe" and those with conflicting scores which resulted in an additional 251 records to be included. In total, 18,786 labels were created in these first two rounds.

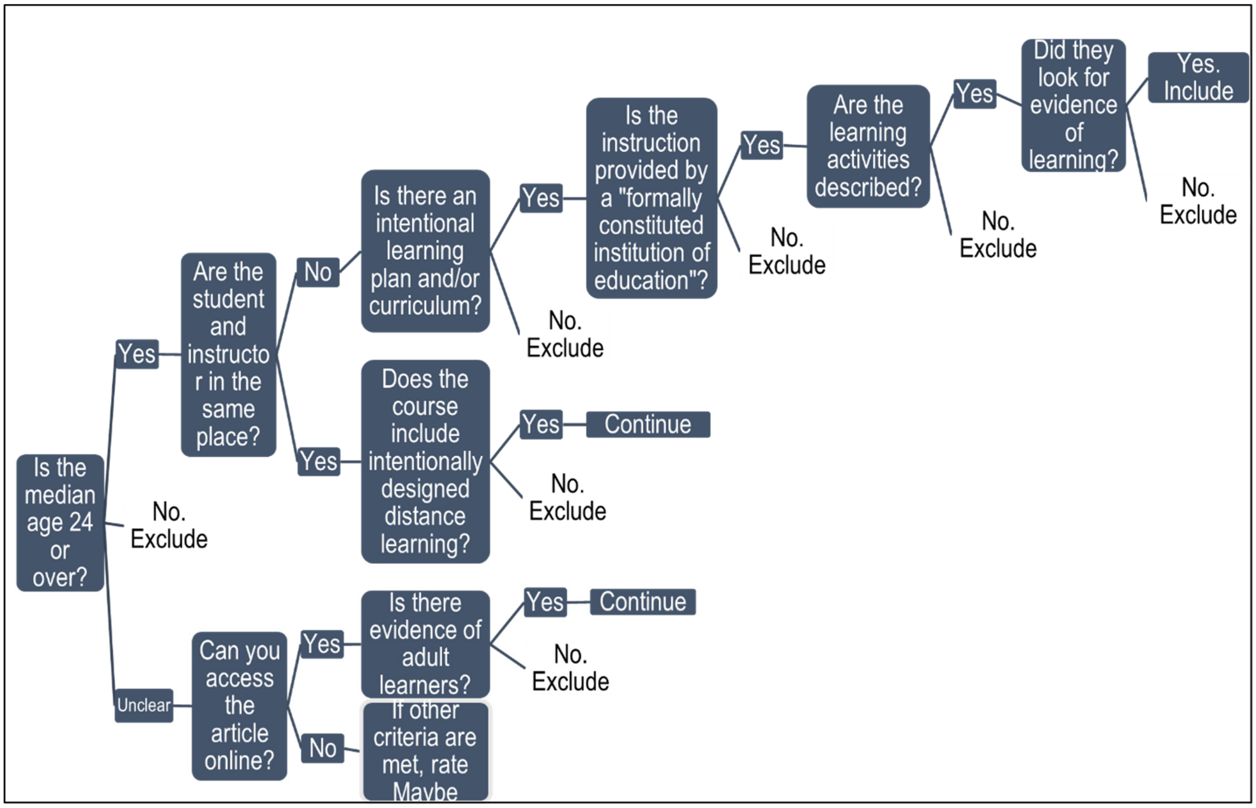


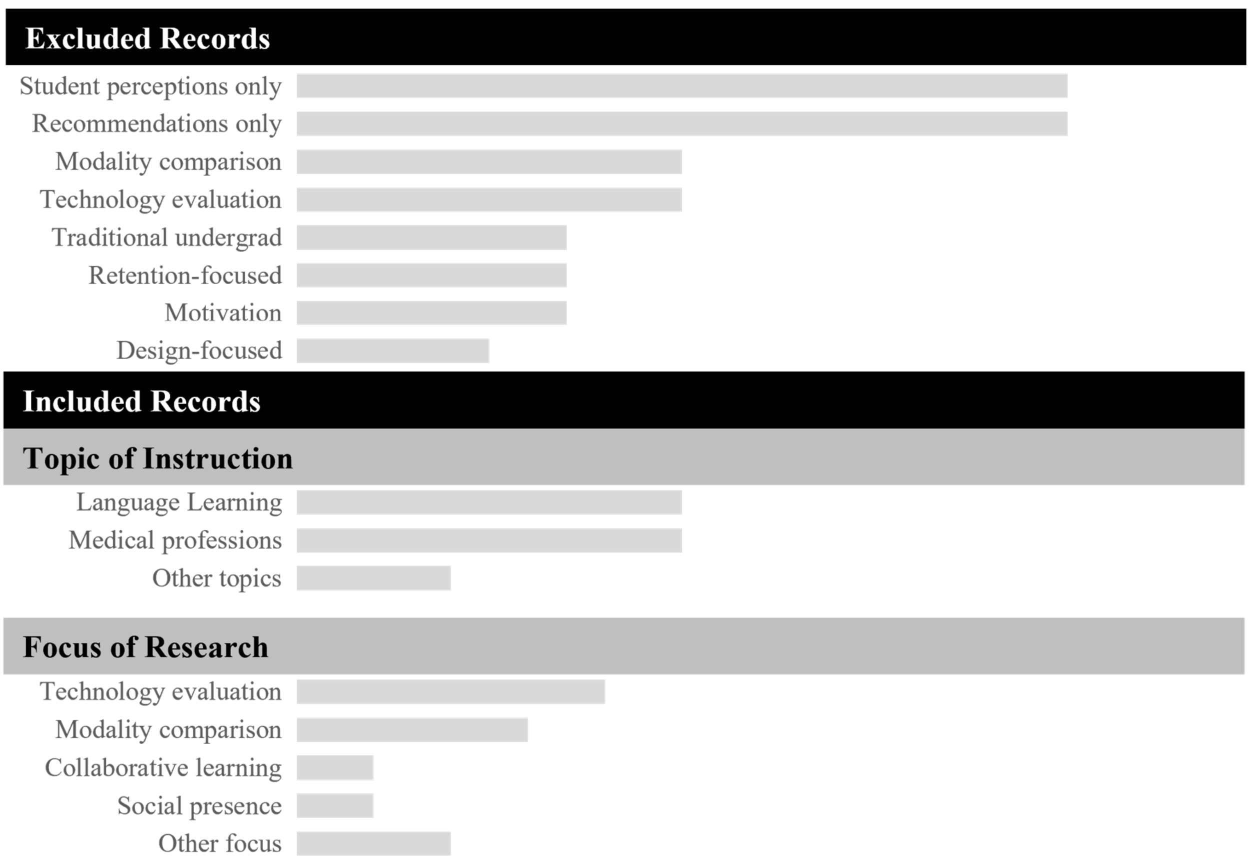
Fig 2. Decision tree developed to facilitate and systematize abstract screening.

The researchers utilized Covidence to review the remaining records again. An additional 178 records were identified as duplicates, 577 were excluded, and 411 were included for the next phase. The full text was retrieved for each of the 411 records to determine if the article actually met the inclusion criteria. Those that will be included will be coded by research type, population, context, learning activities, and subject area. Covidence software will be used to extract data from the indexed articles to create a map of the literature. Descriptive statistics and crosstabs will be used to analyze the quantitative data and thematic analysis will be used for the qualitative data.

Preliminary Results

The research team has completed three rounds of abstract reviews to identify the records that have the most potential for meeting the criteria of studying how adults learn in distance education. We have documented our observations from the abstracts we have reviewed, describing what we saw in the records we included and excluded (see Figure 3).

Reasons for which an article was excluded are as important as reasons for which an article was included. These exclusion criteria help in keeping the focus of the scoping study tight while enabling an understanding of the motivations and drivers supporting the study. Of the studies we excluded, we found that a great proportion of them only reported on student perceptions of learning or only provided recommendations for teaching adults in distance education without presenting empirical data on student learning. While understanding the experience of the adult learner is important, student perception alone is insufficiently reliable to be the only measure. Learners are often not accurate judges of their own learning (Avhustiuk et al., 2018; Deslauriers et al., 2019; Kirk-Johnson et al., 2019). Comparing course modalities without describing the learning, only evaluating the effectiveness or preference of a tool, focusing on learner retention, labeling traditional-aged undergraduates as adults, examining motivation for learning rather than learning itself, and focusing on the design of the instruction rather than its effect on learners were also commonly found exclusion reasons.



Note: Bars show trends, not actual values.

Fig 3. Preliminary results showing focus of excluded and included records.

While adult learning in distance education was studied in relation to a number of different fields, we found that the language learning and medical education studies were more likely to describe and measure the learning than any other topic area. The focus of the included studies also varies. Many focused on the use of a particular technology and they also described and measured the learning of the students, either quantitatively or qualitatively. Similarly, there were also many studies that compared learning between face-to-face and online learning modalities. Other common research foci included collaborative learning, including the Community of Inquiry, social presence, and several other specific topics. Results of the data extraction will be reported at a later date.

Team Processes

The value of this research extends beyond the results of the scoping review to come. The experience of assembling, managing, and collaborating as an international and inter-institutional team of 17 researchers merits its own examination. The large team of researchers is located at different institutions, in different time zones and in different countries. We will describe how the team formed and how members learned of the project, their motivation for participating, and how they managed to persist in a long-term project. We will also share what the team members learned throughout this process, the pros and cons of working on a large team, and the strengths and weaknesses of our particular project. Each team member was asked to reflect on their experience participating in the project. Their voices and perspectives are shared in aggregate below.

Recruitment

The genesis for this project came from the frustration of the lead author who struggled to find quality literature that examined adult learning processes in distance education. Most of the literature she encountered was either (a) about distance learning but did not address age groups or adult learners or was (b) about adult learners but addressed general recommendations not empirical study of learning processes. The lead author reached out to other doctoral students she had met through AECT to form a research team. The project was often discussed at Graduate Student Assembly meetings, so other doctoral students have joined the project during the past 16 months. The lead author posted calls for participation several times over the course of the project on Facebook, Twitter, and Gather which resulted in additional members joining, some who had experience conducting scoping reviews or had completed their doctoral degrees and were experienced researchers.

Motivation to Participate

Motivation to participate in this project varied among the team members. Some members had experience with systematic reviews and were looking to continue this work, while others wanted to increase their experience conducting empirical research. Most had a passion for adult learners and distance education as their primary motivator, and some were hoping to find resources that would be beneficial for their current work with adult learners in distance education as faculty or instructional designers. Other researchers who joined the team later were impressed with the protocol and rigor of the study and wanted to be involved in the project as a collaborative opportunity.

Persistence

Persisting on a long-term research project can be a challenge, especially one that requires hours of tedious work when there are so many other competing demands. Some members of the team have left the group because they were not able to make the time for the project, and some have left the project temporarily to address a major life issue before returning to the project. The project coordinator reiterated to all group members that this was to be expected and that everyone was welcome back if they needed to take a break. Notes for each of our bi-weekly meetings were kept in a running document, including a recording, a weekly update summarizing progress and decisions was sent out by the project coordinator and archived in a google group, and ongoing conversations were maintained in Slack. This let people feel like they could stay up to date with the project even when they were unable to participate.

When asked about their persistence on this project, several of the team members noted the camaraderie and relationships that have developed which make participation enjoyable. There is tremendous respect and admiration for each other. Others noted the helpful articles they have discovered or the skills that they continue to develop as part of the project. One team member explained,

> I have realized that my article reading and analyzing process get better as I keep doing so. I have had the opportunity to discuss my decisions with other reviewers especially when I have wavered between two decisions. Additionally, the weekly meetings have helped me learn different perspectives towards looking at an article.

Completing most of the work asynchronously has provided the flexibility that many members of the team needed to work around their busy lives. With so many researchers in multiple time zones, it was not possible to find one common meeting time, so two meetings were held each week to accommodate the complex schedules. One researcher shared a strategy that helped her continue to plug away at the project. “I keep the Scoping Review tabs grouped on my browser window. That way, when I needed a bit of a mental break, I reviewed some abstracts. Keeping it accessible in the browser kept it on my mind.”

Lessons Learned by Team Members

Most of the team members had never conducted a scoping review before, so this project was an opportunity to become familiar with this methodology. Many of the team members recognized how much more they have learned by being part of a team than they would have on their own. Managing team dynamics and balancing multiple responsibilities were noted skills that were developed. One team member commented on the tolerance and understanding we have for each other in the challenges we each face, which has contributed to our sense of community and dedication to one another.

Several team members commented on the importance of shared definitions and documenting all of our work. For example, some of our conflicting ratings came from mismatches in what counts as learning. We spent several weeks searching the literature for definitions of learning and discussing what we would and would not consider to be learning for the purposes of this study. Seeing so many abstracts was a learning experience in itself for most of the team. One researcher explained, “I think my own manuscripts have improved because of the number of abstracts and articles we've reviewed. Reviewing so many works and looking for specific information (which was sometimes difficult to find) has reinforced the importance of alignment, clarity, details, and precision.” Documenting all of our work and creating the short weekly summaries has been helpful for us to be able to go back and revisit decisions, report on our progress, and to easily onboard new team members. A few of the researchers noted the importance of strong leadership in a large project like this.

Pros and Cons of a Large Team

Working with such a large team has both its benefits and challenges. There are 17 researchers who have made substantial contributions to this project so far, from 16 different universities in four countries from around the world. A dedicated leader for a team of this size is essential as is the selection of appropriate tools and a system for documenting all of the work.

Team members identified several pros and cons of working on a large team. For example, one researcher noted, "diversity of opinions and perspectives (discussing what to include and exclude is so much stronger when dialogically argued over by a large group)." She also expressed that time was a challenge but worth it for the rigor. Another team member said, "Pros: diverse intellectual and cultural perspectives, more ideas generated, more help. Cons: challenging to coordinate, time zones and busy schedules make it difficult to arrange synchronous meetings that work for all." These are consistent with the findings from Daudt et al. (2013) who conducted a scoping review with a large inter-professional team. They reported, "the strengths include breadth and depth of knowledge each team member brings to the study and time efficiencies" (p. 1). The challenges they faced included consensus and resource limitations.

A simple calculation shows the benefits of working with a large team. In our first two rounds of abstract reviews, we recorded 18,786 labels (see Figure 1). If each abstract required an average of three minutes to read, evaluate, and label (many required much more time), that adds up to 56,358 minutes or 939 hours. This is an extraordinary amount of time for a small research team to spend, but only 55 hours per person if spread evenly over 17 team members. The additional team members add to the complexity of the project but also reduces the burden on individuals.

Project Strengths and Weaknesses

Arksey and O'Malley (2005) explained that when conducting a scoping review, "The process is not linear but iterative, requiring researchers to engage with each stage in a reflexive way and, where necessary, repeat steps to ensure that the literature is covered in a comprehensive way" (p. 22). When asked about the strengths and weaknesses of our project, one team member noted, "The start (not necessarily weakness) had growing pains (expected) and we had to figure out what works and doesn't work. It requires flexibility, some rework, and ability to problem solve - also patience!" Having read several studies on scoping reviews, the team was prepared to accept the iterative nature of this type of research. We made several attempts at searching databases with various keyword combinations and worked together as a team to determine our final search string. We reviewed the abstracts multiple times as we came to understand the nature of the literature on adult learning in distance education so that we could make more informed decisions about our inclusion and exclusion criteria. Throughout the process, we found that we needed to be more specific with our definitions and what they look like in research studies. Documenting all of these discussions and this process helped new members to understand the criteria and feel more comfortable with making decisions on abstracts. One researcher explained, "we had to learn as we went about best practices, design methods, best tools for analysis, and deciding what we were actually going to analyze … it was and remains a work in progress."

Synchronous discussions in weekly Zoom meetings were where we hashed out most of our team decisions, although we did carry on conversations asynchronously. One weakness of this project was the inability to find a common time for everyone to meet. With team members in Malaysia, British Columbia, the UK, the east coast of the US, and other places in between, we could not find a time when everyone was available. The team member from Malaysia noted that an 8:00 am EST meeting is at the end of her day at 8:00 pm, so she is often exhausted and is not able to contribute as much as she would like, while the team member in Utah found morning meeting times to be a challenge as she juggled her work and a toddler at home. We tried to address this challenge by adding the Slack platform to make asynchronous communication easier than it was with the Google Group and asking for input from each member of the team before we made decisions about definitions, inclusion criteria, or technology tools. All of the zoom meetings were recorded, and this was helpful for team members to catch up on missed meetings or for new members to familiarize themselves with the project.

One of the strengths of this team was how tech savvy the members were as the majority of the researchers were engaged in educational technology is some form. This allowed us to explore a variety of technology tools and strategies to find the ones that worked best for us. The tools that we found to be most helpful were Google Drive, Docs, and Groups, Zotero to maintain a shared library of our records, Slack for ongoing conversations, Covidence for full text review and data extraction, and VOSViewer for bibliographic analysis.

We looked at several tools to assist with reviewing the abstracts and doing data extraction of full-text articles. These included Rayyan, Abstrackr, Cadima, Covidence, SRDR, and a custom solution in Google Forms. The features that drew us to Abstrackr were the simple interface, the ability to select keywords for color coded highlighting, tags that could be added to abstracts, a notes tool, and most importantly, the artificial intelligence that continuously learned from our labels to sort the remaining abstracts by relevance. Using this tool saved us from reviewing almost 5,000 abstracts, which was a big time saver. However, only a limited number of fields could be imported with each record. Because we lost the DOI and URL field from any record that had them, we were unable to use a tool to automatically locate and import full text articles for those we wanted to review. This made it necessary for us to manually locate and upload pdf full text for the 411 records included in that round.

Conclusion

It is an ambitious undertaking to map the literature on a specific topic, but the scoping review methodology is an appropriate strategy. Our research team found that having many hands made light work. Our initial findings include a lack of research that specifically focuses on the process of learning in adults in distance education; most literature used student perceptions and satisfaction as the data source while other articles included recommendations for working with adult learners in distance education without empirical data on adult learners. Language learning and medical continuing education were the two dominant fields that described and measured learning processes of the adults in their studies. Scoping reviews are iterative in nature requiring multiple reviews of searches and abstracts to determine the final inclusion criteria. This team benefited from the wisdom and experience of so many voices in this process which led to a richer understanding of the literature and a more rigorous study.

The recent global pandemic has drawn attention to distance learning in general. With increasing disruptions to learning due to global events, including increasing numbers of non-traditional learners (Garret et al., 2021; OECD, 2021), developing a deeper understanding of the current state of empirical and analytical research on adult learning in distance education is becoming more pertinent. Once completed, this scoping review will provide synthesized definitions, suggestions for future research, and organized concepts and literature for other researchers and practitioners to consider for future research.

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College in the Schools: Presenting a college course on creativity in high school

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Abstract

Creativity is an inherent trait in humans, but measured creativity peaks in fourth grade. It is an essential skill often ignored in traditional education. Through “concurrent enrollment”, a university credit course designed to develop learner creativity was offered to high school students. They were compared to students from the parallel university course using the Torrance Tests of Creative Thinking, and they were scored comparably if not higher in most metrics. Observations from the process and experience will be presented.

Keywords: creativity, dual-enrollment, concurrent enrollment, high school

Introduction

In the United States, in most states, students have a wide range of options to earn college credit while still enrolled in high school. High school students can earn college credit through Advanced Placement or International Baccalaureate programs; both offer more rigorous courses as part of the regular high school curriculum (Center for School Change, 2015). Students also can enroll in on-campus classes at colleges and universities. And in most states, American high schools can participate in what are called “concurrent enrollment” programs (Flynn, 2019).

Concurrent or “dual” enrollment refers to university courses presented in high schools for college credit, where students are enrolled in both high school and college. The courses are taught by qualified teachers in the high school, follow college syllabi, and are monitored by university faculty. They are meant to be equivalent to the same class offered on campus. The program at the University of Minnesota is called College in the Schools (CIS). Other higher education institutions in the state also offer concurrent education offerings, including private colleges and other state educational systems.

The program offers courses at over 100 high schools in Minnesota and Wisconsin. Courses are offered in basic sciences, foreign languages, math, statistics, and English (University of Minnesota, 2021). In 2021, for the first time, College in the Schools offered a course in the design field called Creative Problem Solving.

The course has been taught as a regular course at the University of Minnesota for over 20 years. Located in the College of Design, it has the singular goal of developing creativity in learners. It differs from most courses as it is not about the teaching of facts or information, but is rather about the development of a cognitive skill: creativity (What Works Clearinghouse, 2017). The course is required for Retail Merchandising majors and also attracts a large number of students from other majors including architecture, graphic design, communications, agriculture, and business.

The course work centers on a series of challenges or “Do Something Differents” which occur weekly for the first 12 weeks of the course. The goal is to develop in learners a habit of trying new things, seeking more answers, and being creative in all efforts. In class exercises, discussion, and lectures round out the course.

Traditional informational “content” is also included in the course with readings and quizzes to examine basic elements of creativity. This includes an understanding of the two basic forms of thinking, *divergent* and *convergent* thinking. Convergent thinking is the single-answer, direct form used in most education, whereas divergent thinking continually seeks new and different answers.

Application

The creativity course was taught for the first time at a high school in fall semester 2021. A section of the course was presented by an instructor based at Anoka high school and who was the director of the maker space. He had extensive experience in managing and running the makerspace and in teaching science and supporting classes.

The course coordinator (and university instructor) visited the high school on multiple occasions to observe the class in process. This was required as part of the College in the Schools program. Two additional visits were used to apply the Torrance Test to the class, to monitor the class, and one additional time to explain the standardized results. Visits were also required by the university to assess teacher performance in the course.

The high school course and its concurrent offering in the university were compared using the Torrance Tests of Creative Thinking (TTCT). It is a widely used evaluation of creativity. Results and the structure of the test were presented to students in both courses as part of the regular content.

Both groups of students completed the first (or “A”) version of the TTCT in the first week of the term. University students took the second “B” version the test in the 11^{th} week of the semester; the high school students in the class completed the B version in the 12^{th} week. The different versions are used for pre- and post- treatment but are comparable in content and execution. The tests were sent to the publisher, STS Testing, for scoring for both the on-campus students and the high school students.

Test results were distributed to all students for both versions of the test, increasing their understanding of how creativity is evaluated. University students received results prior to the end of the semester; but as the high school term had ended, those students received their results prior to the start of their second term.

Both the A and B versions of the test have six questions that require verbal, written responses. Three of the questions on both tests focus on a single image; the other three questions require answers regarding hypothetical situations or as an alternative uses test.

Each question in tests was scored yielding a combined raw score for three metrics; Fluency, Flexibility, and Originality.

Half of the students in the high school class were juniors, half seniors. The Torrance Tests rate scores based on grade level only through the 12th grade. High school students were rated by the scoring agency as 11th or 12th grade; all college students were scored as adults. All university students are scored as grade 13 or adult.

As raw scores are not manipulated by previous calculation, they provide the clearest sense of the performance of the participants. Comparison by raw scores for Fluency, Flexibility, and Originality provides a direct comparison between the university students and the high school students.

Grade-based results showed impressive gains for the high school students. As high school students, their scores were compared with students of comparable age and grade available in the test publisher's data base. Anoka students increased their average standardized score from the 63rd percentile to the 94th percentile for their age group. Their scores went from 107.04 to 136.15.

On-campus results were comparable to previous iterations of the course. University based students increased their standardized score from the 56th percentile to the 71st percentile for the open/adult grade level (which results in less substantial gains in comparison). Their average standardized score went from 108.24 to 114.08.

Results were also compared with 2013 testing of a similar population in the same school district, the average standardized score for 11th grade students was 99.87 (Hokanson and Bart, 2014). Comparable testing methods for that research were used but the Figurative Torrance Test was the research instrument. Higher initial scores could be attributed to the expression of interest in creativity among students choosing the course, implying possible higher initial skill levels.

Three other metrics were also examined for both groups, fluency, flexibility, and originality.

`	high school [N=30]		university [N=43]	
	Pre-	post-	pre-	post-
Fluency	98.3	138.78	87.6	128.7
Originality	79.0	120.89	66.6	106.7
Flexibility	47.1	55.67	44.7	57.0

Table 1: Average raw scores, pre/post

For the high school students, average raw score for the first metric, Fluency (the measurement of the ability to generate new ideas), increased 41 percent. Originality, the measure of the uniqueness of ideas in the general population increased 53 percent. Flexibility, the development of new and unusual ideas increased 18 percent. Gains were similar for university students, the average raw scores increased 42.99% for Fluency, 55.00% for Originality, and

24.11% for Flexibility. For the on-campus students, Fluency increased 58.3%; Originality increased 73.6%, and Flexibility increased 31.1%.

Comments of class participants

High school students were receptive to the course as evidenced in their comments:

How would you describe this class to a friend or peer who was considering taking it next year?
"A class where you are able to mentally push yourself and watch your performance."

"I would definitely take it because you really learn how to truly expand your creativity and learn about yourself."

How was this class different from other classes you have taken?
"It was my first class that was mentally challenging."

"It was different in a sense…the material is improving on what you already know. It was expanding your creativity and it really got students out of their comfort level."

What would you say is the #1 tip for success in this class?
"Don't be afraid to put yourself out there and don't hold back. No one judges and honestly, the more crazy, the more creative it is."

Why do you think your average, age-based score changed the way it did from the pre to post-test? What was different for you when you took the pre versus the post-test?
"Because I was able to practice throughout the class on the level of my answers and amounts and because of my level of participation."

"The post test felt more natural and I felt like I could think of much more much faster."

"I think my average score changed because I wasn't worried about having a good idea like before. The post-test I was able to write down more ideas and have more original ideas."

Closing thoughts... what do you do with the experience provided by taking this Creative Problem Solving class? What do you carry with you into the future? How does this live on, beyond being a class with a grade?
"I'm able to think past my first idea. I find myself thinking differently than how I did before. I try to think more into the adjacent possible."

"I learned throughout this class to not only be more creative but more outgoing. This class really pushed me out of my original comfort level and to do things just for the grade. I also learned how to apply creativity into my daily life."

"I want to be a more fluent conductor in communicating ideas by the time I enter the work force. I'll carry with me the weird and fun experiences that occurred during my time in the class. The

concept of "Do the most good" will stick with me well beyond my time in school, as will the work ethic and vision of [the teacher].”
“The ability to go into challenges and jobs more confident and in more creative ways.”

Summary

The class demonstrated a college level course could be successfully presented to selected high school students, providing an opportunity for them to earn college credit while still in high school. While they participated in a “pilot” offering of the class, they found the class to be worthwhile as a learning experience. Their performance was better or at least comparable to a parallel course offered on campus by the sponsoring university. The high school students were competitive with the on-campus university students in their test-based performance in the class, even scoring higher in raw- and age adjusted results. While the high school students scored higher in the initial testing, they recorded gains in terms of raw scores that were less substantial.

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Investigating challenges of debugging tasks in an undergraduate computational thinking course

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Abstract: While debugging is a critical application of computational thinking (CT), it has not been getting enough attention in CT research studies in higher education. This exploratory qualitative study aims to identify students' debugging challenges in Scratch, a block-based programming language. We analyzed students' coding journals through open coding and thematic analysis. The findings show the most challenging block categories for the undergraduates are Control, Operators, and Variables and the top three debugging projects students had issues with were the projects using nested repeat, the multiple operators, and the nested if/else projects that relate to Control, Operator, and Variables blocks. Insufficient understanding of CT concepts and shortage of CT practice may be the main reasons for the challenges. We suggested some pedagogical strategies to support teaching and learning computational thinking skills through debugging activities.

Introduction

Computational thinking (CT) is widely acknowledged to be more than programming but a set of problem-solving skills (Shute et al., 2017; Wings, 2006), which is critical to the new generations of students to fully understand and participate in the computer-based world (Román-González et al., 2018). There has been considerable interest in incorporating CT into K-12 education (Barr & Stephenson, 2011). As a means of higher cognitive skill, CT calls for more attention from both researchers and practitioners in higher education too (Pérez-Marín et al., 2020). However, despite increasing attention to the field, there is still no consensus in regard to the definition and basic components of CT. Debugging is considered to be an important component of CT by many scholars (Brennan & Resnick, 2012; Cruz Castro et al., 2021; Jaipal-

Jamani & Angeli, 2017; Shute et al., 2017). Debugging process of finding and fixing errors deepens learners' conceptual understanding and improves their problem-solving skills.

Previous research on debugging mainly focuses on how to improve debugging efficiency in practice. To help learners or programmers decrease bugs in programming and find bugs more effectively after programming, different approaches were adopted to classify and analyze the existing bugs (Mccauley et al., 2008). However, as most of the relevant research was based on text-based syntactic languages, they might not be adapted to other programming contexts such as block-based languages, which are widely used for teaching beginner learners. More importantly, although the analysis of bugs might disclose some underlying causes like a misunderstanding of concepts or cognitive limitations, they do not directly reflect their real thinking process or mindset. **Therefore, this study utilized coding journals as data sources to study the natural cognitive debugging process of learners in an online undergraduate computational thinking course.** We focused on the challenges of debugging most students have faced in Scratch programming and the reasons behind their struggle from the perspective of CT.

Literature Review

Construct of Computational Thinking (CT)

CT was first introduced by Seymour Papert, and he claimed that computer models could help children with intangible and abstract knowledge by giving them concrete form, and helping them develop metacognitive skills (Papert, 1980). But increasing attention has been given to it till CT was defined by Wing as a thinking process coming before computational technology (Wing, 2006). In 2012, Wing updated the CT definition, emphasized its essential role of abstraction and automation, and pointed out CT foundations in math and engineering. She clarified CT definition by stating that that CT was related to cognition rather than artifacts. The application of CT can support humans and machines to execute the solution effectively (Wing, 2012).

Although there is no agreement on whether the nature of CT is an approach, a skill, a thinking process, or a mindset, and whether it can be independent of using a computer, scholars agree that CT is not a single skill, but a combination including various complicated abilities (Cruz Castro et al., 2021; Jaipal-Jamani & Angeli, 2017; Lu et al., 2022; Peteranetz et al., 2018; Romero et al., 2017; Shute et al., 2017a; Weintrop et al., 2016; Wing, 2008, 2012). Among many components, abstraction (Brennan & Resnick, 2012.; Cruz Castro et al., 2021; Jaipal-Jamani & Angeli, 2017; Peteranetz et al., 2018; Shute et al., 2017; Wing, 2008, 2012), algorithm (Brennan & Resnick, 2012; Buitrago Flórez et al., 2017; Castro et al., 2021; Jaipal-Jamani & Angeli, 2017; Peteranetz et al., 2018; Shute et al., 2017), problem-solving skills (Buitrago Flórez et al., 2017; Shute et al., 2017a; Weintrop et al., 2016; Wing, 2012), debugging (Brennan & Resnick, 2012.; Cruz Castro et al., 2021; Jaipal-Jamani & Angeli, 2017; Shute et al., 2017), and generalization (Cruz Castro et al., 2021; Peteranetz et al., 2018; Romero et al., 2017; Shute et al., 2017) are common features.

Since Brennan and Resnick's (2012) CT framework covers the most common feature mentioned above, their framework will be adopted in this paper as a conceptual framework. Their CT framework was developed from programming on the platform of Scratch, a block-based programming language, to allow their users to create and share their programming projects. Scratch is popular in programming for novice beginners, especially beginners in K 12. They defined CT as CT concepts, CT practices, and CT perspectives. CT concepts refer to concepts needed for programming, including sequences, loops, events, conditionals, operators, and data. CT practice means specific practices during programming, including being incremental and iterative, testing and debugging, reusing and remixing, and abstracting and modularizing. CT perspective is about perspectives on the world around them and themselves, including expressing, connecting, and questioning.

Debugging

As an important part of CT, there is also no consensus on debugging, regarding its constructs. Debugging requires both knowledge and skills (Xie et al., 2019). Learners need to know some basic knowledge of programming constructs (Tew & Guzdial, 2010), such as syntactic rules of coding language to specify the structure or form of codes. Debugging is a practical skill with which basic programming principles and mathematics are applied to find problems, isolate sources, identify errors, and fix bugs that prevent the codes from executing designed functions properly (Liu et. al., 2017). Debugging is also defined as a serial and iterative cognitive process to seek the reasons why desired results are not achieved in a program (Wong & Jiang, 2018). It's highly demanding for some high-order cognitive skills such as logical thinking, and mathematical thinking.

The complexity of debugging makes its practice quite challenging even for professional programmers. Researchers have investigated debugging challenges from different perspectives. One of the approaches is to study the causes of bugs. Early research mainly attributed the bugs to the complexity of programming languages. Later, it was acknowledged that there are underlying reasons for the bugs (Bonar& Soloway, 1985): such as a misunderstanding or partial understanding of knowledge **such as a misunderstanding or partial understanding of knowledge (Perkins and Martin,1986; Pea, 1986)**. Ko and Myer (2005) broadened the boundary of the research from cognitive limitations to environmental factors, including programming systems and external environments. The research extends our understanding of the roots of the bugs but is not specific enough as sometimes bugs are rather contextualized. Bugs that frequently appeared in syntactic programming language might not appear in Block-based languages. For example, it was believed that many bugs were the result of a discrepancy between natural language and programming languages (Pea, 1986). Similarly, Spohrer and Soloway (1986) stated that one of the causes of bugs was "data-type inconsistency" which means there are different requirements or rules regarding different data types. In block-based languages, the probability of making these types of errors is very low. In another word, more attention could be cast on a "breakdown" between goals and plans (Spohrer, Soloway, & Pope, 1985) or "cognitive limitations" (Ko & Myer, 2005) behind the bugs, which is more relevant to the individual development of CT.

Another approach to studying debugging is to determine the categories of bugs (Mccauley et al., 2008). As for block-based language, Frädrich et al. (2020) tried to categorize the bugs in Scratch into three categories: syntax errors such as no conditions in infinite loops, general bugs such as using a variable without defining it, and Scratch-specific bugs like missing erase all. They further divided the categories into 25 patterns, which cover most bugs novice learners might frequently encounter. This type of research is beneficial for our understanding of the properties of bugs. However, the detailed and complicated classification might increase the cognitive load of both teachers and students in memorizing and understanding, and classifying those patterns, and therefore might be hard to be applied in real education.

Some scholars centered on the cognitive process of debugging, focusing on main cognitive strategies (Johnson, 1990; Yoon & Garcia, 1995, Xu & Rajlich, 2004, Lin, 2015, Lowe, 2019). Debugging process is the construction of the representation of the functional property of codes and a discrepancy between plan and goal (Johnson, 1990). There are two main strategies used in the process: comprehension strategies and isolation strategies (Yoon & Garcia, 1995). The formal is to comprehend the discrepancy and the latter is to search for clues, assume possible bugs and test them. Xu and Rajlich (2004) described the debugging process using six levels of Bloom's taxonomy of cognitive learning, from "knowledge" through "comprehension", "application", "analysis", "synthesis", and "evaluation". Some recent research employed eye-tracking technology to observe students' debugging processes (Lin et. al., 2015; Beelders, 2022). Results showed that high-performance students tended to organize the codes in chunks and review them in a more logical manner. In contrast, low-performance students focused on the details of syntactic features and tended to review line by line aimlessly.

Most previous research adopted observational and anecdotal methods to study bugs (Mccauley et al., 2008). They observed learners' programming processes or did some static analysis of the bugs to categorize bugs or trace the reasons behind the bugs. Observational studies provide rich descriptive data with high accuracy, but it is rather time-consuming and difficult to free from researchers' bias. More importantly, it's not possible to know the real thinking and mindset of the subjects through observation. Studying debugging through bugs may have the same issue as the bugs may sometimes eliminate the complex cognitive process of debugging.

To supplement previous research, we employed coding journals with prompts as the main data source to identify the challenges novice adult learners frequently meet when debugging Scratch programs. The reflective coding journals gave students chances to record their struggles, dilemmas, trials, failures, and exploration (Phelps, 2005), which is aligned with the non-linear, leaning-from-failure process of debugging. Moreover, the journals also help facilitate learning as it solidifies the connection between their experience and the meaning (Denton, 2011). Our purpose is neither to study the bugs or the causes of the bugs in a holistic way nor explore learners' computer debugging skills. Instead, we focus on the challenges of debugging most students have met with in Scratch programming, and explore the reasons behind their struggle from the perspective of CT. The research questions are as follows:

- Which Scratch block categories are more difficult for students to debug?
- What debugging issues do students face and why?

Methods

Data collection

This study was conducted with 74 students who enrolled in an online course, "Computing and Information Technology" at a large public university in the southwest of the States. The course was one of the core curriculum courses for undergraduate students, and it was designed to use Scratch as a computational tool to improve students' digital literacy, problem-solving, and critical thinking. The course was composed of 14 modules, and students are encouraged to create, share, and reflect on their own programming projects. The debugging practice in this course contained six debugging projects in which students were asked to fix bugs or errors in the given projects to implement the required functionalities of Scratch they had learned in previous modules. More specifically, eight-block categories (i.e., Control, Motion, Looks, Sound, Events, Control, Sensing, Operators, and Variables) had to be properly used. It was also required to use key CT concepts such as if-else, multiple if-else, repeat, repeat until, operator, and variables in each project. After finishing their projects, students were asked to share their projects and reflect on their programming process in coding journals with pre-structured prompts by the instructor.

We collected the coding journals (n = 74) in which students reflected on their debugging practices with given structured prompts:

- Among nine Scratch Block categories, which Block category is most difficult for you when completing the debugging projects?
- What issues did you face in the six debugging projects?

Data Analysis

The data was analyzed to identify the main themes using open coding and thematic analysis (Braun & Clarke, 2006; Clarke et al., 2015; Terry et al., 2017). First, the six debugging projects were analyzed to search for the main bugs. After that, students' coding journals were read several times to ensure familiarization with the data. Then two main researchers of the study coded the data together to generate the themes. To achieve reliability and validity, they reviewed and discussed every theme together. When there is any disagreement, a third coder who is the designer and instructor of the course joined the discussion to help reach an agreement.

Results

The findings show that Control block category was the most difficult (n = 34) followed by Operators (n = 27) and Variables (n = 26) amongst the nine Scratch Block categories when debugging. In Scratch, Control block is used to control the events and movements of the sprites under certain circumstances. Operators provide support for mathematical, logical, and string (text) expressions (Brennan & Resnick, 2012), with which programmers can compare variables and values, do mathematic calculations, and work with strings. Variable is self-defined by the users to store, retrieve and update numerical values like speeds, and scores. The top three debugging projects students had issues with were the projects using nested repeat (n = 33), the multiple operators (n = 23), and the nested if/else (n = 22) projects that relate to Control, Operator, and Variables blocks as well.

Regarding the Control blocks, the challenges are caused by the difficulty of logical thinking, the nature of complexity, and the lack of understanding of each block. Since conditional blocks are in this category, students were confused about the order of actions. A student stated that "It was hard to know what order blocks were supposed to go," and the other student said, "order matters more than anything. 15 students mentioned that control blocks require a lot of logical thinking. Next, 12 students stated that the nature of the combination with other blocks caused the complexity of using control blocks. More specifically, when control blocks are combined or nested with operators and variables, it is difficult to decompose them into smaller actions when testing larger blocks. Lastly, we found that some students did not fully understand what each control block functions. They said that "it is confusing to understand which control blocks to use and when to use" and "The repeat and repeat forever as well as the if/else blocks were a little confusing." The low understanding level could be called fragile knowledge (Perkins & Martin, 1986).

Since operators have numerous combination options with other blocks and require fundamental mathematical thinking, it would be hard to track pre-defined variables. Thus, the two categories are challenging for students. First, many students believed operator blocks were difficult because they manage various conditions and need to be nested into other blocks. One student stated that “It allows many possibilities and options, therefore make debugging more difficult,” and another student said that “The operators block I believe there are so many options I get a bit overwhelmed.” Second, multiple or nested operator blocks could be difficult for students with poor math backgrounds to find and resolve errors. Since the operators are not simple math but are related to complicated control over sprites or actions, learners need more practices to utilize operators (Zhang & Nouri, 2019). Third, variables are self-defined, so students should be aware of how variables were assigned and where the variables were used. Two statements from the coding journal are as follows: “I didn’t know how variables were set up and just confused”; “It’s hard to figure out what the purpose it or how it should be used.” The last finding is the lack of debugging strategies. Students underestimated the debugging tasks, and they did not know efficient ways to resolve issues. Although the debugging process should be taken more seriously even when creating an actual programming project, it seems like they oversimplify the task in the six debugging projects. For instance, they described their individual debugging process as “move around the blocks to notate what changes and what does and, once again,” “just try and try differently,” or “I kept clicking the green flag.” A few students used the decomposition strategy to break down a project into separate blocks to test each block. Some students used forward or backward debugging strategies to test blocks step by step.

Discussion

Few empirical studies on CT have shed light on how to understand learners’ debugging challenges in Scratch. This study investigated students’ debugging practices from a qualitative approach. Our findings show that the three block categories including Control operator and Variables were more challenging and were possible causes of the obstacles even after completing a number of programming projects.

There are many reasons behind students’ Scratch debugging challenges. Similar to Perkins and Martin’s (1986) “fragile knowledge” and Ko and Myer’s “knowledge breakdown”, our findings also suggested short of knowledge could explain learners’ debugging failure. According to Perkin and Martin, fragile knowledge could be classified into missing knowledge (I don’t know), inert knowledge (I don’t remember), misplaced knowledge (It’s not applicable to the current context), and conglomerated knowledge (Two structures were combined incorrectly) (Perkin & Martin, 1986). In our study, students attributed their difficulties in debugging to their missing knowledge about some blocks and conglomerated knowledge when using variables and operators simultaneously. Their reflection proves the importance of knowledge construct in debugging.

More importantly, we found the knowledge gap of the learners originated from some CT conceptual breakdown. In the nine blocks of Scratch, most of them only involve one or a few CT concepts. For example, Motion block mainly relates to the concept of sequence: a sequence of programming instructions finally produces a certain action, which is comparatively easy, especially for debugging. However, Control blocks involve multiple concepts of CT. To correctly debug, one has to be familiar with at least 4 concepts: conditional, event, sequences, and loops, which increase the difficulty of understanding. Operator and variable blocks most of the time are combined to achieve some functions. To debug, one has to understand the concepts of operator and data. Operators enable coders to manipulate both numerical data and textual data, and Variables deal with data storing, retrieving, and updating. The conceptual complexity of those blocks brings challenges to novice programmers when they are debugging.

Conceptual weakness is not the only reason for the debugging challenges, another reason is related to their CT practices. As stated before, debugging is also a skill. It stands on the end of productive skills on the continuum from reproductive skills to productive skills (Romiszowski, 1993). According to Romiszowski (1993), practice is essential to skill development. It bridges "knowing the relevant CT concepts" and "learning how to make use of the concepts to debug". However, debugging practices, as a combined process of constant testing and code correction (Xu & Rajlich, 2004), are iterative and incremental (Brennan & Resnick, 2012). In another word, they are quite labor-intensive and difficult (Araki, at. al., 1991). However, through the journals, we found many students underestimated the difficulty of debugging, which sometimes lead to their debugging failure. Besides, codes containing mixed use of Control, Operator, and Variables blocks sometimes need to be modularized and decomposed to help emerge the errors. Novice programmers short of such practices may find debugging very frustrating. Our findings also emphasized the importance of strategies in debugging practice, which is consistent with Brennan and Resnick's research (2012). Based on Brennan and Resnick, it's essential to develop strategies for both "dealing with" and "anticipating" problems in codes. For novice programmers, it's hard to develop those strategies by themselves. According to their coding journals, most students continuously used the "trial and error" strategy and gave up when the strategy failed.

Students' challenges with debugging reflected their insufficient understanding of CT concepts and shortage of CT practices. Our finding implies that pedagogical strategies should pay special attention to providing conceptual knowledge in programming classes because knowledge construction is fundamental for learners to develop skills and cognitive abilities. One way to facilitate students' conceptual learning is to build their knowledge through practice. We suggest that compared to complicated creative projects, designing small and specific tasks involving one or a few concepts is more effective, especially for novice learners. We also suggest providing scaffoldings including explicit instructions or resources for those comparatively difficult block categories. For example, when teaching adult students Variables, it would be beneficial to directly explain the differences between Variables as a programming block in Scratch and variables as mathematical knowledge in their minds.

Debugging is never a linear practice; therefore it supports students by learning from failure (Kafai et al., 2019; Michaeli & Romeike, 2019). As teachers, it is important to help students have rational anticipations of the potential difficulties of debugging and get them mentally prepared for the complicated debugging process. Sometimes, demonstrating some complex practices can be beneficial to students, such as showing them how to filter irrelevant data to concentrate on the main logic first or how to subdivide a program into smaller chunks to find the errors more efficiently. Providing debugging procedures or strategies to guide students, such as systematic forward/backward debugging, decomposing debugging, or peer debugging, are key components of computational thinking practice (Brennan & Resnick, 2012). We may consider inductive reasoning to teach programming to enhance computational thinking and encourage interaction among students.

Our study is limited to lacking the triangulation of the transcription of students' journals, and systematic and comprehensive analyses of the causes of students' difficulties. Future studies might include a wider range of students and add other data resources like surveys, interviews, and their performance in the course because the current study is restricted to coding journals only.

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A Preliminary Examination of a Gamified Course to Address Affective Domain Issues in Learning Statistics

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Abstract

Online statistics courses in higher education are frequently a source of anxiety for students. While there have been many studies conducted on the cause of math anxiety and anxiety in computer-based learning, few studies have focused on statistics anxiety in an online course. This study examines whether students' anxiety could be lowered by using gamification and Mayer's Multimedia Principles in an asynchronous, online statistics course. Previous studies showed that by adding elements of gamification to a learning environment, anxiety could be lowered. By adding game elements like storyline, boss battles, applied equipment, and achievement levels, the original online statistics course was redesigned to become Stats Kwon Do, a martial-arts, gamified course.

Other research has shown that certain multimedia principles such as segmenting, personalization, and coherence could relieve learners' anxiety. In the redesigned course, these and other multimedia principles were incorporated. Two groups of students over the course of two semesters completed the redesigned Stats Kwon Do course. At the end of each week, students provided reflective feedback on how they felt about the course and note areas that needed improvement. After analyzing the over 400 student comments, the findings offered guidance as to which redesigned components of the course reduced anxiety. During the first two weeks of the course, gamification was regularly cited by students as reducing anxiety. Overwhelmingly, students noted that certain multimedia principles made the biggest difference in lowering their anxiety, specifically, shorter videos (segmenting), repeated opportunities to learn and practice the material, and the use of visual elements.

Introduction

Statistics courses are a valuable and necessary component of degree completion in higher education. Graduate students are required to take statistics to ensure they use proper methods for collecting data, apply correct analyses, and present effective results. These courses also ensure graduate students can evaluate and interpret the research of their peers. Beyond the classroom, the ability to understand and use statistics is of high value in many fields, as it offers foundations for making informed decisions which could have large impacts within an organization and for its stakeholders (Gal & Ginsburg, 1994).

With such a high value connected to understanding and using statistics, one would assume statistics would be a popular course at the graduate level. However, though required in most graduate programs, just the opposite is found: Students often approach statistics courses with anxiety. Because of this anxiety associated with taking a statistics course, statistics courses have been viewed as "obstacles" to a desired degree. DeVaney's (2010) study showed that the presence of a required statistics course sometimes resulted in students changing to an entirely different program of study that did not have a statistics requirement.

Literature Review

In the 1980s, research was conducted on the effect of anxiety on learning. These studies showed that learners with high anxiety performed at lower levels in academic courses (Bandura, 1982). In the years following, studies showed a strong correlation between math anxiety and poor math performance. (McLeod, 1989; Hembree, 1990; Peterson & Fennema, 1985; Kloosterman, 1989; Grootenboer & Marshman, 2015). In 1990, testing of students while reducing their anxiety showed that, when math anxiety was reduced, higher achievement was consistently achieved (Hembree).

Anxiety, as defined by Spielberger (1966), can refer to anxiety that is innately part of one's personality (Trait anxiety) or to anxiety that fluctuates depending upon a transitory situation (State anxiety) such as increased task difficulty. This author defined Trait Anxiety as "a motive or acquired behavioral disposition that predisposes an individual to perceive a wide range of objectively non-dangerous circumstances as threatening, and respond to these with A-State reactions disproportionate in intensity to the magnitude of the objective danger", and he defined State Anxiety as "subjective, consciously perceived feelings of apprehension and tension accompanied by or associated with activation or arousal of the autonomic nervous system" (Spielberger, 1966).

Since the time of Spielberger's studies, the most widely accepted basis for gathering data on transitory (State) anxiety has been through an individual's honest introspection or qualitative data (Spielberger, 1966; Cambre & Cook, 1985). Wolpe noted that anxious responses can be highly individualized, and one student may have anxiety because of a previous experience with and reactions to specific stimuli, like an online statistics course (1981).

In the 1970s, Tobias did significant testing of the effect of different instructional methods upon State anxiety (1977). According to Tobias (1979), anxiety (an affective state) can indirectly affect learning (a cognitively mediated process) in certain stages of learning: preprocessing, during processing, and right after processing just before output. However, Tobias noted that the most debilitating effect of anxiety occurs during preprocessing. This research found specific instructional methods that relieved anxiety at each stage. During preprocessing, these studies found that student anxiety was decreased by allowing students to reinstitute input through rewatching audio or video materials or by using branching to revisit gaps in the learning. During processing, these studies showed that reducing the difficulty level of questions, reducing the load on memory by giving students access to prior instructional content, and ensuring the information was well organized all reduced anxiety in learners.

In recent years, gamification has received much attention as a way of reducing anxiety in learners. Several studies in just the last 10 years have shown that gamifying learning can increase learners' enjoyment and engagement as well as improve student attitude and motivation. Studies from 2016 also found that games engage higher-order cognitive skills (Brady & DeVitt, 2016), though a study done by Giannaokos showed they do not necessarily lead to knowledge acquisition (2013). Prensky and McGonigal's stated that digital, game-based learning can increase student's self-efficacy, optimism, motivation, performance and improve growth mindset (McGonigal, 2011; Prensky, 2001).

In 2001, Ashcraft & Kirk found that learners with high math anxiety have less available working memory, as some of the learner's working memory is taken up by the anxiety rather than the material at hand. This is especially pronounced when learners are working with computations. Therefore, developing instruction that relieves learner anxiety is essential.

Cognitive Load Theory (CLT) states that only a certain amount of information can be held in one's working memory at any given time. To maximize learning, instructional methods should be chosen that do not place an extraneous load on the working memory (Sweller & Chandler, 1991). Mayer's Cognitive Theory of Multimedia Learning (CTML) states that certain multimedia principles can offer ways to reduce extraneous load by removing distracting or irrelevant material (Coherence, Signaling, Redundancy, Spatial and Temporal Contiguity principles), manage intrinsic load by chunking information and defining concepts early (Segmenting, Pretraining, and Modality principles), and using scaffolding and pacing to foster generative processing (Multimedia, Personalization, Voice, and Image principles) (Mayer, 2021).

Though these studies have shown that adding gamification elements to a learning environment can decrease anxiety for students, and Mayer's Multimedia Principles have been shown to reduce extraneous load, manage intrinsic load, and foster generative processing, few studies have been conducted for applying multimedia principles in an online setting to reduce anxiety.

Objectives

There were several goals in redesigning the online statistics course. First, to gamify the course and apply multimedia principles to reduce students' State anxiety and increase interest in the course. Second, to create an exemplar course for instructional design students that modeled Quality Matters standards and best design practices. Third, to use more of the tools within the Moodle LMS, automate the grading of assignments, and make the course more interactive using H5P.

Gamification

Specific game elements were added to the redesigned course. Statistics held some similar foundations as the martial arts which led to the Stats Kwon Do theme. For example, the balanced held by martial artists connects to measures of central tendency. A martial artist's ability to know their reach relates to measures of variability, etc. Levels, another game element, was added by way of earned martial arts belts of different colors (Figure 1). A story was added using a narrative that led students through Quests (Modules), Missions (Assignments), earning Power Ups (calculation tools), and culminating in Boss Fights (demonstrating learning via exams). Additionally, Multiple Attempts at viewing and practicing the content, and Goals and Progress Markers (Figure 2) in the form of a map which fills as the student progresses (Peters & Cornetti, 2020). The choice was made to not use the game element of Winning or using a Leaderboard to ensure students focused on playing and learning rather than on competing with one another.

Figure 1

Red Belt Level Animation

Note: Animation of martial artist performing for a red belt level.

Figure 2

Quest 2 Progress Marker

Note: The forest curve which functions as a map on which the forest animals appear while progressing through the course.

Multimedia Principles

Several multimedia principles were used to model best instructional design practices and to attempt to reduce anxiety in students. To reduce extraneous load, the principles of Coherence, Spatial and Temporal Contiguity, Signaling, and Redundancy were incorporated in all multimedia. To manage essential processing, Segmenting, and Modality were applied as well. To foster generative processing, the Voice and Personalization multimedia principles were used in the videos, and the use of Generative Activities was applied in the form of multiple examples and activities following each 3 to 5-minute video.

Research Design

The overarching question guiding the research was "Can using gamification and multimedia design principles reduce state anxiety in an online statistics course?" The research used qualitative data gathered from two groups of graduate students in an online statistics course over the course of its two first semesters undergoing the redesign process.

The first group consisted of 31 students enrolled in the initial redesign of the Stats Kwon Do course, and the second group consisted of 10 students in the second semester of the continued redesign of the Stats Kwon Do course. At the end of each chapter of the course, students were asked to provide feedback concerning a) statistics material that was still unclear, b) technology issues they encountered, and c) what they liked or disliked about the course. The student feedback served as data for a) improving instruction, b) improving the online interface, and c) analyzing students' affective domain of learning. Feedback concerning unclear statistics material was used as formative evaluation by the instructional designer for improvements in future semesters, as well as providing the instructor with the opportunity to directly address the confusion with the student and/or review the content the next week in the instruction. Feedback concerning technology issues encountered offered the instructional designer/instructor opportunity to troubleshoot technical issues early, consider improvements for future semesters, and mitigate continued disruptions. Lastly, feedback concerning what students liked about the course offered qualitative data on students' anxiety level with a relationship to what caused or relieved the anxiety within the course.

To help improve the instruction, student weekly feedback was collected in Moodle, transferred to a spreadsheet, and color-coded so that, as any comment was repeated by a student in a given week, it received darker shading (Figure 3). Thus, the more students noted the same issue, the darker the comment area would appear on the spreadsheet. This heatmap spreadsheet provided the instructor a visual cue as to where the most commonly noted problem or praise was reported during the week, which would guide either immediate or future improvements. The spreadsheet was also used to brainstorm possible solutions to issues students noted within the course in their comments.

Figure 3
Week 1, Semester 1 Heatmap of Student Feedback

8/23-8/29	Module 1 Feedback	Recommended Actions to Take	h5P Ideas
Issues	Notation of Sigma and Sigma squared	*Create the equations in equation editor or math type and importing them in that way.	
	Need More Practice Problems	*At beginning of lesson, tell students expectations: "You will need to go slowly and pay close attention to details..." *Provide *a few practice problems with arrows pointing to things they need to pay close attention to.* *Allow students more scaffolded practice (H5P Branching Scenario)problems that they can practice as long as they wish before the graded problems.	**Lesson 1-1** H5P Mark the Words ("Highlight the Independent Variable") and Multiple Choice where they answer WHAT the variable is and WHY it is the variable. **Lesson 1-2** H5P Drag and Drop with Feedback of WHY or WHY not it is that kind of data and then Multiple Choice (move from simple to more complex) **Lesson 1-3** H5P Multiple Choice for students to identify HOW to solve and then have them demonstrate solving using H5P Arithmetic Quiz **Lesson 1-4** H5P Multiple Choice for choosing HOW to find/solve for the LRL and URL. Then use H5P Advanced Fill in the Blank where students *write* the LRL and URL with Feedback.
	More examples of types of scales of measurement	*On the video for 1-2, it would helpful to write or use/draw pictures to help separate ideas rather than just static paper for 15 min. *Provide plenty of extra practice questions similar to what they will see on the test at varying levels of difficulty with feedback for WHY that is or is not the answer. *Allow students to practice as much as desired before taking graded portion. *Create a Glossary within the course for students' referral. Could also create a Glossary quiz without grade attached to help them practice keeping the new vocabulary straight.	*H5P Interactive Video. Introduce each type of data with pictures/drawings, pause for review questions within the video before proceeding to next type of data. Then at end, review all types.Students can easily toggle to specific sections to review that type of data. * See above for **Lesson 1-2**
	Alignment with book	*Go through the book and note what pages/sections/chapters align with each Lesson or Module. *Add those pages to overview for each Chapter/Module within Moodle. *Clearly state in several places that the book does not align with the Lesson/Module numbers.	
	Poorer quality of CC videos (Use Live Transcribe?)	*Clearly state in several places that students using the CC videos need to view them in "full screen mode"	
	Clearer explanation/examples of "Quasi-Independent Variables" and "Independent Variables"	*Use drawings or pictures for students to hang memory/differentiate types of variables *Use several separate simpler examples to get students acquainted with one type of variable before adding in another variable (scaffolding). *Specifically for differentiating Independent and Quasi-independent variables, give lots of examples/scenarios. "Quasi independent" was new to me. *Create a Glossary within the course for students' referral. Could also create a Glossary quiz without grade attached to help them practice keeping the new vocabulary straight	*H5P Interactive Video. Introduce each type of variable within scenarios with pictures/drawings, pause for review questions within the video before proceeding to next type of variable Then at end, review all types.Students can easily toggle to specific sections to review that type of data. *H5P Multiple Choice with lots of scenarios to practice with feedback explaining WHY. Allow students to practice for mastery before taking the graded portion.

Note: Student feedback for Week 1 of semester 1 with darker color noting more frequent mentions of a type of comment in the first column, possible solutions for the issues named in the comments in the second column, and possible ways to incorporate H5P for solving the issue.

The comments were also gathered in a Google document and categorized by code. The coded categories included General Questions (statistic questions, general course questions, and general comments), Technology Questions, Ideas for Improvements, Anxiety Reducers (comments including things students "enjoyed", "loved", or were "helped by") and Anxiety Producers (comments including things that "worried", "stressed", "concerned" students).

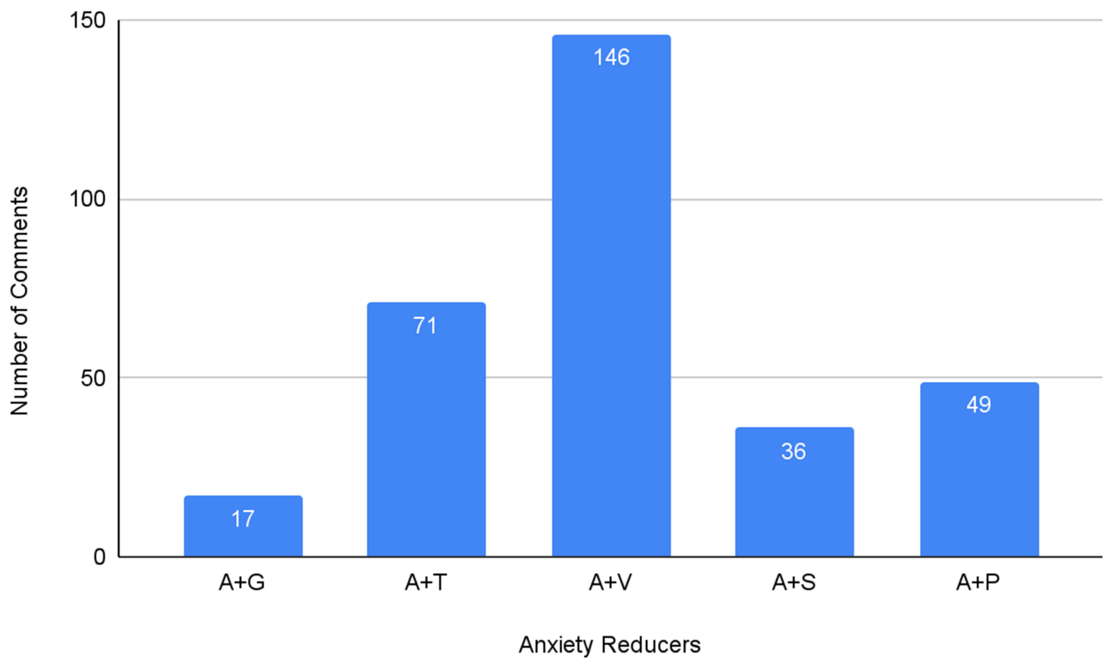
To gather feedback on what specifically helped or increased anxiety within the course, the last two categories were further broken down into Anxiety Reducers and Anxiety Producers and coded. The coded subcategories for Anxiety Reducers were Gamification (comments noting game aspects of the course), General Teaching Comments (non-specific comments reference to the whole course) Visual elements (Video lesson, visual handouts), Segmenting (chunking of the lesson), and Mastery Practice (multiple examples, practices, attempts, and repeated video viewing). The coded subcategories for Anxiety Producers were Statistics (previously held anxiety of statistics), Teaching (missing or confusing instructions or course organization), and Textbook (textbook-related anxiety, vocabulary in the textbook).

Findings

In the first semester, a total of 1176 feedback comments were collected and coded. In the second semester, after trivial comments were removed, another 107 comments were collected and coded for a total of 1283 comments related to the course content.

Examination of the subcategory of Anxiety Reducer comments for the first semester, found the majority of comments (78%) cited the lesson videos and handouts as the source of their improved anxiety about the statistics course, followed by general teaching practices in the course (38%), opportunities to practice (26%), segmenting (19%), and gamification (9%) (Figure 4).

Figure 4
First Semester Anxiety Reducers

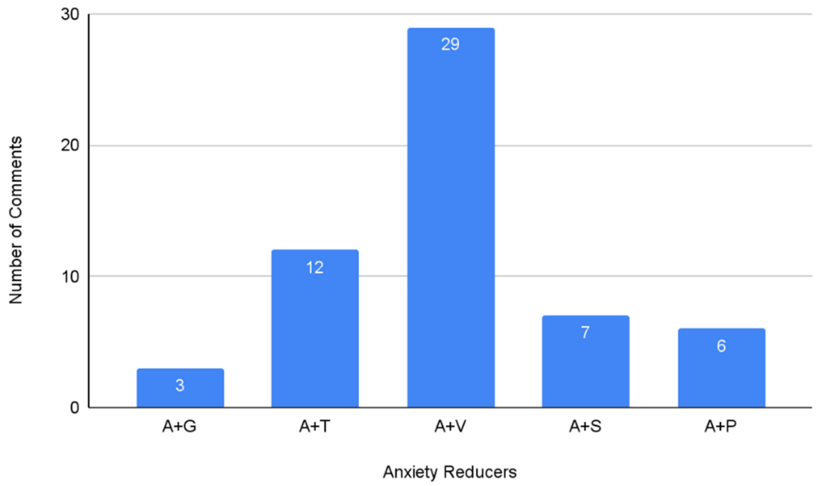


Note: Number of comments made about reduced anxiety referencing gamification (A+G), non-specific references to the course (A+T), video lesson and visuals (A+V), use of segmenting the learning (A+S), and ability to practice or view learning materials multiple times (A+P) in the first semester.

In the second semester, the majority of comments again cited the lesson videos and handouts as the source of improved anxiety (51%), with non-specific teaching practices following at 21%. Segmenting was cited in 12% of comments, followed by 11% for opportunities to practice, and 5% cited specific gamification items (Figure 5).

Figure 5

Second Semester Anxiety Reducers

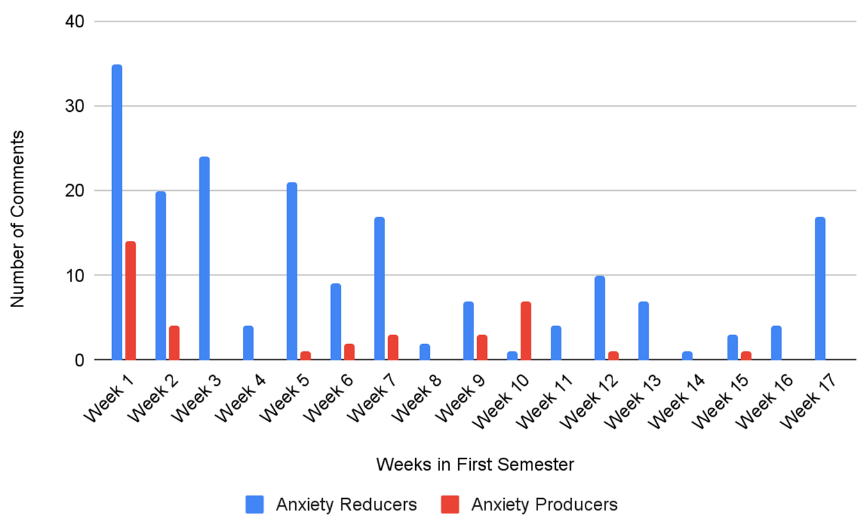


Note: Number of comments made about reduced anxiety referencing gamification (A+G), non-specific references to the course (A+T), video lesson and visuals (A+V), use of segmenting the learning (A+S), and ability to practice or view learning materials multiple times (A+P) in the second semester.

Most references made to feeling anxious were made in the first and second weeks of the first semester (Figure 6) and only increased in the 10th week when students were required to use text objects instead of videos for learning about hypothesis testing.

Figure 6

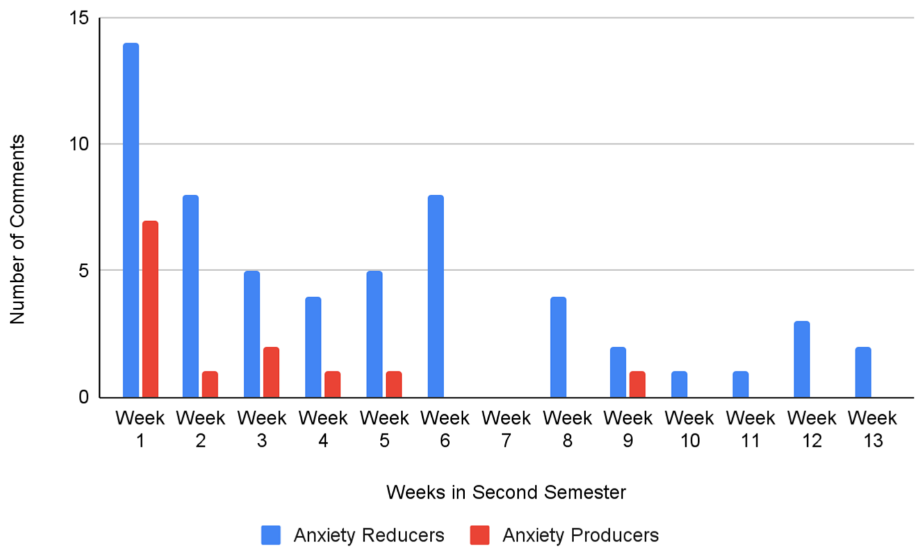
First Semester Anxiety Comments Comparison



Note: Comparison of comments citing Anxiety Reducers and Anxiety Producers in the first semester.

Similarly, in the second semester, comments about feeling anxious were very common in the first several weeks but dropped or disappeared in the weeks following (Figure 7). Some anxiety again resurfaced in week 9 when hypothesis testing was again the topic.

Figure 7
Second Semester Anxiety Comments Comparison



Note: Comparison of comments citing Anxiety Reducers and Anxiety Producers in the second semester.

Gamification Effect on Anxiety

The use of gamification seems to have reduced student's initial anxiety about the course. Many of the student comments reflected this effect. Some references included:

> "Wahoo! I'm a yellow belt! The videos are super incredibly helpful. I am feeling even more confident with statistics. I am hopeful for this semester."

> "Statistics is an intimidating topic for me, but you have started the semester on a lighthearted note with "Stats Kwon Do." I actually almost look forward to the boss fights haha!"

> "Enjoying the course so far. I find it well executed and fun. Very much enjoy the Stats qwan do approach gives a bit of levity to what is a pretty intimidating discipline."

Effects of Multimedia Principles on Anxiety

Throughout the course of both semesters, student feedback sighted general and specific references to multimedia principles (Clark & Mayer, 2016) implemented within the course that lowered their anxiety. In particular, the use of chunking or segmenting the instructional videos and materials student found helpful. Some feedback references include:

> “It's really nice to have the video recordings and the handouts, and the lessons broken up into pieces like this so it's not overwhelming.”
>
> “I must admit that I am finding this course to be much more manageable than I had initially thought it might be. I tend to struggle with any type of math, but am finding that the way the class is designed and broken up makes it very doable and less intimidating. I really appreciate all the examples and step-by-step videos for each topic. I like having the visual and various options to see the problems done multiple times. Thank you for making this class less scary! “
>
> **“**I have been stressed out about taking this course. Math and I do not typically get along very well. I will say that just going through chapter one, I am feeling a bit calmer about the class. I like how you are breaking each item down, one by one and step by step. I love the handouts, and print them to take notes on while watching your videos.”

While one of students’ highest number of comments was the use of video lessons and visuals, all of which had incorporated one more of Mayer’s Multimedia Principles, it is not clear which particular principles relieved anxiety, but only that the application of one or more of them did seem to relieve anxiety. Further study is needed to break down which multimedia principles provide the most relief.

Conclusion

In the results of this study offer several patterns that can be seen in both semesters. First is the initial spike of comments about anxiety followed by a steady decline of anxious comments the rest of the semester. In the first weeks of the course in both semesters, students made many comments about feeling anxious including, “I’m quite fearful of statistics” and “I have struggled with math my entire life. This course is the one that I am afraid of taking and dealing with the most in my program.” Juxtaposed to this is the additional comments about game elements in the course by week 2 or 3 that show relieved anxiety and even confidence: “Wahoo! I'm a yellow belt! The videos are super incredibly helpful. I am feeling even more confident with statistics. I am hopeful for this semester” and “Very much enjoy the Stats kwon do approach gives a bit of levity to what is a pretty intimidating discipline.”

However, by the end of the course in both semesters there were very few comments about the game elements. By the time students were at the end of the course, they may have grown accustomed to the game elements as a natural part of the course. Nevertheless, the gamification did seem to relieve their initial anxiety upon entering the course. This initial relief of statistical anxiety may have allowed the students to begin the course without too many negative effects of anxiety, until they were into the flow of the course and had established a less negative view of the course material.

The second pattern observed is the high volume of student comments regarding specific course components based on multimedia principles which reduced the student’s anxiety. In both semesters, most of the comments pointed to the segmenting of the videos followed by examples and activities which fostered generative processing as a cause for reduction of students’ anxiety (short lectures and successful practice). Additionally, the ability to review and practice the videos and activities improved student confidence and reduced their anxiety. Therefore, it would seem that these multimedia principles did play a role in reducing student anxiety. Further study is needed to confirm which, if any, of the other multimedia principles contributed to the reduction of anxiety.

As this course continues to be improved, more H5P practice and practice blocks will be added for additional practice and mastery of concepts. Sets of these practice activities and examples may be created for specific fields of study to better engage groups of students attending the course by cohort. Question banks will continue to be added or enlarged for better randomization and variety of questions, and branching may be used to better remediate learners. Moodle tools like Books may be used to reduce the scrolling currently required for students, and a mission or task list for each quest will be made added for students to gauge their progress through a module. While the course seems to be actively reducing some anxiety in learners, the goal is to continue this trend and increase student confidence in wielding statistics.

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Online Computing Summer Camp with Non-Verbal Students with Autism Spectrum Disorder

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In recent years, substantial growth in the STEM fields coincides with calls for more STEM workers (Holdren, Lander, & Varmus 2010). However, despite this need, the demand for STEM employees in the United States remains unmet (Taylor 2016; U.S. Congress Joint Economic Committee 2012; Xue & Larson, 2015). Further complicating the issue, the participation of women, minorities, and individuals with disabilities (IWD) in STEM fields remains discouragingly and persistently low (National Science Foundation [NSF] 2017). The recent NSF report, "Women, Minorities, and IWDs in Science and Engineering," shows the persisting underrepresentation of several groups in STEM fields, particularly IWDs, who constituted only 7% of the workers in science and engineering (2017).

To address this unmet need and to increase diversity in STEM fields, scholars have explored various STEM-related initiatives. A particularly noteworthy one relates to computing education in formal and informal learning environments (e.g., Mouza, Marzocchi, Pan, & Pollock, 2016; Starrett, Doman, Garrison, & Sleigh, 2015; Piech et al., 2019). Findings from a recent literature review and several other studies indicate a substantial increase in computing education studies about redressing gender- (Authors 2022; Suajani 2017; Hicks 2019) and race-based inequalities (Scott, Sheridan, and Clark, 2015; Eglash, Gilber, Taylor & Geier, 2013). On the other hand, studies focusing on IWDs remain scarce (Margeliux, Ketenci, & Decker, 2019; Israel et al. 2015; Stefik, Ladner, Allee, & Mealin, 2019).

Motivated to fill this gap, we developed an online, flipped summer computing camp with a data science focus for students with autism spectrum disorder (ASD). Our overarching aim in this study was to examine the impact of computing instruction on participants' acquisition of computing concepts and engagement with computing activities. Given that ASD is a highly prevalent and severe neurodevelopmental disorder resulting in a substantial burden for individuals, families, and society, the demand for quality instruction for students with ASD is critical. Unfortunately, computing is one of the disciplines receiving inadequate attention in research about students with ASD. Lack of instruction in such a needed skill in the current labor market might raise additional barriers to a well-paying job, beyond their existing challenges with social interaction, communication, collaboration, repetitive behavior, and limited interest (American Psychiatric Association, 2013).

Computer Science with Students with ASD

Students with ASD are increasingly part of inclusive classroom environments. Their placement in general education settings is increased from 4.8% to 36% from 1991 to 2013 despite the fact it varies considerably across states in the United States (Barnett & Cleary, 2015).

Based on this trend, students with ASD face an expectation to learn the same content and perform on levels similar to the typical student population. However, most of the educational programs for the ASD population focus on communication, collaboration, life, and functional skills rather than academic content. Among instructional programs, the focus was verbal literacy and mathematics, not computing.

Computing is one of the fastest-growing industries. Research findings indicate that employment in computing occupations could grow 11% between 2019 and 2029, much faster than the average for all occupations (U.S. Bureau of Labor Statistics, 2021). Developing computer science (CS) skills can lead to additional opportunities for higher education and a well-paying job for individuals with ASD. Unfortunately, the employment rate among adults with ASD is abysmally low, with approximately 82% being unemployed (Taylor & Seltzer, 2011).

Computing is an area in which people with ASD could shine due to their greater aptitude to systemize than to empathize. This ability to systemize aligns with fields or interests that require analytical thinking (Baron-Cohen, 2019). In addition, they are a good fit for CS jobs because they have "desirable quantities employers look for, such as careful attention to detail, commitment to high quality and accuracy, box thinking, conscientiousness and diligence, and the ability to work independently" (Felicetti, 2020). Based on these strengths, some technology companies have started programs to hire students with ASD (e.g., Microsoft and SAP).

To prepare students with ASD for jobs that require computing skills, educators need to offer CS instruction tailored to the needs of this population. However, the number of CS educators across the nation is relatively low, and among those, very few are ready to teach students with disabilities, particularly students with ASD. Complicating the issue further, only fourteen empirical studies about computing education feature students with ASD, nine of which involve the research groups of Dr. Israel and Dr. Lindsay. The other five are the work of individual scholars.

Studies suggest that when students' individual needs are met through adapted CS programs in K-12 teaching, their possible proclivity for computing education may increase (Lindsay & Hounsell, 2017; De-Lawrence et al., 2021). One way to promote student desire to learn computing is introducing this field at an early age (Knight, Wright, & DeFreese, 2019). Helping students with ASD to foster an interest in computing early on may increase their likelihood of succeeding in computing (Lindsay & Hounsell).

One common finding of these studies is the lack of research on computer science instruction designed for students with ASD (Knight, Wright, & DeFreese, 2019). Students with ASD require individualized support and when it is not provided students of this group may face various challenges in mastering computing skills (Israel et al., 2015). Documenting these challenges may lead to new tools and curricula to better support students with ASD (Koushik, Kane & Kane, 2019).

Online Teaching CS

One way to increase participation among students with disabilities in CSed is to deploy more online learning environments (OLE). These teaching platforms have many advantages, such as autonomy and flexibility in the learning process and reduction in the stigmas that IWDs tend to experience (Greer, Rice, and Dykman 2014). According to a recent literature review about online learning among K-12 students, IWDs perceive that OLEs promote their learning (Harvey, Greer, Basham, and Hu 2014; Beck, Maranto, and Lo 2014; as cited by Rice and Dykman 2018). Despite these benefits, few scholars have conducted studies focused on the development of OLEs and the assessment of their impact on students with disabilities, especially in K-12 computing education (Greer, Rice& Dykman 2014). Given the exponential increase in technological improvements over the last decade, growth in the number and availability of structured OLEs could partially redress the underrepresentation of IWDs in CS fields.

Among the computing studies conducted with students with ASD, only one study took place in an OLE (Begel et al. 2020). In that study, the authors taught participants computing concepts through game-building activities in a visual block-based context via video call meetings. In addition to delivering the computing curriculum, they tried to improve the communication and teamwork skills of the students. Their findings indicate positive results. Another study with students with ASD provided video-based instruction to teach computing concepts. The findings indicate that a video prompting intervention helped participants grasp block-based coding and acquire all of the target skills (Wright 2019). However, the study was not conducted in an OLE.

Similar to CS education, the recent overall review of literature for online studies with a population with ASD underlined the scarcity of online learning studies with students with ASD. Only four studies were found in higher education studies (Newman et al., 2011). The total of participants of those studies was 22 and they had conflicting findings. Clearly, more research is needed to understand the impact of online learning on students with ASD's understanding of the concepts and engagement with the course material.

Hence, the aim of the current study was to build online computing course and extend the use of block-based programming to teach computing concepts to students with ASD in an online environment in a flipped format. Moreover, the specific objectives of the study were to evaluate the effectiveness of the program among students with ASD on their grasp of the concepts and engagement with the content in a two-week-long summer camp. The following research questions guided the study:

RQ1: Does the fully online, flipped computing summer camp facilitate the acquisition and development of computing concepts?

RQ2: To what extent do participants enjoy and feel engaged in the computing instruction in the fully online, flipped summer computing camp?

2. Method

2.1 Participants

The target audience of the camp was high-school students with ASD and little or no experience in CS and computer programming.

2.1.1 Ali**:** From Dubai, Ali was 29 years old when he enrolled in the summer camp. As a non-verbal autistic student on the spectrum, Ali was in the "severe" classification because he needed constant aid. He received support with communication and using a computer from his mother and father. Until recently, Ali's parents thought he had a very low IQ and could not communicate at a high language level. Once his sister introduced them to the rapid prompting method, they discovered his actual level of intelligence and capability. Ali and his parents explored CS for the first time during our study. His sister had a CS degree, contributing to his interest in CS.

2.1.2 Max: A Caucasian autistic man, Max was 25 years old when he enrolled in the summer camp. He was also taking other classes, including a supply chain class. Max was a non-verbal autistic student on the spectrum; he received support with communication. Because he could not easily use a computer mouse or trackpad, his parents were always with him during the camp, helping him use the computer. Max's parents were CS professionals, and they helped Ali and his parents by holding tutoring sessions during the camp. We called Max's parents "lead parents" in this paper to distinguish them from Ali's parents.

2.2 Study Design

2.2.1 CS Content. The curriculum included computer programming basics through Snap!, a visual block-based programming tool. The content fit into a set of modules containing videos, projects, and resources. Participants followed the sequence in each course module, listening to the lectures and completing projects. The camp curriculum featured three modules, each one more challenging. The first module, "Carol the robot," covered the "basics" of computing: (a) what a program is and (b) some of the main control structures. The second module, "Programming in Snap!," captured the essence of computing: (a) data structures, and (b) recursion. The third module covered the application of computing to data science. However, completion of this third level was beyond the scope of the current study.

2.2.1 Instructional Design. The curricula employed in this study were designed based on explicit instruction. According to a recent literature review, explicit instruction has five essential components (Archer & Hughes, 2010). These five components are as follows: (1) breaking down the complex task into manageable subtasks, (2) modeling the content or skill with precise descriptions and (3) demonstrations, (4) promoting engagement through gradually faded scaffolding, and (5) proving feedback and providing purposeful opportunities to students to demonstrate their learning. In terms of the explicit instruction components, the curricula applied in this study differed in the way promoting engagement gradually faded scaffolding in accordance with the fourth component. We kept highly scaffolding instruction while were increasing the challenge with the projects.

The instructional design for the camp was the flipped classroom, meaning students interact with new content in an online environment asynchronously before attending faculty-led instruction in a synchronous session. Class time permits application of the newly learned information. In our intervention, we conducted two synchronous sessions every day with the participants, one before and one after an asynchronous learning period. First, we conducted a morning meeting using a video call to set the goal for that day and to address any questions or concerns. Students then watched the instructional videos developed by the subject-matter expert and worked on the mini-assignments or lab activity. After this asynchronous learning time, we met with the students and parents again on a video call, reviewed their work, and provided feedback. During the synchronous meetings, we offered positive, verbal reinforcement to the participants.

Development of the instructional videos for the camp followed the principle of video modeling. The subject matter expert recorded videos while explaining the concept using PowerPoint slides. The instructor also kept his camera on so that students could see who was talking during the recording.

research team prepared mini-assignments and lab activities for the students in a step-by-step fashion so that they could analyze each task assigned during the camp. All of the materials are posted on the camp's Canvas page. In addition to videos, slides, and task analysis, we also developed code outlines to accompany each instructional video. Please see Figures 1 for the code outlines developed for the first module.

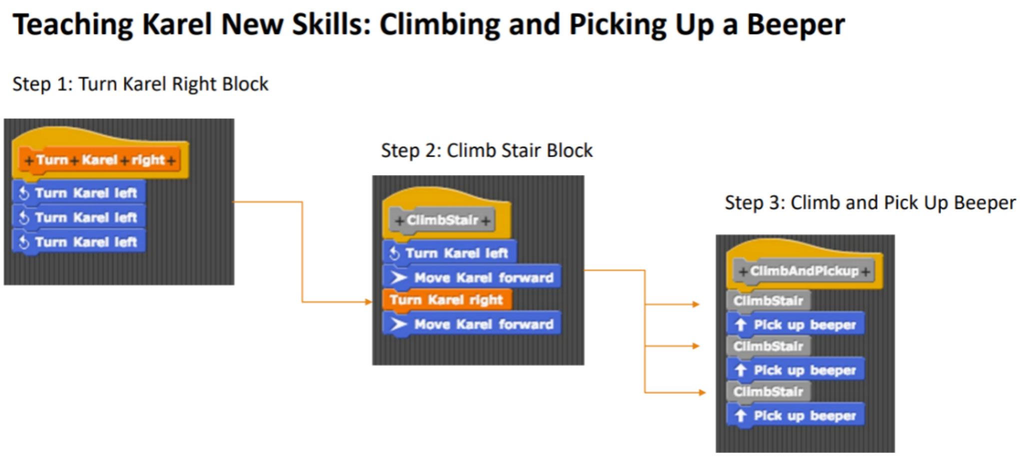

Figure 1. Code Outline for Climbing and Picking Up a Beeper

In addition to our meeting with the participants and their parents, one of the parents took the lead and did additional teaching through one video call per day. During each session, the lead parent explicitly explained and asked specific questions to lead the students to the correct answer for the assignments. For example, when a student was stuck on one part of the code, the lead parent explained the process to the student:

> So you're going to repeat going to a wall and [then] turn left until you are in a place where the beeper is. So I think if we put "repeat until" beeper here, and then that other thing repeats until the front is blocked, turn left . .

2.2.3 Communication

The parents, students, and instructor constantly communicated throughout the synchronous sessions to teach computing and help with the assignments. The parents had to use the spelling board to communicate with their child, and the students often answered quickly and correctly using the board. Here is an example of a parent summarizing how the student communicated with them:

> I read him the task, and I say, "what do we do first? … How do we find the beeper in the corner?" And he said to move forward until she is blocked. So I put to do this until and then put in "blocked" and put in "move forward." Then I said, "what's next?" And he typed, "turn left," and then I said, "okay, what's next?" And he typed, "move forward until blocked." I said, "okay, what's next?" And then I said, "what kind of command are we going to use next?" And he typed, "loop." Then he typed, "repeat until beeper here."

2.3 Data Collection and Analysis

We collected four primary forms of data to examine the impact of the online computing camp on engagement with CS, grasp of CS concepts, and overall satisfaction with the program: (a) recorded video sessions, (b) scores on the Computational Thinking Test (CTT), and (c) interviews with participants and their parents.

2.3.1 Recorded Video Session Data Collection and Analysis. Using seventeen recorded video sessions, we analyzed all of the interactions during the sessions to understand the engagement and learning of the participants. One author of this paper first transcribed the recorded sessions. Then both of the authors conducted open thematic coding. The first round of coding aimed to identify passages of text linked by a common theme. The authors discussed all of the misalignments, eventually establishing 100% agreement. 2.3.2 Computational Thinking Test.

The main CS concepts covered on CTT are the following: Basic directions and sequences (4 items), Loops using counts (4 items), Loops using “until” (4 items), simple If conditional (4 items), complex If/else conditional (4 items), While conditional (4 items), and simple functions (4 items) (Roman-Gonzalez et al., 2017). The questions covered three types of cognitive tasks: sequencing (14 items), completion (9 items), and debugging (5 items). Some of the questions assessed understanding of nesting.

2.3.3 Interview. We conducted semi-structured interviews with participants and their parents at the end of the program. The primary purpose of the interviews was to triangulate the findings regarding engagement, perceived learning, and satisfaction with the program. We asked the following questions: 1) Do you like programming? 2) Is the camp material challenging? Difficult? 3) Would you like to continue learning programming?

3. Results

This section begins by presenting the descriptive findings of the participants' performance during and right after summer camp. Next, we present a qualitative analysis of their engagement with the camp material and instructors. All of the results were summarized around the research questions.

3.1 RQ1: Does the fully online, flipped computing summer camp facilitate the acquisition and development of computing concepts?

Table 1. Ali's CTT Results

	Nesting	
	Yes (Correct)	No (Correct)
1. Basic directions and sequences	NA	4 out of 4
2. Loops using counts	NA	4 out of 4
3. Loops using “until”	2 out of 3	1 out of 1
4. Simple If conditional	1 out of 4	NA
5. Complex If/else conditional	1 out of 4	NA
6. While conditional	1 out of 4	NA
7. Simple functions	1 out of 4	NA

3.1.1 CTT Result for Ali. Ali answered at least one question correctly for each concept, regardless of whether the question was in a nested format. He correctly answered almost all of the questions without nesting: basic sequences, Loops using counts, and Loops using “until.” However, he struggled with complex concepts and nested elements. Please see Table 1 for more details.

3.1.2 Field Notes through Recorded Videos and Interview with Ali. During the tutoring sessions, both the parents and the instructor asked Ali questions to ensure he understood code tracing, code building, code labeling, debugging, and basic concepts (e.g., “if we're going to create a command, do you remember what it's called in a snap?”). The code tracing questions required Ali to understand each line of code and decide which changes would obtain the desired outcome. Most of the time, he was able to answer correctly. However, the parents sometimes needed to repeat the question several times:

> Mom: Tell me, where does this change need to go to? Look at these commands, and where does this change beeper count go to? Below what? Tell me.

Ali: Below pick-up beeper, is that right?

The questions about code building focused on the code featured in the assignments. Ali was able to follow the conversation and answered correctly. He asked for help two times during all of the sessions when answering questions about code building, especially ones related to loops and iteration.

The questions about code labeling were to teach Ali how to write clear code and label it meaningfully so that whoever might use it later could make sense of it. A few times throughout the program, the instructors asked students to name a piece of code. At the beginning of the intervention, Ali labeled the code pieces with real human names (e.g., "Cindy"). After explicit instruction, he named all of his code according to what it was or what its purpose was. We considered him a "verbose" code labeler because he used detailed names to label his code.

The students inevitably had to debug their code because that task is an important part of CS. The instructor helped with debugging by drawing attention to certain areas of the code where there might be a problem and often helped with very specific parts of more difficult code. Finally, the instructor asked some direct questions to check whether Ali understood the concepts. Ali was very good at those questions and accurate used CS jargon, an impressive feat given that he was spelling those terms:

Instructor: The conditionals are okay, and something else, he said something else: two things, two points he said. Do you remember the second one? What was it?

Ali: (spelling) Iterate.

In addition to these informal assessments during the tutoring sessions, Ali coded independently without the instructor and with little help from his parents (using the computer mouse or trackpad). His mom drew attention to his achievement during the interview:

Mom: Uh, tell him what you did this morning... We went through the whole of assignment one once again, and this time, Ali did it completely [by himself].

Instructor: Oh, excellent, Ali. There you go."

3.2.1 Max's CTT Results. Max answered 24 out of 28 questions correctly on CTT in ten minutes, quite faster than a typical student. He answered all questions about basic directions and sequences, Loops using counts, Loops using "until," and While conditionals correctly. Although he missed only one question about complex If/else conditionals, he missed two questions about simple If conditionals. In addition, he correctly answered 3 out of 4 questions about simple functions.

3.2.2 Field Notes through Recorded Videos and Interview with Max. We conducted the same types of informal assessments with Max. Max's parents asked him what to do to complete the assignment step-by-step. On one occasion, his mom told the researchers that he debugged a couple of mistakes and successfully built the code blocks. He also labeled the code correctly from the beginning. The instructor called him a concise labeler. Max learned the CS jargon quickly during the camp. He was able to talk about loops and conditionals early on and identify them as the main concepts:

Mom: You understand the fundamentals?

Max: Yes.

Mom: Like what?

Max: Loops, conditionals.

Some of the interview questions related to how much he learned. His mom reported that he did not have any problem understanding the material and that he could complete the assignments without help. Max's dad talked about how Max caught errors in the code that he had missed himself. This outcome was impressive because the dad was a CS professional. Here is what the dad said about the mistake he made and how Max fixed it:

Dad: It was funny because he caught a problem I missed—turning left instead of turning right. And he created a turn right command instead of turning left a bunch of times.

3.2 RQ2: To what extent do participants enjoy and feel engaged in the computing instruction in the fully online, flipped summer computing camp?

3.2.1 Ali. Our observation data revealed that Ali engaged with the content and actively participated in the instruction. We recorded his engagement during the instruction, and his mom described his engagement with the course materials outside of synchronous sessions.

During the synchronous meetings, Ali appeared distracted many times. However, his responses to the questions about the content coming from the lead parent showed that he was focused and listening. He answered questions quickly without an extra reminder from his parents. His answers were mostly correct. Another indicator of Ali's engagement during the synchronous meetings was his help-seeking behavior. When he did not know the answer to a question, he asked explicitly for help:

Mom: He's saying, you tell me... the question is so hard.

Ali: I need help.

In addition, his mom explicitly checked his perceived comprehension of concepts during the meeting. He reassured his parents that he understood the material.

In contrast to the instances when Ali showed engagement with the content, he sometimes turned his attention to the food he was eating, a noise in the other room, or various other environmental elements. His parents reminded him to keep his hands on the board, look at the screen, focus, and sit down approximately 5 to 10 times a day.

Outside of the synchronous meetings, Ali watched the online materials with his parents. In addition, he willingly worked on the assignments. His mom expressed excitement about Ali completing an assignment without her help. While his mom was sharing her excitement, Ali also showed how he felt after completing an assignment or a piece of code: he spelled out "so happy."

Based on the interview with Ali and his father, we concluded that Ali enjoyed working on CS-related projects. Ali said he liked the CS camp and thought it was "interesting to see how programming is done." He admitted that he struggled at the beginning of the camp, but he did not say it was difficult at the end.

3.2.2 Max. Max attended two synchronous meetings. During those meetings, Max was on top of the content and able to build the code requested in the assignment. His parents never had to remind him to pay attention; he remained focused. During the interview, Max spelled that he found computing "difficult sometimes," and he "liked it more than he thought he would." He also stated that he would like to continue learning programming.

In addition, his mom said, "He's very interested in programming. For each task, he likes to get finished. He feels good. He'll stay here and sit with me until he feels like it's finished. Then he gets up and celebrates."

4. Discussion

Our study extends efforts to include students with ASD in CS fields (Begel et al. 2020; Israel et al. 2020). The main contribution of this study is the investigation of the impact of an online, flipped summer camp on the extent to which non-verbal autistic students engaged with and learned CS concepts. Two students with ASD participated to this study which took place in an online environment in a flipped course instructional design. Both of the students were non-verbal and communicated through spelling board during the camp with the help of their parents.

Our findings show that non-verbal students with ASD are highly engaged with the CS material. Their learning was no different from neurotypical students in the instructional setting of this study: (a) asynchronous online instruction, (b) 1:1 instruction online synchronous tutoring, and (c) communication support. This finding is in line with the previous studies (Lindsay & Hounsell, 2017; Lamptey et al., 2021). Max answered 24 out of 28 questions correctly on CTT. Both the parents and the instructor asked Ali and Max questions to ensure they understood code tracing, code building, code labeling, debugging, and basic concepts (e.g., "if we're going to create a command, do you remember what it's called in a snap?"). Both of them answered most of the questions correctly, and Ali asked for help occasionally (i.e., two times during the camp). In addition, in CTT test, Ali answered at least one question correctly for each concept, regardless of whether the question included nesting. However, he correctly answered almost all of the questions without nesting. These questions covered basic sequences, Loops using counts, and Loops using "until." He struggled with complex concepts and nested elements. More research and efficient instructional materials are needed to teach the complex CS concepts (e.g., nested loops) than regular video-based lecturing, and scholars need to investigate the impact of these materials on learning. In future studies, we plan to compare the impact of code outlines and pseudocode text-based learning on students' understanding of advanced computing concepts.

In addition, more validated instruments are in need of understanding how well individuals with ASD grasp CS concepts. There are few validated instruments available in the literature, but none of them were designed with students with ASD in mind. We used validated assessment by Roman-Gonzalez (2017). However, one of our students found it too long (28 questions total) and completed the test in two sessions. In the next iteration of this camp, we plan to use half of the questions covering the CS concepts outlined in the original test. Besides these, scholars need to investigate newly emerging alternative assessments (e.g., in-video questions or emoji-based surveys) to measure attitude toward CS learning, especially the ones that could be used in informal learning contexts.

5. Limitation

The limitations of this study call for future research. First, the generalizability of the findings is limited by the small sample size. Scholars need to evaluate the effectiveness of online computing teaching in a flipped format using a large sample size. Second, the participants were both over 20 years old and male. Future studies should include diverse participants so that the findings are more generalizable in terms of gender and age. Third, we focused on the participants' grasp of computing concepts and practices and their engagement with the content. However, student-level factors have proven to influence performance in CSed, such as self-efficacy (Authors, 2019) and self-regulation (Lishinski et al. 2016). Scholars should consider including individual differences as factors related to the participation of individuals with ASD in CS activities. Fourth, both of participants use rapid prompting method which was questioned by a number of researchers and professional organizations. It was parents' choice already and changing the way of communication was beyond the scope of our study. The main concern raised in the literature for rapid prompting is the uncertainty of authorship in communication. To overcome this issue, the research team watched the videos several times and revised the observation notes. Future studies should do similar intervention with students with ASD who uses some other communication method than rapid prompting.

6. Conclusions

Although CSed is gaining tremendous attention worldwide, research on individuals with cognitive disabilities in the context of CS is growing at a slower pace. As a result, there is a limited literature on CS education for students with disabilities, including with ASD. This study extends efforts to expose broader populations to CS and investigated the feasibility and effectiveness of using online learning in a flipped format to teach CS concepts and practices to individuals with ASD. We examined the participants' learning of CS concepts and engagement during the camp. The findings suggest that online CS teaching studies featuring individuals with ASD can make positive contributions. With the right instruction and 1:1 support, individuals with ASD can successfully learn computing concepts and practices.

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The Impact of Visualizing Learning Behavior on Learning Strategy Use in Class

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Abstract

Note-taking is an effective learning strategy for SRL development. However, learners cannot write what the teacher wants them to because they lack opportunities to learn note-taking skills. Therefore, we proposed that learners learn note-taking from each other in class. This study aims to reveal the impact of visualizing learning behavior on learning strategy use in class. We developed a tablet-based note-taking assist system that can visualize where learners have written using data collected in real time. We divided 40 learners into using and not using the visualization function groups. The results indicated that learners felt a sense of classroom community using the visualization. Visualizing others' unclear elements suggested that learners tried to judge whether they understood. However, the visualization could not affect the amount of note-taking.

Keywords: Note-taking, Interaction, Nudge, CSCL, Learning visualization

Introduction

Self-Regulated Learning

OECD (2018) supposed that learners need to develop self-regulated learning (SRL) skills in a vision for the future of education. SRL is the ability to cycle through forethought, performance, and reflection on their own to learn effectively (Usher & Schunk, 2018). Learners plan through task analysis and control motivation in the foresight phase. In the execution phase, learners use learning strategies to monitor their learning while following the plan. In the reflection phase, learners reflect on their learning and improve their plans. These three phases enable learners to learn effectively. Nilson (2013) proposed note-taking as one of the effective learning strategies for SRL development for in-class learning support.

Effectiveness and Problems of Note-Taking

Note-taking has two features: encoding and storage functions (DiVesta & Gray, 1972). The encoding function facilitates recognition processing by combining the learning contents with the learner's prior knowledge through writing notes. The storage function enables effective review by reading notes. Morehead et al. (2019) suggest that many learners take notes in class but cannot write what a teacher wants students to write because they have few opportunities to learn note-taking skills. One of the ways to support note-taking is to distribute class material. Writing directly on the class material facilitates understanding of the class (Avval et al., 2013). However, Lannone and Miller (2019) suggest that more support is needed to encourage more learners to take notes because few learners take organized notes on the teacher's explanations.

Who Provides Feedback on Note-Taking?

It is difficult for teachers to teach how to note-taking in class (Nilson, 2013). We proposed learning strategies such as note-taking among learners. For interactions among learners to be active, they must have a sense of classroom community with each other. ROVAI (2002) defines the sense of classroom community as the belief among members that their educational needs will be met by working on a common learning goal with each other. If students get a sense of classroom community in the class, students will feel a sense of humanity and help each other improve their learning behaviors.

Nowadays, many countries witnessed the growing trend of teachers and learners using information and communication technology (ICT) in classes in recent years. Of course, in Japan, the Ministry of Education, Culture, Sports, Science, and Technology (MEXT, 2020) has promoted a policy to allow all students to own devices to develop networks in elementary to high school. Furthermore, as it has become possible to collect educational data, such as a learner's sequence of learning behaviors, learning analytics has also developed to support learners by analyzing and reporting these data (Baker & Inventado 2014). An example of such a feedback system is the "Metaboard," a learning analytics dashboard that supports learners' metacognition and SRL by visualizing their learning behavior (Chen et al., 2020). Furthermore, learners can take notes using a pen and tablet in class without any stress (Özçakmak & Sarigöz, 2019). However, there is little research that supports tablet-based note-taking through learner interaction.

Nudge Theory in Education

We focused on the nudge theory to promote interaction with others in the class. Research on nudges has been active in the field of behavioral economics. Thaler and Sunstein (2009) define the nudge as any element of choice behavior that changes people's behavior predictably without narrowing the choice or significantly changing the economic stimulus. Research on nudges has also been applied to educational studies (Weijers et al., 2020). However, most research is confined to nudging on teaching policies, for example, reduction in dropouts and increase in credit earners. However, there was little research on nudging the learning strategies among learners in class. In this study, we define "educational nudge" as improvements in a learner's note-taking, achieved by referring to the colors and positions of the note-taking of other learners. Thus, we aim to learn each other's learning strategies, such as note-taking in class.

Purpose

This study aims to reveal the impact of visualizing learning behavior on learning strategy use in class. We used a tablet-based note-taking assist system developed by Kondo et al. (2021). We had learners use the system in class and evaluated its effectiveness with questionnaires and a note-taking log. We explored the three research questions as follow:

1. Does the visualization of others' note-taking improve learners' sense of classroom community during note-taking?
2. Does the visualization of others' note-taking increase the amount of writing?
3. Does the visualization of others' note-taking contribute to using in-class learning strategies?

System Overview

In this study, we used Nudge for Note Taking Assist System (NoTAS) developed by Kondo et al. (2021). NoTAS is a web application that supports note-taking in a class where each learner and teacher has a tablet. It can deliver class materials (PDF) to a browser, allowing learners to write notes and highlight using a tablet pen. NoTAS also maintains a note-taking log, showing when and what kind of content was written or deleted. NoTAS consists of four types layers (**Figure 1**).

Furthermore, NoTAS can visualize others' note-taking information using the collected logs. When a learner writes notes on or highlights class material, the approximate locations of notes and highlights created by others in the class are visualized on the same material in almost real time. This layer overlaps with the number of learners in class; thus, the greater the number of learners who fill in the same part, the darker the color appears. Consequently, the areas written by many learners are emphasized. **Figure 1** shows an example of the NoTAS visualization. Red areas indicate that other learners wrote notes. Yellow areas indicate that other learners highlighted important elements. Blue areas indicate that other learners highlighted unclear elements. We hypothesize that learners who cannot take notes would be aided by assuming that the notes many were taking were correct and providing them with visualization on their tablets in class.

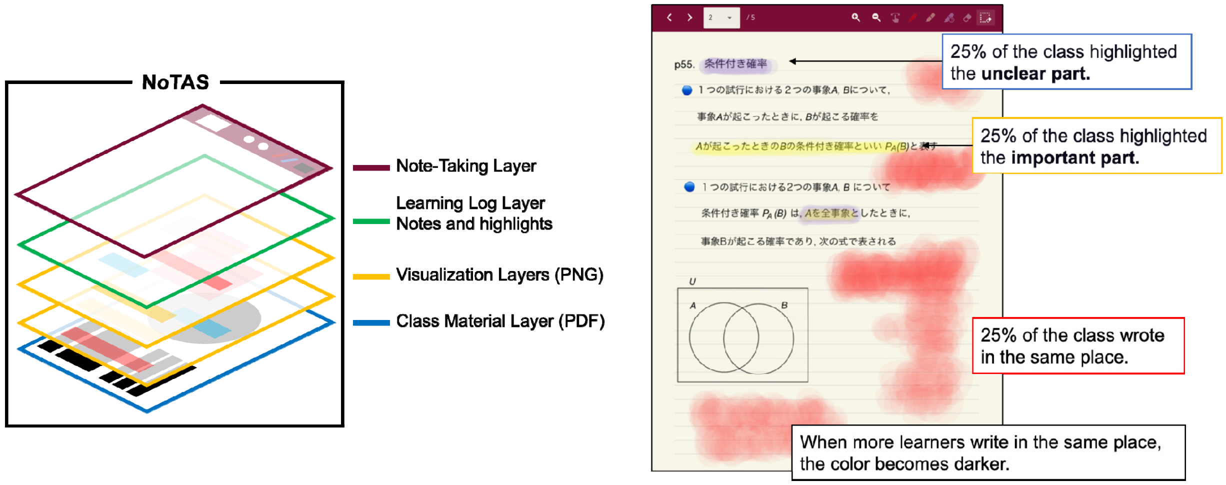

Figure 1. NoTAS composition and visualization interface

Methods

Procedure

We recruited undergraduate and graduate students enrolled in a science university in Japan and the participate in this research were 40 students (24 males, 16 females; mean age of 22.5 years). We also divided into experimental and control groups. We conducted this study in October 2021 and May 2022.

First, the participants listened to a description of the research and signed a consent form. Then, they answered a pre-questionnaire using Google Forms. In addition, we also distribute them an iPad 6th and a tablet pen. They practiced using NoTAS. The experimental group took the class using the NoTAS visualization, and the control group took the class without it. The class content comprised four instructional design theories. Each content was eight minutes. The teacher displayed the class materials that had been distributed to the learners on the screen, wrote on the board and explained. Learners watched the class video using a projector because there was no difference in the contents between two groups.

Furthermore, five collaborators (who were not participants) wrote what the teacher wanted the learners to write following the class progress. This is because if none of the learners wrote, no visualization would have appeared, and we could not have evaluated the visualization effectiveness. Thus, the collaborators wrote notes and highlights to intervened with the learners. Finally, the learners answered a post-questionnaire survey.

Data Collection

Sense of Classroom Community Index

We quoted 15 items related to community awareness for Sense of Classroom Community Index (SCCI; Rovai, 2002). We have partially rewritten the text to be more consistent with the purpose of this study. Moreover, we created and added 3 original items about others' note-taking. We asked all items using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Nudge Scale

We created 22 items for a Nudge Scale. This scale consisted of three visualization types: six items for the visualization of others' notes, four for the visualization of others' important elements, and four for the visualization of unclear elements. Finally, we asked eight items about their impressions of NoTAS visualization. These items were answered only by the experimental group on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Note-taking Log

We collected the note-taking log of each learner using NoTAS. NoTAS can save what learners write when learners write or delete notes and highlights in class material. Based on this log, we scored one point for each description the teacher wanted learners to write on class material. The description types are transcribing, important highlights, unclear highlights, notes, and symbols.

Guidelines for Analysis

Firstly, we compared the results of the two groups SCCI to investigate RQ1, "Does the visualization of others' note-taking support learners' sense of classroom community during note-taking?" We used SCCI as a measure to improve their sense of classroom community. Next, we compared the amount of note-taking between the two groups to investigate RQ2, "Does the visualization of others' note-taking increase the amount of writing?" Finally, we compared the median of the visual group's nudge scale with the 3.00 because we asked only the experimental group for the nudge scale. We also investigated RQ3, "Does the visualization of others' note-taking contribute to using in-class learning strategies?"

Results

In total, 40 participants answered the three questionnaires. They were undergraduate and graduate students. The 22 learners in the experimental group who used the NoTAS visualization were 13 males and nine females with an average age of 22.3 years. The 18 learners in the control group who did not use the NoTAS visualization were 11males and seven females with an average age of 22.7 years.

In our pre-questionnaire, we asked the learners, "Have you ever used a tablet device (iPad and Chromebook) and a tablet pen for note-taking in a class?" A chi-square test of the two groups' experiences with note-taking using tablets reveal no significant differences (χ^2 (1) = 0.00, p = .97, φ = .01). Furthermore, the results of the post-questionnaire show that all learners had not learned the content of this lesson.

Sense of Classroom Community

A Shapiro-Wilk test results show that all items of the SCCI were not normal. **Table 1** shows the results of Mann-Whitney U test for the sense of classroom community scores. The index was reliable, with a Cronbach's alpha of 0.88. The experimental group were denoted as "Visual" while the control group were denoted as "Non-visual." In addition, (R) is a reverse item, and we conducted the reversal process when analyzing the data. Therefore, a higher mean score for the item (R) indicates a better result. The results showed significantly difference for 11 items and a marginally significant difference for one item. For all items, the mean scores of the visual group were higher than those of the non-visual group.

Table 1. Sense of classroom community comparison

Item	Visual		Non-visual		M_1-M_2	U		r
	M_1	SD_1	M_2	SD_2				
1. I felt that learners in this class cared about each other.	2.50	1.34	1.89	1.28	0.61	143.00		0.28
2. I felt that I was encouraged to ask questions.	2.59	1.14	2.22	1.00	0.37	160.50		0.19
3. I felt uneasy exposing gaps in my understanding. (R)	3.82	1.40	3.50	1.43	0.32	174.50		0.12
4. I felt connected to others in this class.	3.95	1.09	1.11	0.32	2.84	3.00	***	0.98
5. I did not feel a spirit of community. (R)	3.45	1.26	1.61	0.78	1.84	48.00	***	0.76
6. I felt that this class resulted in only modest learning because of using NoTAS. (R)	3.68	1.29	3.11	1.37	0.57	150.50		0.24
7. I felt that I received timely feedback on my notes and highlights in this class.	3.36	1.18	2.00	0.84	1.36	76.00	***	0.62
8. I trusted others in this class.	2.95	1.29	2.67	1.14	0.28	175.00		0.12
9. I felt isolated in this class. (R)	4.32	1.00	2.94	1.16	1.38	75.50	***	0.62
10. I felt that I could rely on others in this class.	3.36	1.18	1.44	0.71	1.92	41.00	***	0.79
11. I felt that other learners did not help me learn in this class. (R)	3.95	0.90	2.72	1.23	1.23	88.00	**	0.56
12. I felt that members of this class depended on me.	1.73	0.88	1.22	0.55	0.51	131.00	*	0.34
13. I could feel how the other learners were listening to the teacher's explanation in this class.	4.23	1.11	2.50	1.30	1.73	63.00	***	0.68
14. I felt uncertain about others in this class. (R)	3.59	1.26	2.78	1.40	0.81	132.50	†	0.33
15. I found that the other learners were taking notes very hard.	4.55	0.60	3.67	1.03	0.88	99.00	**	0.50
16. I felt confident that others would support me.	2.91	1.11	1.61	0.85	1.30	74.00	***	0.63
17. I felt that I had enough opportunity to learn how to take notes in this class.	3.18	1.22	3.06	1.16	0.12	182.00		0.08
18. I was curious about others' note-taking behavior.	4.05	1.33	2.83	1.43	1.22	88.00	**	0.56

Visual: n =22, Non-visual: n = 18 $^{\dagger}p < .100$, $^{*}p < .050$, $^{**}p < .010$, $^{***}p < .001$

(R): Reverse score, 5-point Likert scale

Note-taking Log

We conducted a Shapiro–Wilk test on each item to check for normality. The results indicated no normality of the distribution. Thus, we chose to use a Mann–Whitney U test. **Table 2** shows the Mann–Whitney U test results for the amount of writing. We compare the amount of description that the teacher wanted the learners to write between the two groups. The description type and the number of units set by the teacher are eight transcribing, 20 notes, 16 important highlights, four unclear highlights, and 16 symbols. The amount of writing was higher in the visualization group, but not significantly.

Table 2. Comparison of the amount of writing

Type of description	Visual		Non-visual		M_1-M_2	U	r
	M_1	SD_1	M_2	SD_2			
1. Transcribing	6.68	1.89	6.56	1.15	0.13	158.00	0.20
2. Notes	4.46	4.07	3.67	2.47	0.79	192.00	0.03
3. Important Highlight	8.27	4.49	7.11	3.38	1.16	164.00	0.17
4. Unclear Highlight	0.32	0.65	0.33	0.49	-0.02	183.00	0.07
5. Symbol	2.41	2.44	2.17	1.92	0.24	194.00	0.02
6. Total Score	22.14	9.97	19.83	6.24	2.30	176.00	0.11

Visual: n =22, Non-visual: n = 18

Nudge Scale

We asked only the visual group for the nudge scale. We conducted a Shapiro–Wilk test on each item to check for normality. The results indicated no normality of the distribution. Thus, we chose to use a One-Sample Signed Rank Test and compared the median of the visual group with the 3.00. **Table 3** shows the One-Sample Signed Rank Test results for the nudge scale. The index was reliable, with a Cronbach's alpha of 0.95. (R) is a reverse item, and we conducted the reversal process when analyzing the data. Therefore, a higher mean score for the item (R) indicates a better result. The results showed significantly difference for three items related to visualizing others' unclear elements. The median of No.11 and 13 was significantly lower than 3.00, and the median of No.12 was significantly higher than 3.00.

Discussion

Does the visualization support learners' sense of classroom community during note-taking?

Learners felt connected to and rely on others in this class. They also felt a spirit of community and isolated during class. Therefore, Learners felt trust and connected to other learners in class using NoTAS visualization. Furthermore, learners felt that they received sequential feedback on their notes and highlights in this class. We suggest that when NoTAS visualized others' notes and important / unclear elements, learners use the visualized information to guide their note-taking and reading of class materials. In addition, learners felt that "other learners help me in the class" and they felt confident that others would support them. These results suggest that learners felt that other learners helped them to write notes and highlights on class materials using NoTAS visualization in class. The mean of the item "I felt that members of this class depended on me" was also significantly higher in the experimental group. However, we did not find that they felt much relied upon by the other learners because the mean was very low, 1.73. One reason for this could be that the visualization was anonymous. Since NoTAS did not share who was writing in real time, they probably did not feel that others were referring to their writing. However, we believe this is a reasonable outcome because nudges include a normative sense of being naturally guided by others' actions. Finally, learners found that the other learners were taking notes and listening to the teacher's explanation in the class. Thus, learners could watch the others' note-taking and learning by the visualization.

Table 3. Note-taking factors

	M	*SD*	*M*-3.00	*W*	*r*
1. When others' notes were visualized in red, I thought to write notes myself.	3.14	1.39	0.14	117.00	0.08
2. When others' notes were visualized in red, I thought about listening to the explanation.	3.23	1.48	0.23	122.00	0.04
3. When others' notes were visualized in red, I was curious about what others were writing.	3.55	1.50	0.55	156.00	0.23
4. When others' notes were visualized in red, I thought to draw symbols such as arrows and enclosures myself.	2.77	1.48	-0.23	84.00	0.34
5. When others' notes were visualized in red, It was helpful for me to write notes and highlight myself.	3.14	1.36	0.14	93.00	0.26
6. When others' notes were visualized in red, I thought of drawing figures and tables myself.	2.77	1.31	-0.23	75.00	0.41
7. When others' important elements were visualized in yellow, I thought to highlight myself.	3.45	1.54	0.45	145.50	0.15
8. When others' important elements were visualized in yellow, I was curious about what others were writing.	3.27	1.35	0.27	88.50	0.30
9. When others' important elements were visualized in yellow, I thought about listening to the explanation.	3.14	1.39	0.14	114.00	0.10
10. When others' important elements were visualized in yellow, It was helpful for me to write notes and highlight myself.	3.41	1.26	0.41	129.00	0.02
11. When others' unclear elements were visualized in blue, I thought to highlight myself.	2.27	1.12	-0.73	25.00 *	0.80
12. When others' unclear elements were visualized in blue, I was curious about what others were writing.	3.82	1.01	0.82	151.50 **	0.20
13. When others' unclear elements were visualized in blue, I thought about listening to the explanation.	1.77	0.92	-1.23	4.00 ***	0.97
14. When others' unclear elements were visualized in blue, It was helpful for me to write notes and highlight myself.	3.14	1.39	0.14	117.00	0.08
15. The visualization made it easier to take notes on the teacher's explanations.	3.33	1.68	0.33	62.00	0.03
16. The visualization made it easier to understand the teacher's explanation.	3.27	1.71	0.27	69.00	0.15
17. I felt more confident when others' writings appeared in the same position as mine.	2.87	1.36	-0.13	45.50	0.24
18. I felt more confident when I saw others' writing simultaneously with mine.	2.73	1.39	-0.27	33.50	0.44
19. I felt impatient when I saw other students' writing simultaneously with mine. (R)	2.87	1.51	-0.13	59.50	0.01
20. I could quickly judge the parts of the class material I did not understand using the visualization.	3.20	1.82	0.20	58.00	0.03
21. I felt impatient when others' writings appeared in a position where I had not written. (R)	3.27	1.49	0.27	43.50	0.28
22. I could quickly judge whether the class material parts were important using the visualization.	3.53	1.64	0.53	76.00	0.27

$n = 22$, (R): Reverse score, 5-point Likert scale $^{\dagger}p < .100$, $^{**}p < .010$

However, the non-visualization group had lower scores on many items. Thus, it is difficult to promote a sense of classroom community simply by taking face-to-face classes, even if the learners are physically close to each other.

Does the visualization increase the amount of writing?

The note-taking logs revealed that learner did not significantly differ in the amount of transcription, notes, important / unclear highlights, or symbols they wrote when using the visualization. Mueller and Öppenheimer (2016) indicated that writing down explanations is a learning behavior with a high cognitive load because it requires selecting and summarizing the necessary information. In the NoTAS visualization, we considered that the learners could not write notes because they could not see what others had written. Furthermore, college students may have their note-taking methods based on their past experiences and are less susceptible to change due to visualization. We suppose that this is because this study was a short-term experiment. This result suggests that learners learn more about note-taking by using the NoTAS visualization in the long term.

Does the visualization contribute to using in-class learning strategies?

In Nudge's scale, we found significant differences only in the item related to visualizing others' unclear elements. When visualizing others' unclear elements, they considered why others drew them. Therefore, learners could judge whether they understand better by visualizing the unclear part than by writing notes or highlights. It is also possible, although not significant, that learners use the visualization of the important parts as a reference for their notes and highlights. Furthermore, we suggested that visualizing others' notes may have triggered the learners to think about what other learners wrote. The NoTAS visualization seems to have encouraged the learners to pay attention to the teacher's explanation and to look at the class materials. Thus, NoTAS visualization can be a trigger for improving learners' in-class behavior. In the future, we will investigate the influence of each type of visualization (notes, important elements, and unknown elements) on learning behavior based on the correlation between the Nudge scale and the SCCI items related to helping others.

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Technologies, Learning Strategies, and Development of Second Language Skills in the Digital Age

Volodymyr Lazar

Like many other areas of human knowledge, the field of language learning has undergone changes affected by the application of digital technologies. Chapelle (2009) underlined the power of technology as a medium for both supporting new kinds of language learning activities and challenging established language acquisition theories stating that technology "dramatically extends and changes the breadth and depth of exposure that learners can have with the target language and interactive events in which they have the opportunity for language focus" (p. 750).

Extensive research into the booming use of technologies for language learning (see, for example, a most recent comprehensive review by Shadiev and Yang, 2020) brings out two discreet areas that exhibit relationship: kinds of technologies and learning behaviors that they enable. The transformative nature of applying technology to education sparks several reasonable questions: once digital technologies affect every field of human learning, how might learning approaches of today's language learners be influenced by them? What "ubiquitous" (Prensky, 2001, p. 1) digital tools would be preferably utilized by them for language learning? What language learning goals and objectives are most efficiently supported by their preferred digitally-based practices?

The search for the answers to these questions guided the rationale for the present study which can be articulated as the assumption that extensive exposure and anytime and anywhere access availability to data in a second or foreign language (L2) may have an effect on the use of learning strategies and on the language learning process as a whole. The research rationale drove the purpose of the study which was to determine whether and what kind of relationship exists between categories of digital learning resources widely available through the use of computing devices and the Digital Natives' (Prensky, 2001) ways of managing their language learning strategies (LLS; Rubin, 1975; Oxford, 1990) while mastering L2 skills and aspects. In other words, the purpose of this study was to highlight the learning side of acquiring another language, the digital native L2 learners' choices, practices, and behaviors which suit their cognitive, psycholinguistic, and social needs.

The theoretical approach taken follows the point of view that the theory of self-regulation (Zimmerman, 1990) with all its features and functionality related to constructivism, associative cognitivism, skill acquisition, and complemented by the concept of modal affordances has a reliable explanatory power regarding the relationship between dependent and independent variables of the study. Under this conceptual framework, the study of effects of modern digital technologies on the use of LLS and development of language skills by Net-generation learners is getting a credible conceptual "umbrella" to relate and explain existing patterns of the variation in overall strategy use, strategy use by SILL domains, at the individual item level, and digital language learning tools and content, supported language skills, and other accompanying demographic factors.

The Modern Learner

A popular claim argues that Digital Natives or Net-Geners (Shakarami et al., 2017) have a distinctive set of individual characteristics, habits, and behaviors that include preference for speed, nonlinear processing, multitasking, and social learning, allegedly developed through immersion in digital technology during childhood and adolescence when neural plasticity is high

(Prensky, 2001, Rosen, 2010). Some researchers (Small & Vorgan, 2008) claim that digital immersion, gaming, and use of other digital technologies can profoundly affect the development of their young, highly plastic brains, overdeveloping certain regions of the brain while neglecting others. While developing superior visual skills, hand-eye coordination, and the ability to monitor multiple processes and react quickly to unexpected events, the authors say, that digital occupation appears to suppress activity in the frontal lobe responsible for planning, abstract thinking, and perspective-taking potentially altering some parts of the brain structure (Thompson, 2013).

However, for the present study, the aforementioned opinions and assumptions are just a matter for consideration rather than an assertion upon which to build a solid research argument and make conclusions about Digital Natives' generational distinctions. As Reeves and Oh (2008) point out, for the most part, the research on cognitive, affective, and psychomotor differences between generations is based on small, highly selective surveys, and that factor contributes to some controversial results about learning engagement among today's students and other social groups.

Technologies in the Field of Language Learning

Comprehensible access to engaging, authentic, and culturally specific materials in the target language is crucial for successful language learning (especially for listening and reading input). The principles to provide better access to linguistic and cultural materials can be promoted by improving access efficiency through digital multimedia technologies, increasing authenticity using video and the internet, augmenting comprehensibility through learner control and multimedia (Zhao, 2003).

Shadiev and Yang (2020) note that technologies for language learning and instruction are developing fast, new technologies emerge, some become outdated, so keeping a frequent track of applications and changes and review of earlier, present, and future practices is needed. In their review of technology use in language learning and teaching (Shadiev & Yang, 2020), twenty-three kinds of technologies were mentioned in almost four hundred articles published between 2014 and 2020. For our purposes, we will disregard technologies no longer in use, concentrating instead on those still in use and new, the number of which totals under twenty in the review.

It is worth providing a list of these technological types with the intent of finding out whether they overlap and whether they could be re-grouped based on their functionality in supporting language targets: skills and aspects. The still in use technologies mentioned were as follows: games, corpus, automated feedback, social networking, instant messaging, virtual reality, websites and digital resources, speech recognition, collaborative writing, electronic gloss or annotation, intelligent tutoring systems, and electronic dictionary. Among new technologies, online video, e-books, voice recording, augmented reality, clickers, robots, and wearable devices were listed as having usability in language learning and teaching. From L2 methodological and pedagogical perspectives, it seems reasonable to distinguish the following widely adopted digital tools: online course textbooks, online references, digital learning resources, language learning websites, audio/video platforms, collaboration platforms, social and news media (Wang & Vásquez, 2012; Zanoni, 2016) as well as the aforementioned games, tutoring systems, and assistive technologies.

Setting

The setting for this study was made up by Midwestern University face-to-face and online students, particularly, its undergraduate population enrolled in L2 courses in the Department of Modern and Classical Languages during the 2021 Fall semester. A criterion-based convenience cluster sampling method was utilized in the study in which whole groups of students studying a foreign language of the Indo-European language family as their major or minor were selected as the survey respondents. The survey list of languages included Romance (Spanish and French), Germanic (German and Norwegian), and Classical (Latin) languages as target options. Overall, 327 respondents attempted the survey, 26 survey responses were left in progress and a week later they were automatically recorded as not completed, and two recorded as "not wishing to participate", thus bringing the total number of completed and analyzed responses to 299.

Instrument

The questionnaire offered to the respondents contained four sections, or Scales, each aimed at collecting specific information about the four research components: the learner, digital technology categories, L2 skills and aspects, and language learning strategies used. The data collected introduced first-hand students' experiences as evidence for and the subject matter of the study variables related to the research questions. 12 categorical variables with 41 subsets made up Scale 1 and 70 ordinal variables with identical five-point Likert scale template were organized into three Scales to elicit responses from the participants. Scales 1, 2, and 3 were made up by the PI while Scale 4 was a borrowed authentic, validated, and reliable strategy questionnaire designed by Oxford (1990).

The latter, the six-factor Strategy Inventory for Language Learning (SILL) developed by Oxford in the early 1990s is the most frequently employed screening instrument around the world. It consists of fifty individually measured items and reflects several established cognitive and affective learning theories concerning declarative and procedural knowledge, schema building, metacognition, motivation, emotions, and attitudes in the learning process (Oxford, 2011). The instrument's question typology seems to successfully reveal its interaction with actions a language learner typically undertakes in a learning situation that may or may not require the learners' conscious awareness of behavior choices made. The actions, or strategies, are combinable in clusters or chains and have cognitive, emotional, and social roles.

Technological Categories

The introduction of the technological section is intended to get one of the key data for obtaining answers to research questions. Alongside with the SILL section, it is another pivotal source of the research data. It helps to make connections between the use of widely distinguished and rather universal classes of digital technologies and all other survey sections: L2 skills (reading, writing, listening, and speaking) and aspects (pronunciation, vocabulary, grammar, and style) developed and the SILL.

Adjusting the literature review data about commonly available digital resources that are aimed at developing L2 language skills, the following ten types of technologies, in our opinion, best expose the ubiquitous nature of digital language learning resources and exhibit the strongest relatedness to supporting the development of various linguistic skills. Bearing in mind that the study survey addresses university students, (1) online e-textbooks may open the list to be followed by (2) online reference sources, (3) language practice websites (online training exercises, quizzes, tests etc.), (4) online learning resources (OLR), i.e. specific tools/aids (spelling and grammar checkers), (5) assistive technologies (speech recognition, text-to-speech conversion, closed captioning/subtitles, computer assisted translation), (6) social and news media, (7) audio/video sharing platforms, (8) collaborative writing tools, (9) games, with (10) intelligent tutoring systems closing the Technology Scale item list.

Research Questions

The research was guided by the following questions:

1. What categories of digital learning technologies are engaged in L2 learning by undergraduate university students as the digital age learners? 2. What digital learning tools contribute most to supporting the development of L2 skills and aspects? 3. What tendencies in the use of language learning strategies are noted among the digital age L2 learners?

Method

Both descriptive and inferential methods of data analysis were employed in the study to obtain answers to the research questions. Frequencies and descriptive statistics (percentage, range, means, standard deviations, skewness, kurtoses, and rank) were computed for all sections of the survey and for each individual item to avoid violating any test assumptions made by the individual tests. High- and low-frequency use cases were also determined for each Technology, L2 skills, and LLS Scale item.

Once these parameters of the Scales were established, a series of multivariate correlations was performed to investigate relationships between the individual scale items of the four research Scales. The cross-tabulation SPSS tool was applied to investigate correlations not only between the variables, but between their numerous subsets as well to find out a deeper correlational panorama and even minute statistically significant cases of relationship. To go further with generalizing sample results, *t*-testing was used to identify statistically significant correlational patterns between the Scales items. An alpha level of .05 was set up as the criterion for significant findings.

The directions and expanse of data collection and analysis were aimed at getting as much information about the four scales' predictor and outcome variables as possible thus obtaining reliable statistical grounds to frame answers to the research questions. The data magnitude also allowed us to put forward substantiated research implications and delineate the guidelines for future research.

Findings: Technologies and LLS Correlations

Analysis of correlations between digital technology categories and language learning strategies (SILL domain items) was done on an item-to-item basis with focus on the correlations between strategy usage levels (low, medium, and high) differentiated by the SILL scale points in the intervals from 1 to 2.4, 2.5 to 3.4, and 3.5 to 5.0 (Oxford, 1990) and technology categories usage levels measured respectively. Additionally, the means of transformed variables representing items' scale points subsets (or intervals), when applicable, and of the domains as single constructs were also analyzed for correlations.

Social Domain Strategies

The Social domain showed high medium range descriptive values ($M = 3.43$, $SD = .84$, ranked 1) with item means ranging from 3.22 to 3.75. High usage of socially oriented learning practices was registered among 54.2% of respondents, with 35.1% medium, and 10.7% low. By rank, it's the highest strategy domain utilized by the survey respondents in L2 learning. Two Social strategy items represent the domain's high scale range and the other four the medium one. No low scale usage items were registered. Cross tabulation for significant correlations was focused on comparison of two transformed variables representing high and medium scale ranges and of the whole domain as a construct with the Tech categories.

Social domain item 6, *I try to learn about the culture of L2 speakers*, represented the domain's highest mean value (M = 3.75) and established statistically significant correlation with one Tech category, *online references* (χ^2 (16, N = 299) = 32.40, p = .009), while the composite high strategy usage variable established none. The transformed medium strategy usage variable established statistically significant correlations with two Tech categories, items 6, *news and social media* (χ^2 (64, N = 298) = 86.16, p = .03) and 7, *audio/video platforms* (χ^2 (64, N = 298) = 89.17, p = .02). The Social domain as a construct was found to establish statistically significant correlations with two Tech categories: 5, *assistive technologies* (χ^2 (92, N = 299) = 115.18, p = .05), and 7, *audio/video platforms* (χ^2 (92, N = 298) = 136.80, p = .002).

Meta-Cognitive Domain Strategies

The Meta-cognitive domain showed high medium range descriptive values (M = 3.26, SD = .73, ranked 2) with item means ranging from 2.4 to 4.03. High usage of meta-cognitive activities was registered among 34.8% of respondents, with 54.2% medium, and 11% low. As many as four items out of nine, *I pay attention when someone is speaking the L2*, with the highest among all 50 items mean value of 4.03, *I try to find out how to be a better learner of the L2* (M = 3.69), *I notice my L2 mistakes and use that information to help me do better* (M = 3.58), and *I think about my progress in learning the L2* (M = 3.55) represent high strategy use range.

In correspondence to technologies used in L2 learning, item 3 was found to be in statistically significant relations to five out of nine Tech items: *online textbooks*, *online references*, *online learning resources*, *assistive technologies*, and *audio/video platforms*. The transformed variable (the mean of the high usage range item means) was found to be in statistically significant relations to three Tech items, *online references*, *online learning resources*, and *language learning games* with the mean of the transformed variable still in the high usage range (M = 3.71).

It was noted that the transformed variable constituted by meta-cognitive items with higher usage means also exhibited a broader spectrum of statistically significant correlations than the derivation variable. For example, one meta-cognitive item (item 8) significantly correlated to five Tech categories (*language learning websites*, *online learning resources*, *news and social media*, *audio/video platforms*, and *language learning games*), item 5 correlated to three Tech items (*language learning websites*, *audio/video platforms*, and *language learning games*), item 1 to six items (*online textbooks, online references*, *online learning resources*, *news and social media*, *audio/video platforms*, and *language learning games*), and item 6 to six as well (*online textbooks*, *online learning resources*, *assistive technologies*, *news and social media*, *audio/video platforms*, *and intelligent tutoring systems*).

The Meta-cognitive domain as a construct shows significant correlations to five Tech categories that repeat previously described correlation counterparts of the meta-cognitive items. Significant correlations were registered on high, medium, and low use scale ranges of the Meta-cognitive domain, and so this factor allows them to be regarded as contributors to the domain support.

Cognitive Domain Strategies

The Cognitive domain showed medium range descriptive values (M = 3.02, SD = 0.66, rank 4) with item means ranging from 1.86 to 3.89. High usage of cognition was registered among 22.1% of respondents, with 61.8% medium, and 16.1% low. On item-to-item scale, strategies *I try to find patterns in the L2* (M = 3.89) and *I look for words in my own language that are similar to new words in the L2* (M = 3.76) exhibited the highest usage, in fact, the only two representing the high interval out of 14. In correspondence to technologies used in L2 learning, strategy 11 (*I try to find patterns...*) was found to be in statistically significant relations to 7 out of 10 Tech items: *online references*, *language learning websites*, *online learning resources*, *assistive technologies*, *news and social media in L2*, *audio/video platforms*, and *language learning games*. Strategy 10 (*I look for similarities...*) was found to be in statistically significant relations to 4 Tech items: *online textbooks*, *news and social media in L2*, *language learning games*, and *intelligent tutoring systems*.

Medium domain usage was recorded for 10 items, and that makes it the most item represented scale usage range. To find out statistically significant correlations between medium usage range cognitive items and technology classes and to avoid detailed description of each of the items, a new variable was created as a mean of these 10 items' means. The analysis showed that medium range values that represent the use of the cognitive domain contribute to establishing significant correlations with Tech items 6, *news and social media in L2*, 7, *audio/video platforms*, 9, *language learning games*, and 10, *intelligent tutoring systems*.

The two low usage interval cognitive variables, 8 (M = 2.26), *I write notes, messages, letters, or reports in the L2*, and 7 (M = 1.86), *I read for pleasure in the L2*, also establish many statistically significant correlations with the Tech items as medium usage cognitive variables. Cases with statistical significance were observed in correlations between them and *language learning websites, online learning resources, news and social media, audio/video platforms, collaboration platforms, language learning games*, and *intelligent tutoring systems* Tech items. The Cognitive domain as a composite construct shows significant correlations with *online references* (χ^2 (172, N = 299) = 207.07, p = .04), *news and social media* (χ^2 (172, N = 298) = 242.78, p < .001), *audio/video platforms* (χ^2 (172, N = 298) = 252.67, p < .001), and *intelligent tutoring systems* (χ^2 (172, N = 299) = 215.89, p = .01).

Compensation Domain Strategies

The Compensation domain showed medium range descriptive values (M = 3.05, SD = 0.65, rank 3) with item means ranging from 2.36 to 3.55. High usage of compensation techniques was registered among 26.2% of respondents, with 56% medium, and 17.8% low.

Only one out of six strategies, *If I can't think of an L2 word, I use the word or phrase that means the same thing*, with the mean value of 3.55 represents the high use range. In correspondence to technologies used in L2 learning, this variable was found to be in statistically significant relations to *online learning resources* (χ^2 (16, N = 297) = 31.08, p = .01) and *news and social media* (χ^2 (16, N = 297) = 26.45, p = .05).

Four strategies with medium range means, *To understand unfamiliar L2 words, I make guesses* (M = 3.33), *When I can't think of a word during a conversation in the L2*, *I use gestures* (M = 3.21), *I read the L2 without looking up every new word* (M = 3.1), and *I try to guess what the other person will say next in the L2* (M = 2.78) were transformed into one composite variable representing the medium use range items of the compensation strategy (M = 3.1, SD = .67). The latter was found to establish statistically significant correlation with one Tech item that comprised a variety of tools known as *assistive technologies* (χ^2 (60, N = 298) = 85.11, p = .02).

The Compensation domain as a construct shows significant correlations to one Tech item, *assistive technologies* (χ^2 (92, N = 298) = 129.97, p = .01), that exhibited significant correlations on medium and low use scale ranges as well. This factor allows them to be regarded as strategy contributors to the support of the compensation domain.

Memory Domain Strategies

The Memory domain showed one of the lowest descriptive values (M = 2.9, SD = 0.61) with item means ranging from 1.79 to 3.71. High memory usage was registered among 15.1% of respondents, with 58.1% medium, and 26.8% low. On item-to-item scale, strategy 1, *I think of relationships between what I already know and new things I learn in L2*, exhibited the highest usage mean (M = 3.71) among all other nine memory domain strategies. On the SILL range, it represents high strategy use interval. In correspondence to technologies used in L2 learning, this memory strategy was found to be in statistically significant relations to *online textbooks* (χ^2 (16, N = 299) = 28.47, p = .03), *online references* (χ^2 (16, N = 299) = 36.16, p < .01), *online learning resources* (χ^2 (16, N = 298) = 26.33, p = .05), and *audio/video platforms* (χ^2 (16, N = 298) = 30.49, p = .02).

Memory strategy 2, *I use new L2 words in a sentence so I can remember them*, follows item 1 in rank (M = 3.31), but represents the medium interval of strategy use. With respect to technologies used in L2 learning, this variable was found to be in statistically significant relations to *online textbooks* (χ^2 (16, N = 299) = 29.22, p = .02), *online references* (χ^2 (16, N = 299) = 30.89, p = .01), *news and social media* (χ^2 (16, N = 298) = 58.20, p < .001), *audio/video platforms* (χ^2 (16, N = 298) = 56.79, p < .001), *language learning games* (χ^2 (16, N = 299) = 39.07, p = .001), and *intelligent tutoring systems* (χ^2 (16, N = 299) = 34.00, p = .005).

The two low usage interval memory strategies, *I use rhymes to remember new L2 words*, and *I physically act out new L2 words*, do not establish as many statistically significant correlations with the Tech items as medium and high usage memory variables. Occasional cases of statistical significance took place with *language learning games* and *intelligent tutoring systems,* the items which experienced extremely low usage among the respondents.

The Memory domain as one composite variable shows significant correlations with *online learning resources* (χ^2 (120, N = 298) = 150.50, p = .03), *audio/video platforms* (χ^2 (120, N = 298) = 157.14, p = .01), *language learning games* (χ^2 (120, N = 299) = 201.78, p < .001), and *intelligent tutoring systems,* (χ^2 (120, N = 299) = 202.41, p < .001). The first two technology categories which exhibit from high to medium usage means on the positive scale spectrum (3.52 and 2.77 respectively) and ranking (3rd and 6th) may be supposed to contribute most to memory utilization in L2 learning.

Affective Domain Strategies

The Affective domain showed low medium range descriptive values (M = 2.54, SD = .67, rank 6) with item means ranging from 1.34 to 3.33. High usage of affective activities was registered among 8% of respondents, with 43.5% medium, and 48.5% low. It is the lowest strategy domain utilized by the survey respondents in L2 learning. Three Affective strategy items represent the domain's medium scale range and the other three the low one. No high scale usage strategies were registered.

Affective strategy *I encourage myself to speak the L2 even when I am afraid of making a mistake* exposed the highest of the two extreme mean values (M = 3.33) and established statistically significant correlation with one Tech category, *news and social media* (χ^2 (16, N = 298) = 28.20, *p* = .03), while the lowest mean value item 5 (M = 1.34), *I write down my feelings in a language learning diary*, exhibited statistically significant correlations with seven Tech categories, items 3, *language learning websites*, 4, *online learning resources*, 6, *news and social media*, 7, *audio/video platforms*, 8, *collaboration platforms*, 9, *language learning games*, and *intelligent tutoring systems*.

However, such results should not be confusing as there is substantial difference in the nature of the above-mentioned data: the item with the higher mean value contributed to the significance due to more observed than expected counts on positive scale points displaying relations between "always/almost always or usually use" and "always/almost always or usually true of me" while the one with the lower mean value indicated the negative scale points range. The latter correlations are established between "never or almost never use" and "never or almost never true of me" scale points, so, in fact, not being converted into any L2 learning activities, they do not imply actual strategies.

The Affective domain as a construct was found to establish statistically significant correlations with four Tech categories: *assistive technologies*, *news and social media*, *audio/video platforms*, and *language learning games*. However, the lowest usage mean of the Domain does not let us suppose that these correlations signify substantial involvement of digital technologies into managing stresses and emotions in the L2 learning process.

Findings: Technologies and L2 Skills Correlations

Analysis of correlations between digital technologies categories (Tech items) and their support of the development of L2 skills and aspects was performed using the SPSS® Statistics cross-tabulation tool. Each of the ten technology Scale categories was examined from the perspective of exhibiting statistically significant correlations with Scale 3 four language skills items, *reading*, *writing*, *listening*, and *speaking,* and four language aspects items, *grammar*, *vocabulary*, *pronunciation*, and *style*. The findings are as follows:

- *Online textbooks* were found to be in statistically significant correlations the development of *reading* skills (χ^2 (16, N = 299) = 43.52, *p* < .001), *vocabulary* (χ^2 (16, N = 299) = 41.67, *p* < .001), *writing* (χ^2 (16, N = 299) = 29.76, *p* = .02), and *listening* (χ^2 (16, N = 299) = 26.68, *p* = .05) skills.
- *Online references* also significantly contributed to the development of *vocabulary* (χ^2 (16, N = 299) = 28.58, *p* = .03) as well as *pronunciation* χ^2 (16, N = 298) = 28.83, *p* = .03).
- *Language learning websites* significantly correlated with one language skill, *writing*, and one language aspect, *grammar*. The statistical output for both correlation pairs showed higher values for grammar (χ^2 (16, N = 299) = 36.91, *p* = .002) than for writing (χ^2 (16, N = 299) = 29.37, *p* = .02).
- *Online learning resources* were statistically significantly correlated to two language aspects, *grammar* (χ^2 (16, N = 298) = 25.91, *p* = .05, and *style* (χ^2 (16, N = 297) = 32.51, *p* = .01).
- *News and social media*, *audio/video platforms*, and *collaboration platforms* established statistically significant correlations with *grammar* (χ^2 (16, N = 298) = 32.76, *p* = .01), *style* (χ^2 (16, N = 297) = 37.90, *p* = .002), *listening* (χ^2 (16, N = 298) = 43.82, *p* < .001), *pronunciation* (χ^2 (16, N = 297) = 32.76, *p* = .008), and *speaking* (χ^2 (16, N = 299) = 27.01, *p* = .04).

- Only one significantly correlated technology/language pair was established between *assistive technologies* and *pronunciation* (χ^2 (16, N = 298) = 40.02, p < .001).
- The two least frequently utilized tools, *language learning games* and *intelligent tutoring systems*, also displayed the establishment of statistically significant correlated pairs with *reading*, *writing*, *listening*, *pronunciation*, and *style*, but of reverse value: significance in these correlated pairs was achieved due to higher than observed counts in the negative intersections of the correlated scale points that evaluated the usage and role of the item in the development of language skills or aspects as "below average" and "usually do not - never or almost never".

Conclusions

Although quite a few new models and environments for teaching and learning appeared, such as blended learning, e-learning, ubiquitous learning, or incidental learning, which are more adapted to learners' needs and limitations, and in which focus is put the on learners and a more autonomous way of learning (Pareja-Lora et al., 2016), this research supports the view that they did not lead immediately to the innovative use of digital technologies for language learning. The differences in the digital use among the Digital Natives suggest that although the use of digital technologies for basic communication is common for them, very few create text, audio or video content (Thompson, 2013).

As none of the study variables has been manipulated by the researcher, it may indicate that the achieved results are more likely to reflect existing real-world relationships manifested in the research assertions thus adding strength to its external validity. Along with this, high likelihood of the correlational strategy used in this study to build strong directional predictions (Price et al., 2014) brings potential credit to the study results and the subsequent discussion conclusions.

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An Innovative Mobile Learning Acceptance Model for Out-of-Classroom Learning

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Abstract

Mobile learning can positively impact learning in different aspects, but the retention rate of mobile learning apps is unsatisfactory. Based on the Technology Acceptance Model and the updated DeLone and McLean Information System Success Model, this study develops an innovative model to examine factors impacting learners' acceptance of mobile learning outside the classroom. Six hundred eighty-one adults in the US participated in this study, and structural equation modeling was used for data analysis. Results indicate that perceived usefulness, perceived ease of use, mobility, compatibility, and service quality are significant determinants of learners' behavioral intention to use mobile learning outside the classroom.

Keywords: Mobile Learning, Mobile Learning Acceptance, Technology Acceptance Model, DeLone and McLean Information System Success Model, Outside Classroom Learning.

Introduction

Although the adoption of m-learning apps has been increasing and has clear benefits, the user retention rate of m-learning apps is low. Only 25 out of 1,000 users still use an m-learning app after 30 days since they first used it (Statista Research Department, 2021). The lack of eagerness to use m-learning apps directly impedes the positive effects of m-learning apps on learning, even if those apps are well-designed. Therefore, there is a pressing need to explore factors impacting learners' acceptance of m-learning apps. With this in mind, we intend to investigate factors impacting learners' acceptance of m-learning outside the classroom, focusing on the quality of m-learning apps. Based on the Technology Acceptance Model (TAM) (Davis et al., 1989), the updated DeLone and McLean Information System Success Model (DL&ML) (DeLone & McLean, 2003), and previous relevant studies, we propose and examine a new m-learning acceptance model.

Technology Acceptance Model

The Technology Acceptance Model (TAM) proposed by Davis (1986) is designed to explain and predict users' acceptance of new technological systems. TAM is derived from the Theory of Reasoned Action (Fishbein & Ajzen, 1975) in social psychology and has become one of the most used models for measuring the adoption of information systems due to its understandability and simplicity (King & He, 2006). In education, TAM is also a leading model for examining and predicting the acceptance of new learning technologies (Granić & Marangunić, 2019).

Perceived usefulness, perceived ease of use, attitude, and behavioral intention are the four constructs that explain users' actual adoption behaviors toward a technology system (Davis, 1989). Perceived usefulness refers to the extent to which a user believes that using a specific technology system will increase their job performance; perceived ease of use refers to the extent to which a user believes that using a particular technology system would be free of effort (Davis, 1989). In TAM, users' system use is influenced by their behavioral intention to use the target system, which in turn, is affected by their attitude toward the use and perceived usefulness. As TAM's two key determinants, perceived usefulness and perceived ease of use, jointly impact users' attitudes, perceived ease of use also impacts perceived usefulness.

DeLone and McLean Information System Success Model

DeLone and McLean (1992) developed the initial DeLone and McLean Information System Success Model (DL&ML) to understand the antecedents of information system success. This model identifies six critical constructs and explains information systems' success and interrelationships. These constructs include two quality constructs, system quality and information quality, and four non-quality constructs, system use, user satisfaction, individual impact, and organizational impact. As information system research progressed, DeLone and McLean (2003) refined the original DL&ML, resulting in the updated DL&ML. Like the initial model, the new model emphasizes the importance of system quality and information quality on the success of information systems but differs in adding service quality as another critical quality construct of information system success.

According to DeLone and McLean (1992), information quality is the quality of the information produced by the system in the form of reports; system quality is the quality of the information system itself, which focuses on the expected characteristics of the system. Besides, service quality is the extent to which information systems provide support to users to assist users' system use (Wang & Wang, 2009).

Proposed Model and Hypotheses

The constructs of the proposed model can be classified into two categories: (1) constructs from TAM and (2) quality-related constructs based on the updated DL&ML. Figure 1 shows the proposed m-learning acceptance model and relationships among its constructs.

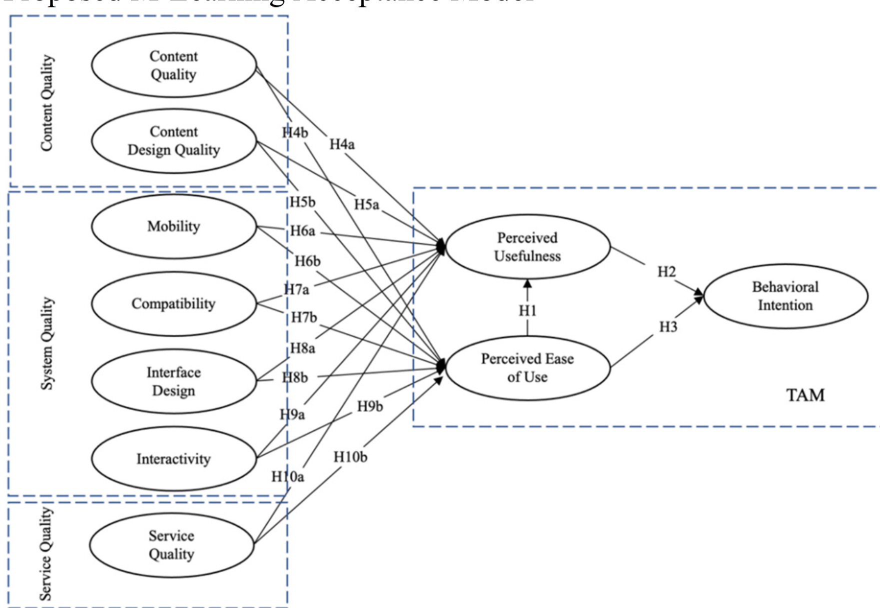
In TAM, perceived usefulness is the dominant determinant of users' behavioral intention to use technology systems, followed by perceived ease of use; perceived ease of use also directly impacts perceived usefulness (Davis, 1989). When it comes to m-learning, a large body of studies further confirms the relationships between the three variables (e.g., Iqbal & Bhatti, 2015;

Nikou & Economides, 2015; Poong et al., 2017). Therefore, this study proposes hypotheses H1 to H3, as shown in Figure 1.

According to the updated DL&ML, information quality, system quality, and service quality are the three critical quality dimensions of information system success (DeLone & McLean, 2003). Therefore, the quality-related constructs included in the proposed model are identified around the three quality dimensions of the updated DL&ML.

The proposed model includes seven quality-related constructs. Among them, content quality and content design quality correspond to the information quality dimension; mobility, compatibility, interface design, and interactivity correspond to the system quality dimension; and service quality corresponds to the service quality dimension. The seven quality-related constructs and their corresponding relationships included in the proposed model have been investigated in educational research (e.g., Almaiah et al., 2016; Cheng, 2012; Sabah, 2016). Therefore, this study proposes hypotheses H4a to H10b, as indicated in Figure 1.

Figure 1 The Proposed M-Learning Acceptance Model



Note. All the proposed relationships are positive.

Method

Six hundred eighty-one adults in the US aged 18 years or above with experience in using m-learning apps outside the classroom were recruited to participate in this study. The data collection technique used for recruitment is convenience sampling. Specifically, we distributed an online survey on Amazon Mechanical Turk (MTurk), an online crowdsourcing platform recruiting individuals to complete required tasks for business and research purposes.

The online survey consists of 1) a participant consent form with a study description, 2) screening questions, 3) measurement items for model constructs, and 4) demographics. To ensure the validity and reliability of the survey, the measurement items for model constructs are adapted from previous studies with necessary modifications to fit the context of this study. A 7-point Likert scale ranging from a (strongly disagree) to 7 (strongly agree) is used for measuring.

We performed a descriptive analysis to reveal learners' perceptions of the critical factors impacting their acceptance of m-learning apps outside the classroom. Then, a structural equation modeling (SEM) was conducted using Mplus 8.0 with the maximum likelihood estimation method to test the proposed model and hypotheses. We adopted a two-step strategy when using SEM. Step one involves the evaluation of the measurement model, whereas step two examines the structural model. This two-step approach ensures that the conclusions on structural relationships are based on a set of measurement instruments with appropriate psychometric qualities.

Results

The descriptive statistics for items by each latent construct are presented in Table 1. None of the mean values surpass outside of the logical bound (i.e., 1 to 7). The measurement model was examined for reliability and validity.

Table 1 Descriptive Statistics and Psychometric Properties of Items by Constructs

Construct	Items	Mean	SD	Factor Loading	Cronbach's α	Composite Reliability	AVE
Content Quality (CQ)	CQ1	6.038	0.899	0.720	0.737	0.736	0.482
	CQ3	6.040	0.901	0.666			
	CQ4	6.134	0.895	0.695			
Content Design Quality (CDQ)	CDQ1	5.706	1.183	0.473	0.609	0.620	0.298
	CDQ2	5.327	1.367	0.394			
	CDQ3	5.790	1.049	0.595			
	CDQ4	5.969	1.036	0.677			
Mobility (MO)	MO1	6.170	1.033	0.778	0.778	0.779	0.541
	MO2	6.200	0.934	0.699			
	MO4	6.081	0.918	0.727			
Compatibility (COM)	COM1	5.934	0.969	0.758	0.837	0.837	0.562
	COM2	5.975	1.014	0.722			
	COM3	5.950	1.003	0.753			
	COM4	6.029	0.983	0.765			
Interface Design (ID.)	ID1	5.777	1.130	0.692	0.846	0.848	0.583
	ID2	5.809	1.112	0.765			
	ID3	5.858	1.065	0.821			
	ID4	5.952	1.005	0.770			
Interactivity (INT)	INT1	4.924	1.575	0.795	0.894	0.890	0.632
	INT2	4.677	1.678	0.774			
	INT3	4.962	1.523	0.850			
	INT4	5.009	1.536	0.850			
	INT5	5.310	1.298	0.696			
Service Quality (S.Q.)	SQ1	5.090	1.261	0.836	0.904	0.904	0.702
	SQ2	5.223	1.205	0.810			
	SQ3	5.078	1.313	0.843			
	SQ4	5.244	1.261	0.862			

Perceived Usefulness (PU.)	PU1	5.893	0.982	0.815	0.861	0.861	0.608
	PU2	5.956	0.945	0.742			
	PU3	5.903	0.934	0.760			
	PU4	6.109	0.863	0.800			
Perceived Ease Of Use (PEOU)	PEOU2	5.652	1.085	0.581	0.740	0.742	0.494
	PEOU3	5.896	0.983	0.750			
	PEOU4	6.117	0.908	0.763			
Behavioral Attention (BI.)	BI1	5.931	1.013	0.769	0.827	0.829	0.548
	BI2	5.905	1.025	0.741			
	BI3	6.062	0.918	0.687			
	BI4	6.191	0.900	0.760			

Evaluation of Measurement Model

The measurement model was assessed using Confirmatory Factor Analysis (CFA). Firstly, the internal consistency of each scale was examined using Cronbach's alpha, and composite reliability for all the constructs was evaluated. We eliminated three items (CQ2, MO3, PEOU1) to improve internal consistency based on corrected item-total correlation.

The list of standardized factor loadings, factor correlation, and reliability indices are summarized in Table 1. Factor loadings greater than 0.4 were regarded as practically significant and representative of the underlying construct (Backhaus et al., 2006). The results show that the factor loadings for all items were larger than 0.4, so all items are posited to reflect those constructs well.

Convergent and discriminant validity was assessed by analyzing the average variance extracted (AVE). When the AVE of all the latent constructs is greater than 0.5, a measurement model is considered to have adequate convergent validity and reliability (Fornell & Larcker, 1981). All the latent constructs' AVE were greater than 0.5 except for content design quality (CDQ) and Perceived Ease Of Use (PEOU). The CDQ and PEOU constructs was kept because it was required for hypothesis testing even though its AVE is slightly less than 0.5.

To provide evidence for the discriminant validity of the measures, the squared root of the AVE for each construct is higher than the highest correlation of any pair of latent variables. The highest correlation between latent variables shown in Table 2 is 0.967 between content quality (CQ) and CDQ. For any construct, this surpasses the squared root of AVE. Also, the construct CQ strongly correlates with mobility (MO), perceived usefulness (PU), and behavioral intention (BI). Furthermore, the correlation between CDQ and Interface Design (ID) is significant at 0.835, which is greater than the square root of the AVE for any construct. To improve validity, CQ and ID were removed from the analysis.

According to the overall fit indices, the final measurement model provided a respectable adequate fit to the data (See Table 3; $x^2(406)$ = 1404.588 (406), $p < 0.001$., RMSEA= 0.060, SRMR = 0.062, CFI = 0.914, TLI = 0.902).

Table 2 Discriminant Validity by Fornell and Larcker (1981) Criterion

	CQ	CDQ	MO	COM	ID	INT	SQ	PU	PEOU	BI
CQ	**0.694**									
CDQ	0.967	**0.546**								
MO	0.917	0.785	**0.735**							
COM	0.879	0.826	0.807	**0.750**						

ID	0.733	0.835	0.625	0.655	**0.763**					
INT	0.093	0.251	0.035	0.181	0.164	**0.795**				
SQ	0.257	0.380	0.051	0.191	0.353	0.531	**0.838**			
PU	0.851	0.743	0.757	0.771	0.642	0.149	0.325	**0.780**		
PEOU	0.733	0.602	0.728	0.653	0.625	0.020	0.08	0.673	**0.703**	
BI	0.804	0.690	0.782	0.817	0.587	0.129	0.161	0.819	0.762	**0.740**

Note. Bold diagonal values indicate the square root of the average variance extracted, whereas the rest of the values indicate correlations between variables.

Table 3 Measures of the Model Fit

	Measurement model	Structural model
Chi Square (degrees of freedom)	1404.588 (406)	1449.207 (411)
RMSEA	0.060	0.061
SRMR	0.062	0.063
CFI	0.914	0.911
TLI	0.902	0.899

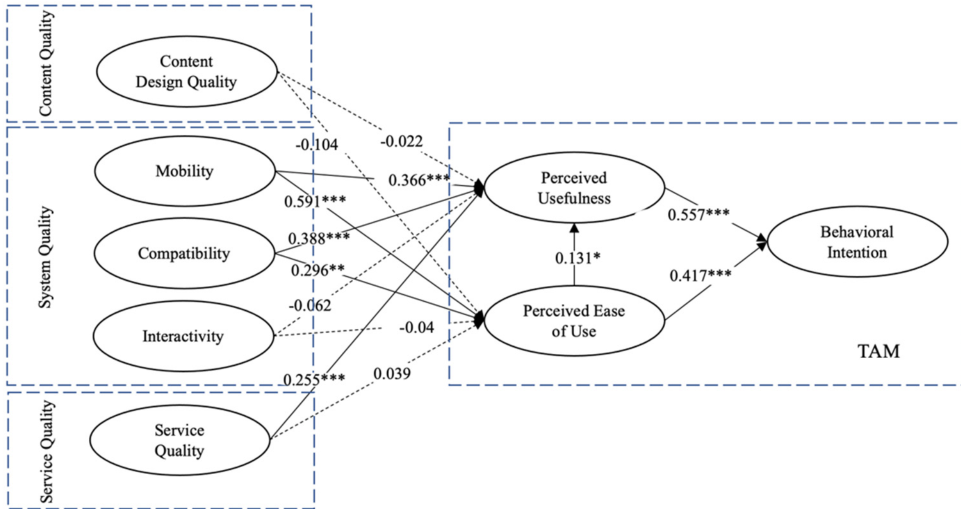
Assessment of Structural Model

The structural model was specified and assessed by setting regression paths based on hypotheses. The results of the structural model evaluation are summarized in Table 3. The proposed research model showed an acceptable fit with the data, according to the overall fit indices of the SEM analysis ($x^2(411) = 1449.207$, $p < 0.001$., RMSEA= 0.061, SRMR = 0.063, CFI = 0.911, TLI = 0.899).

We conducted the path analysis of latent variables to test the hypotheses. Figure 2 shows the structural model results, and Table 4 presents the results of the hypotheses testing. The latent path analysis supports variation of perceived ease of use (PEOU) is related to MO and Compatibility (COM) ($\beta = 0.591$, $p < 0.001$; $\beta = 0.296$, $p < 0.01$, respectively). Also, expected change of PU is associated with MO, COM, service quality (SQ), PEOU ($\beta = 0.366$, $p < 0.001$; $\beta = 0.388$, $p < 0.001$; $\beta = 0.255$, $p < 0.001$; $\beta = 0.131$, $p < 0.05$, respectively). Lastly, BI is related to PU and PEOU ($\beta = 0.557$, $p < 0.001$; $\beta = 0.417$, $p < 0.001$, respectively). However, CDQ and interactivity (INT) have no significant influence on both PU or PEOU, and SQ has no significant influence on PEOU.

The mediation effect of PEOU on BI through PU was examined by testing its indirect and direct effects. While the total effect of PEOU was estimated by 0.701(p <0.001), the amount of indirect effect was 0.104 (p <0.05), and the amount of direct effect was 0.596 (p <0.001). Both the indirect and direct effects were found to be statistically significant. Thus, the effect of PEOU was partially mediated by PU. This finding implies that there are two distinct ways that PEOU affected BI (See Table 4).

Figure 2 The Results of the Structural Model



Note. *p<0.05, **p<0.1, ***p<0.01

Table 4 Hypotheses Test Results

Hypothesis	Hypothesized paths	*Est.*	*SE.*	*C. R.*	*p*	Result
Direct effect						
H1	PEOU->PU	0.131	0.06	2.179	< 0.05	Supported
H2	PU->BI	0.557	0.047	11.843	< 0.001	Supported
H3	PEOU->BI	0.417	0.05	8.317	< 0.001	Supported
H5a	CDQ->PU	-0.022	0.117	-0.19	0.849	Not supported
H5b	CDQ->PEOU	-0.104	0.15	-0.69	0.490	Not supported
H6a	MO->PU	0.366	0.105	3.501	< 0.001	Supported
H6b	MO->PEOU	0.591	0.118	5.027	< 0.001	Supported
H7a	COM->PU	0.388	0.087	4.44	< 0.001	Supported
H7b	COM->PEOU	0.296	0.111	2.667	< 0.01	Supported
H9a	INT->PU	-0.062	0.036	-1.726	0.084	Not supported
H9b	INT->PEOU	-0.04	0.046	-0.867	0.386	Not supported
H10a	SQ->PU	0.255	0.048	5.356	< 0.001	Supported
H10b	SQ->PEOU	0.039	0.061	0.633	0.527	Not supported
Mediation effect (direct & indirect effect discomposed from total effect)						
Total	PEOU-->BI	0.701	0.100	7.008	< 0.001	Supported
Direct	PEOU->BI	0.596	0.087	6.823	< 0.001	Supported
Indirect	PEOU-> PU ->BI	0.104	0.050	2.103	< 0.05	Supported

Discussion and Conclusion

This study investigates the impacts of quality factors on learners' acceptance of m-learning outside the classroom by introducing the three quality dimensions of the updated DL&ML model into TAM. After surveying six hundred eighty-one adult learners and analyzing the data collected using a structural equation model, an innovative m-learning acceptance model was developed.

Although researchers have noted the importance of the three quality dimensions of the updated DL&ML model, namely content quality, system quality, and service quality, on m-learning acceptance (e.g., Almasri, 2016; Almaiah & Alismaiel, 2019), few of them clearly state the components of each quality dimension. Building on existing research, this study goes one step further and reconstructs the components of the three quality dimensions in the context of m-learning. Such an approach not only contributes to the consistency of m-learning quality assessment but also provides a clear direction for the design and development of m-learning. Furthermore, this study explicitly focuses on the acceptance of m-learning outside the classroom by adult learners from various backgrounds and educational levels, both students and non-students. Therefore, it fills the gap where research on m-learning acceptance has paid little attention to non-student populations and learning beyond higher education settings (Al-Emran et al., 2018).

The results suggest that learners' behavioral intention to use m-learning outside the classroom is significantly attributed to perceived usefulness and ease of use. When learners consider an m-learning app to be easy to use and valuable to their learning, they are more willing to use it in the future to support their out-of-classroom learning.

Another important finding of this study is that mobility and compatibility under the system quality dimension are perceived positively and significantly impact the usefulness and ease of use of m-learning by learners. When learners feel that they can use m-learning without the limitation of time and location, and when m-learning is compatible with their learning needs and learning styles, they are more likely to use m-learning outside the classroom. Due to the complexity and flexibility of the learning environment outside the classroom, such as fragmented learning time and unfixed learning place, it is understandable that mobility and compatibility are perceived as essential by learners. Therefore, m-learning outside the classroom should provide a personalized learning experience with flexible learning modes, such as offline learning to cater to the needs of different learners.

We also found a significant and positive impact of service quality on the perceived usefulness of m-learning. That is, the more timely and effective support service an m-learning app provides to learners, the more likely learners think the app is useful for their learning. Similar findings can be found in the studies conducted by Sabah (2016). This finding implies that a productive m-learning app may not be able to provide sufficient assistance for learning outside the classroom if it lacks service support. An easily acceptable m-learning should allow learners to get the support they need promptly and offer the right solutions to their requests.

In sum, this study establishes an innovative model to examine determinants of learners' acceptance of m-learning outside the classroom. The results show that two quality dimensions, namely system quality (mobility and compatibility) and service quality, and two learners' beliefs, namely perceived usefulness and perceived ease of use, play an essential role in m-learning acceptance outside the classroom.

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Designing for Engagement: Evaluating a Faculty Institute for Rapid Online Course Design

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Abstract

This study sought to address the research question of whether online courses redesigned by participants in an online, cohort-based course design workshop contain an increased number of student engagement elements compared to previous versions of the courses. The authors created an observation rubric based on widely used measures of student engagement, and using this, determined whether old or new versions of courses contained more engagement elements. The study then used statistical analysis to compare the data collected for each pair of courses. The results found that for a vast majority of pairs, student engagement elements were more prevalent in redesigned versions, and that the improvement between these old and new versions was statistically significant.

Introduction

Since the advent of online learning in higher education in the 1980s (Harasim, 2000; Kentnor, 2015), faculty have taken various approaches to online course development, ranging from independent efforts by a single faculty member (Oblinger & Hawkins, 2006), to complex collaborations involving a team of specialists playing multiple roles, and the use of varied technologies (Abdous, 2020; Hixon, 2008; Xu & Morris, 2007). This study is an evaluation of an approach to online course development taken by Utah Tech University in 2021 that sought to strike a balance between these two approaches.

In March 2021, using federal funds from the Higher Education Emergency Relief Fund (Coronavirus Aid, Relief, and Economic Security Act, 2020), Utah Tech created an initiative to rapidly develop 14 new online programs by the end of the year (December 2021). These new programs would include 175 new or redesigned online courses which were to be completed with quality and student engagement in mind.

Utah Tech Online, a university administrative unit with responsibilities that include learning design (instructional design), faculty development for online teaching, and educational technology support, was tasked to create a process to support faculty in the creation of the courses. With existing course development processes and learning design personnel insufficient to meet this new demand, Utah Tech Online developed a new approach to course development called the Course Design Institute (CDI) in which faculty cohorts are guided by learning designers through the process of designing (or redesigning) and developing online courses.

The purpose of this study is to assess how well online courses designed through the Course Design Institute incorporated elements that encourage student engagement, as compared to those same courses designed and taught before the institute. The research question that guided our work was:

Do the new online courses redesigned by CDI participants show an increased number of student engagement elements?

Significance of the Study

This study contributes to the literature in two areas: approaches to online course development, and methods to assess the presence of student engagement elements in online courses.

Online Course Development Approaches

Online course development approaches in higher education have varied over time, across institutions, and amongst faculty. When online learning was new, the approach was often a largely independent effort by a single faculty member (Oblinger & Hawkins, 2006). Over time, specialized roles such as instructional designers, media designers, and educational technologists were added as a support to faculty, which transformed many course development projects into collaborative efforts (Abdous, 2020; Hixon, 2008; Holsombach-Ebner, 2013; Xu & Morris, 2007).

At many institutions, this collaborative approach takes the form of pairing an instructional designer with a faculty member–a duo which typically forms the primary collaborative partnership on the project—and the other roles are added as needed. The literature notes the success of these collaborative partnerships in enhancing both course quality and teaching effectiveness (Drysdale, 2019; Khanova, 2012), as well as faculty satisfaction with the process (Drysdale, 2019; Chittur, 2018). The literature also documents the necessary ingredients for an effective collaboration to occur (Chen & Carliner, 2021; Drysdale, 2019; Halupa, 2019; Chittur, 2018; Pan, et al., 2003).

One situation that can pose a challenge to this approach, however, is when there is a need for rapid scaling of courses and programs (Baab, 2016). One-on-one collaboration is resource-intensive, and while there are strategies to help make this consultative process more efficient (Parscal & Riemer, 2010), when resources are limited, rapid scaling still poses a significant challenge in terms of workload and maintaining quality.

To address this, some have adopted a faculty cohort model of course development, wherein a group of faculty are guided together through the online course development process within a specific time-frame. In-person workshops following this model have been used to develop both in-person courses (Simmons, 2006), and online courses (Keengwe & Georgina, 2012; Hernandez, et al., 2004; Franklin, 2003), but instances of *online* workshops to assist faculty in this process appear less frequently in the literature.

Even so, where they are mentioned, cohort-style online course development workshops/seminars offered online do enable the completion of rapid-scaling initiatives (Baab, 2016), and faculty express satisfaction with the cohort nature of the programs (Franklin, 2003; Hernandez, et al., 2004). Regarding quality, however, while some assessments find courses produced in such workshops to be sufficient (Hernandez, et al., 2004), the literature leaves unanswered the question of whether an online, cohort-style workshop can inspire the design of online courses that contain greater numbers of student engagement elements. This study fills this gap in the literature with a focus on assessing how well online courses designed through the CDI incorporated features that specifically encourage student engagement, as compared to those same courses taught before the institute.

Assessing The Presence of Student Engagement Elements in Online Courses

For decades, an increased level of student engagement has been recognized in higher education as an important element—a "key factor" (Kuh, et al., 2006, p. 31)—correlating with the achievement of positive student outcomes such as performance, persistence, satisfaction (Kuh, et al., 2006), critical thinking, improved grades, and many others (Trowler & Trowler, 2010; Kahu, 2011). Kuh (2009) describes student engagement as an indicator of quality, or even a "proxy for student success" (Kuh, et al., 2006, p. 34) because it is an element institutions are able to directly influence—including through exceptional online course design.

With this close tie to student learning outcomes, *measuring* student engagement has gained prominence (Trowler & Trowler, 2010; Zepke & Leach, 2010), and along with it, so have instruments that serve this purpose. Well-known instruments include the Community College Survey of Student Engagement (CCSSE) (CCSSE, 2017) and the National Survey of Student Engagement (NSSE, 2021). Similar surveys created specifically for online students include the Survey of Online Student Engagement (SOSE), which was derived from the CCSSE, and the Online Student Engagement Scale (OSE) (Dixson, 2010)—also a survey. Other efforts to assess student engagement in online courses and programs include learning analytics techniques (Ginda, et al., 2019), and the triangulation of data from multiple sources, including surveys and tracking data from learning management systems (Dixson, 2015).

A common thread to these measurement methods is their dependence on valuable data either from or about students' participation in courses and programs. In some situations, however, direct assessment of student engagement as it occurs or occurred is not yet possible because student participation data for courses or programs is either unavailable or does not yet exist, as in the case with this study, where courses being assessed had not yet been taught. In situations like this, an instrument that nonetheless could be used to assess a course for the presence of course design elements that *encourage* student engagement would be valuable. A search of the literature yielded no such instrument, which is the gap this study fills. In this study, the authors adapted survey questions from the SOSE to create a new instrument that can be used to assess the *design* of online courses for the presence of student engagement elements.

Methodology

Context

The CDI was developed as a 12-week, Canvas LMS-hosted online course that can be used with the help of a facilitator or as a self-paced job aid. Taking a constructivist approach, the institute introduces participants to the principles of the backward design framework of course design (Wiggins & McTighe, 1998), student-centered and active learning techniques, and a set of institutional online teaching best practices informed by the Quality Matters Rubric (Quality Matters Higher Education Rubric, Sixth Edition) and expertise within the university. It also provides a review of technical Canvas skills.

Faculty participants begin by reflecting on the relevance and purpose of the course they are designing, which leads to identifying course learning outcomes. Faculty then develop the assessments and activities that help students meet outcomes, and then add both student-to-student interaction elements and opportunities to connect with the real world. Learning designers led the institute and provided both feedback and additional support as needed. The intent of the institute is to encourage increased student engagement through the design of high-quality online courses and programs.

Research Design

The purpose of this study is to determine whether the online courses redesigned by the instructors who participated in CDI contain more instructional elements that encourage student engagement than before they were redesigned.

Document analysis method was used to analyze the learning materials presented in the courses designed before and after CDI. "Documents" refer to public or personal materials in digital or physical format (Merriam & Tisdell, 2015), and examples of documents include public records (e.g., the U.S. Census), personal documents (e.g., family photos) and educational materials (e.g., program design materials) (Merriam & Tisdell, 2015). The learning materials (i.e., the documents) created by the CDI participants in their online courses provided a window for the evaluators to observe, analyze, compare, and determine whether and/or how many student engagement elements are included in the courses. It also enabled them to determine whether there is a significant difference between the pre-CDI courses and the post-CDI courses in terms of the number of student engagement elements present. In other words, by analyzing the documents that make up these online courses, the authors were able to determine whether the CDI participants applied what they learned to redesign online courses in a way that promotes more student engagement than the previous versions.

Data Collection

Sample

Criterion sampling (Creswell & Poth, 2018) was used to select the courses that would be assessed. The purpose of using this method was to control as many variables as possible. Each sample course needed to meet all of the following criteria:

- The course had both a pre and post CDI version.
- Both the pre and post CDI versions of the course had to be designed by the same instructor.
- The pre-CDI version had to have been taught by the same instructor at least once in the previous 4 years.
- The instructor had to be a participant in the CDI.

- The raters needed to have full access to all the content in the course through Canvas.
- The post-CDI version needed to be complete.

Based on these criteria, 19 courses representing 18 different faculty members were identified out of 86 courses that were part of the first three cohorts of the CDI which were run over the course of two consecutive semesters in summer and fall 2021. Most of these courses (almost 2/3) had been taught by the same faculty member at least *twice* in the previous 4 years, which means they would have had some opportunity to improve the design of the course on their own prior to participation in the CDI. As shown in Table 1, these criteria resulted in a varied sample of courses from diverse subject areas.

Table 1
The Subject Areas and Numbers of Courses Included in the Sample

Subject Area	Number of Courses included
Humanities	6 (C8, C9, C10, C11, C17, C19)
Health Science	3 (C6, C15, C16)
Social Science	4 (C1, C2, C7, C18)
Business	6 (C3, C4, C5, C12, C13, C14)
Total N=	19

Instrument

The instrument used to evaluate the design of each course was a rubric the authors adapted from the Survey of Online Student Engagement (SOSE), which was originally derived from the Community College Survey of Student Engagement (CCSSE) (CCSSE, 2017). The CCSSE, designed for students to complete after taking an in-person course or program, has been widely used as an instrument for evaluating levels of student engagement in educational experiences. As the role of online courses and programs in higher education gained greater prominence, a correlated instrument, the SOSE, was developed, which uses similar questions to assess levels of student engagement in *online* educational experiences. The question sets used in both of these surveys assess student impressions (from their memory) about the presence of specific engagement elements in a course or program they have completed.

Because the design of an online course is preserved in the learning management system (LMS), the presence of engagement elements can be easily observed both before and after the course is taught. To assess the presence of these elements, the authors adapted questions from the SOSE that related only to course design to create an observation rubric that guided the comparison of courses to determine the types and level of engagement students would encounter. These questions were also shaped by the course design features available in the university's LMS (Canvas).

The observation rubric (shown in Table 2) consists of thirteen questions. The topics include identification of social learning features (discussions, group work, presentations), critical thinking (analysis, synthesis, assessment of value or soundness of content, etc.), as well as opportunities for students to connect their learning to the real world through practical problems or interaction with others outside the classroom. Each question asks raters to compare the number of these features in the pre-CDI course to those in the post-CDI course to determine whether the new course contains a greater number of engagement elements.

Table 2
Questions Assessing Presence of Engagement Elements in Courses (Observation Rubric)

1. Does the new course have more class discussions?
2. Does the new course require more presentations (not papers, text responses, exams; requires preparation)?
3. Does the new course have more opportunities for group work?
4. Does the new course have more instances in which students are asked to prepare two or more drafts of a paper or assignment before final submission?
5. Does the new course have more papers or projects that require integrating ideas or information from various sources?
6. Does the new course have more requirements that students discuss ideas from class with others outside of the class?
7. Does the new course ask students more often to analyze the basic elements of an idea, experience, or theory?
8. Does the new course have more assignments (quizzes, discussion, assignments) in which students are asked to synthesize and organize ideas, information, or experiences?
9. Does the new course ask students to make judgments about the value or soundness of information, arguments, or methods more often?
10. Does the new course ask students to apply theories or concepts in practical problems more often?
11. Does the new course invite students to connect their learning to the real world through activities or assessments more often?
12. Does the new course have an introductory discussion forum when the old course does not?
13. Does the new course have more varied types of assessments?

Procedure

Improvement in engagement elements, or lack thereof, was assessed by three independent raters, all professional learning designers for online courses, using the observation rubric. The raters piloted the observation rubric with two versions of a course in the social sciences, one designed before the faculty member was trained using the CDI, and the other after the training.

Answers to the questions were recorded by the raters in an observation form as Yes, No or Maybe. A detailed codebook was developed based on that experience.

The raters then independently coded 19 pairs of courses developed before and after the institute. The raters met weekly to discuss both the functional issues of counting features, and the interpretation of the codebook. When the codebook was expanded and refined, the raters ensured the same criteria were applied to all courses. Rater independence throughout the rating process was preserved.

Data Analysis and Discussion

The purpose of the Course Design Institute (CDI) at Utah Tech University is to improve/increase student engagement in online courses. To evaluate the effectiveness of the CDI in achieving this objective, raters assessed for the presence of student engagement elements in 19 courses in which one course in each pair was redesigned as part of the CDI. Before-and-after assessment data was collected to compare the prevalence of student engagement elements in the newly redesigned courses as compared to the same courses prior to the CDI redesign.

Of the 741 total rater answers (19 courses x 13 questions x 3 raters) there were 248 yeses (i.e., improved), 490 noes (i.e., no noticeable improvement), and 3 maybes (i.e., questionable improvement). For analysis purposes, a “yes” was coded as a 1, a “no” was coded as a 0, and a “maybe” was coded as 0.5.

To test the reliability of the results, tests of inter-rater agreement between the 3 raters were performed using two methods. First, a gross percentage agreement score was calculated, which shows 94.7% agreement between the raters. Second, a test of inter-rater (i.e., intraclass) reliability was performed using SPSS. The SPSS results also evidence strong inter-rater agreement (i.e., well within the bounds of 95% confidence), as shown in Table 3.

Table 3
Intraclass Correlation Coefficient

	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0		
		Lower Bound	Upper Bound	Value	df1	df2
Single Measures	0.774	0.731	0.814	11.303	246	492
Average Measures	0.912	0.891	0.929	11.303	246	492

To test for change/improvement, before-and-after comparisons were made for each course, and across each question. To implement the test, the alternative hypothesis was defined as H1: mean difference > 0, which denotes positive change or improvement as compared to the prior state (i.e., 0). Test statistics were calculated as: mean difference (i.e., mean score) divided by the standard deviation of the before-and-after difference divided by the square root of the sample size (i.e., ts=d-bar / (sd-d / sqrt(n)). The percentage of improvement was also calculated as: the number of yeses divided by n. Results are shown in Tables 4 and 5.

Table 4
Overall Course Improvement

Course	M	SD	n	ts=d/(s/sqrt(n))	P value (2-tailed)	% change/ improvement
C1 (Social Science)	0.821	0.389	39	13.180	0.000**	82%
C2 (Social Science)	0.538	0.505	39	6.658	0.000**	54%
C3 (Business)	0.436	0.502	39	5.419	0.000**	44%
C4 (Business)	0.282	0.456	39	3.864	0.000**	28%
C5 (Business)	0.333	0.478	39	4.359	0.000**	33%
C6 (Health Science)	0.051	0.223	39	1.433	0.076	5%
C7 (Social Science)	0.474	0.499	39	5.933	0.000**	47%
C8 (Humanities)	0.077	0.270	39	1.780	0.038*	8%
C9 (Humanities)	0.282	0.456	39	3.864	0.000**	28%
C10 (Humanities)	0.051	0.223	39	1.433	0.076	5%
C11 (Humanities)	0.115	0.313	39	2.300	0.011*	9%
C12 (Business)	0.436	0.502	39	5.419	0.000**	44%
C13 (Business)	0.359	0.486	39	4.613	0.000**	36%
C14 (Business)	0.077	0.270	39	1.780	0.038*	8%
C15 (Health Science)	0.026	0.160	39	1.000	0.159	3%
C16 (Health Science)	0.205	0.409	39	3.132	0.001**	21%
C17 (Humanities)	0.615	0.493	39	7.797	0.000**	61%
C18 (Social Science)	0.744	0.442	39	10.498	0.000**	74%
C19 (Humanities)	0.474	0.499	39	5.933	0.000**	47%
						Overall: 34%

*significant improvement at alpha=0.05, ** significant improvement at alpha=0.01

The results in Table 4 indicate that 16 of the 19 (84%) courses show statistically significant improvement (alpha=0.05 or 0.01). The last column in the table indicates the percent of change/improvement for each course. Three Social Science courses (C1, C18, C2) showed the most improvement, and the two Health Science courses (C15, C6) and one Humanities course (C10) showed the least. The mean percent of change/improvement across all courses was 34%. Courses C6, C10, and C15 were the only courses not showing significant improvement. A possible explanation for the lack of significant improvement shown in these courses follows.

The pair of courses associated with course C15 were found to contain core content that was essentially identical in both versions, meaning the essence of the course did not change during the redesign. The pair of courses associated with C6 were found to have identical core content as well, with one exception. The redesigned version of C6 contained an improved module page layout, and a module summary page had been added to the end of each module. These improvements have the potential to enhance student engagement, but the questions in the observation rubric do not cover this area of student engagement. A closer examination of these two courses also showed that the previous version of C6 and C15 were well-designed and already contained many of the engagement elements measured by the observation rubric. The lack of significant improvement may be due to a lack of room for improvement within the parameters of the observation rubric.

The pair of courses associated with course C10 also have essentially identical core content. However, both the navigation of the course and the design of the pages showed marked improvement. As with the improvements in C15, these changes have the potential to improve student engagement, but were not addressed by the questions in the observation rubric.

Table 5

Difference between Pre and Post CDI Courses on Each Design Element

Question	M	SD	n	ts=d/(s/sqrt(n))	P value (2-tailed)	% change/ improvement
Q1: Discussion	0.667	0.476	57	10.583	0.000**	67%
Q2: Presentation	0.140	0.350	57	3.024	0.001**	14%
Q3: Group Work	0.211	0.411	57	3.864	0.000**	21%
Q4: Two or more drafts	0.000	0.000	57	0.000	0.500	0%
Q5: Integrating ideas	0.526	0.504	57	7.888	0.000**	53%
Q6: Discussing ideas with others outside the class	0.088	0.285	57	2.320	0.011*	9%
Q7: Analyze	0.553	0.497	57	8.392	0.000**	55%
Q8: Synthesize	0.500	0.500	57	7.550	0.000**	50%
Q9: Judgments	0.465	0.499	57	7.038	0.000**	46%
Q10: Real world application	0.439	0.501	57	6.614	0.000**	44%
Q11: Real world connection	0.211	0.411	57	3.864	0.000**	21%
Q12: Introductory Discussion	0.211	0.411	57	3.864	0.000**	21%
Q13: More varied assessments	0.368	0.487	57	5.715	0.000**	37%
						Overall: 34%

Table 5 shows that of the various areas of student engagement assessed, 12 of the 13 categories/questions show significant improvement (alpha=0.05 or 0.01). The mean percent of change/improvement varies for each question (i.e., each engagement element). The three elements that show the most improvement were Q1: Discussion, Q7: Analysis, and Q5: Integrating ideas. Question 4 (Q4) represents the only criterion that did not show significant improvement. Question 4 states, “Does the new course have more instances in which students are asked to prepare two or more drafts of a paper or assignment before final submission?” This may indicate a tendency of instructors not to employ this strategy in their teaching. It may be due to the lack of awareness or a concern about extra workload. The overall change across all categories/questions was 34%.

Limitations

There are several limitations to consider in this study. First, during the process of rating the courses, the raters noted that many courses included design elements that would likely improve student engagement, but because those specific elements were not part of the observation protocol, they did not affect whether or not student engagement potential in the course was rated as significantly improved. As an example, raters noticed that in most post-CDI courses, navigation was noticeably improved. Second, for several of the courses, the improvement in engagement elements was marginal—it was just enough to qualify the post-CDI version for a "yes" rating, but it represented only a small increase in potential student engagement. Finally, in two pairs of courses, the pre and post CDI courses were each designed for different course scheduling formats (e.g.: 6-week vs. 16-week courses). This change may have affected the number and type of engagement elements included in the design of those two post-CDI courses.

Future Study

Future study on this topic should consider a number of areas. With regard to the observation rubric, future iterations would benefit from adding a question related to improved course navigation. Along with this, attention should be given to defining improved navigability in a way that can be formally evaluated. Additionally, a similar study should be carried out comparing pre- and post- course designs from one-on-one collaborations between faculty and learning designers, and the results should then be compared to this study to determine which model leads to greater improvement in student engagement potential. Finally, an outreach effort to identify cohort-based online training models used in other higher education settings could be mounted in order to compare these models to the CDI.

Conclusion

By comparing elements of engagement in two versions of online courses designed both before and after instructors participated in an online, cohort-based Course Design Institute, this study confirmed that the CDI was an effective approach for increasing the potential for engagement in the new versions. 16 of the 19 courses assessed in the study showed significant improvement. Most of the assessed-for elements, which included social learning features (discussions, group work, presentations), critical thinking components (analysis, synthesis, assessment of value or soundness of content, etc.), and opportunities for students to connect their learning to the real world, were more prevalent in the post-CDI versions of the courses. Two elements, multiple drafts of written work requiring instructor feedback, and opportunities to discuss learning with others outside the class, did not show marked improvement. Future revisions to the CDI should include more deliberate training in these areas.

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Indonesian English Teachers' Design Practices: How Technological Affordances and Costs Effect Learning Designs and Impact Student Learning

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Introduction

The changing face of university students - and universities.

Globally, the make-up of students who are attending universities is changing rapidly. While previous decades have seen increasing access for students into university (often in the form of student loans or free tuition), more recent changes (Bradley et al., 2008) have indicated that the 'average' student is also changing. Instead of being a school-leaver, more and more current students are adults returning to university - or going to university for the first time - at more advanced ages. Of course, this has meant that these students bring with them expectations about their university experience that is different to previous, younger cohorts. They are also more likely to have competing demands upon their time. The Bradley Review (Bradley et al., 2008) recognised this, noting an increased preference for part time university study, and university study directly related to current or future employment. As a result of students with caring responsibilities or work commitments, there have been increased demands for more flexible approaches to study, especially in terms of time commitments and modalities. And increasingly, this has meant more demands for ICT use to enable this to take place. These have been drivers for the increased adoption amongst universities for shorter forms of learning, such as microcredentials, and increasing use of online and blended modalities - although it should be noted that, in some cases, this has always been the dominant approach. It should also be noted that, while it often seems that mobile technology is everywhere, the adoption of these approaches has been unequal between universities, for a variety of reasons, including economic imperatives and decisions related to status and preferred approaches to teaching and learning.

These changes have placed additional demands upon staff - both professional and academic- at universities. In particular, academic staff have been required to develop new skills in the design and implementation of online or blended learning platforms. As universities have embraced the affordances of Learning Management Systems (LMSs), either in blended or online modalities, educators have had to develop new, technologically based skills in managing these sites, as well as reconsidering their pedagogical approaches in order to capitalise upon the opportunities provided. In many universities, especially in developed countries, this has led to an increasing number of learning designers being employed in central or faculty teaching and learning units, tasked with providing support for academics in navigating this change. It has also led to the development of a range of learning design approaches, with terms like blended, hybrid, hyflex, sync and async entering the common lexicon of university teaching and learning strategies.

Literature Review

The adoption of blended and online learning approaches

What have these changes meant for the student learning experience? And what about the experiences of academics? This paper will examine these questions from the perspective of English language learners in a developing country. Research on the perceptions of blended learning by teachers and students in this field has identified some advantages and also disadvantages. For example, in Saudi Arabia, blended English courses for students were generally positively received because students valued the extended reading opportunities and the chance to enrich vocabulary (Al Zumor et al., 2013). Another study, looking at Turkish students, noted the dual benefits of both face to face and online learning. Students valued face to face learning for the student-teacher interaction but they also liked online learning for the instant feedback and personalized study pace (Istifci, 2017). Another Saudi Arabian study noted the importance of a well-structured LMS to foster their teacher-student relationship (Mohsen & Shafeeq, 2014). While some studies have indicated an increased student engagement, other studies have questioned the pedagogical basis for blended learning: for example, some researchers have noted that LMSs are sometimes implemented for more administrative issues rather than pedagogical purposes (Godev, 2014; Mohsen & Shafeeq, 2014). Other problems with blended language courses included resolving technical issues, organising student training, and increasing the number of laboratories (Al Zumor et al., 2013). This means that universities are required to establish digital and physical infrastructure to facilitate teachers and students.

In line with the previous studies, some studies on students' satisfaction with blended language learning have highlighted the implementation of the learning experience being a central factor. Students of Chinese language courses who experienced a blended learning paradigm (combined face-to-face and distance learning) valued the blended learning modality because of the quality of learning, the ability to manage administrative matters, and provide technical support during the distance-learning period. However, they did not value the limited teacher presence during the distance learning part of the program (Hu, 2012). Students of a blended English for Academic Purposes writing course in an Iraqi university argued that the blended course was not as effective as face-to-face learning, although the same study notes that students engaged in course content, making use of feedback mechanisms, open communication and accessing supplementary course materials (Abbas, 2018). There was no correlation between students' achievement and their satisfaction in a hybrid English course at a university in Thailand; however, there was a correlation between students' achievement and their participation, although it was negatively correlated with students' technological comfort (Wichadee, 2015).

There are similarities between the adoption of blended learning and entirely online learning. For example, in an online language course, Chinese students reported difficulties with time management and collaborative work (Sun, 2014). Another study revealed that university leaders were often reluctant to shift into online learning mode because of the additional investment requirements and challenges involved in accrediting and adapting policy (Natalia, 2017).

Other studies on formal distance education have highlighted factors that influenced its implementation. Students valued interactions in the virtual discussion forums that defined roles of tutors, moderators, and learners in an upper-intermediate Spanish course (Comas-Quinn et al., 2012). Access, interaction and affordability influenced decisions to enrol in a master's program in English language teaching (Farooq et al., 2012). Clearly, then, the implementation of both blended and online learning is a complex one, at an institutional level, a faculty level, and even at the level of individual teachers.

Design practice of teachers in higher education

One key factor that emerges from the research is that the design practices of teachers influence the successful implementation of blended and online learning. Yet this is an area that has been relatively unexplored, especially in the contexts of developing countries. Most academic research in this field has been in the form of self-reported studies. For example, one well known study was based on the self-reflections of a large number of academics from a mix of disciplines within different Australian universities (Bennett et al., 2017). Based on this, researchers have established two important findings: 1) a design process model for courses (Bennett et al., 2017) and for assessments (Bearman et al., 2017), and 2) internal and external factors influence teacher design practices (Agostinho, 2011; Agostinho et al., 2018; Bearman et al., 2017; Bennett et al., 2011; Bennett et al., 2015).

Design practices of English language teachers

Even more narrowly, there has been only limited case study-based research upon the design practices of English language teachers in tertiary settings. Grgurović (2010, 2014) has highlighted that participating teachers' technological knowledge and beliefs influenced their design-decision making during the innovation-decision process. Ozmen et al. (2018) have concluded that a design-decision making made was a result of a collaborative team work between team design, teachers, and students, and indicated the different roles of each actor in the unfolding design processes.

Research questions

In summary, then, studies on teacher design practices have thus far been limited, for the most part, to interview based and self-reporting studies. Few studies have investigated the design process and contextual factors that influence experienced teachers who work in blended, online and distance environments Further research should utilise other data collection methods such as observation to minimise the limitation of a self-report study (Bearman et al., 2017; Bennett et al., 2017). Even more importantly, most of these studies focus on higher education institutions in developed countries. To date, there has been little research based in developing countries and this should be remedied.

This paper examines the design processes used by the Indonesian higher education teachers in online distance learning courses during the COVID-19 pandemic. It also discusses the impacts of the teachers' design work on student learning with respect to support that could be accessed by both teachers and students. The research questions is:

1. How did Indonesian university English teachers engage in designing learning during COVID-19?

Methodology

Research design and sites

A case study approach was chosen to investigate the gap described above. It was the most appropriate methodology because the case studies were representative 'cases' in a real-life context (Yin, 2018). Eight case studies were integrated into the overall research design. The sites for the case studies were located in five out of six provinces on Java Island. The sites involved were two Schools of English Literature, and the remaining were Schools of English Education. Two public universities from the study were governed by the Ministry of Religious Affairs (MoRA). One public university and five private universities were part of the Ministry of Education and Culture.

Participating teachers

Eight full-time English language teachers were voluntarily recruited from the universities using convenience sampling. They agreed to follow all the required instructions in the participant information sheet and gave their informed consent before the data were gathered. The participating teachers were de-identified to safeguard their confidentiality and their names were changed to pseudonyms. The following table (Table 1) shows the distribution of the participants.

Participants (pseudonyms)	**Gender**	**Age**	**Degree**	**University Teaching**
Joko	Male	43	Master of Education	15 years
Endah	Female	38	Master of Education	15 years
Bambang	Male	55	Master of Education	29 years
Melati	Female	39	Master of Education	8 years
Rahayu	Female	35	Master of Arts	5 years
Herlambang	Male	33	Doctor of Education	10 years
Sudirman	Male	52	Doctor of Education	21 years
Kartika	Female	50	Doctor of Education	20 years

Table 1: Profile of the Participating Teachers

Data collection

This study used online research methods such as online interviews, observation and document analysis. The E-Interview Research Framework (Salmons, 2014) was adopted. Due to the mitigations put in place from COVID-19, the data were gathered remotely. The primary data was eight pre-design interviews and eight post-design interviews. The other supporting data were observations (i.e., online classes on learning management systems and social media applications), documentation (i.e., directorial and institutional decrees, university updates via websites, curriculum documents, syllabus and semester lesson plans and teaching diaries of participants .

Data analysis

The Data Analysis Spiral introduced and developed by Creswell and Poth (2018) was used. The analysis was conducted both inductively and deductively and the resulting cross-case analysis showed themes related to teachers' design processes for remote learning and also the shifting classroom paradigms.

Findings & Analysis

Adoption of online learning design approaches

The governmental mandates on emergency learning to mitigate the pandemic caused by COVID-19 were implemented in Indonesia from March 2020. The participating teachers were immediately required to implement an online distance learning approach. The teachers were forced to modify their course design from blended learning to online distance learning designs. The English language teachers in this study have shown a similar routine as the university teachers in the study of Bennett et.al (2017) regarding the nature of the design problem in that they used a broad to specific design approach and moved through multiple design phases.

The teachers' design work was an emergency design and was developed by redesigning the syllabus or semester lesson plans. The course plans were originally used for blended learning course designs. They were then redesigned and redeveloped to suit a fully online learning mode. This redesign was undertaken using a broad to specific strategy. The participants worked together with their partners in a team; they discussed the course framework together, or distributed jobs between partners. However, the specific course designs were undertaken individually. The individual design work had three stages. In the planning phase, teachers modified the course framework of the existing syllabus or semester lesson plans. In this stage, most teachers explained that content scopes and learning outcomes were not changed; however, some features were changed such as ideas for activities and assessments strategies to fit the technological affordances and costs. After the teachers finalised the course framework, the design processes moved to a more specific detail approach. Scheduling and descriptions of lesson activities, assessments, and content resources were organised. This concluded the planning stage.

During the implementation stage, the participating teachers taught weekly lessons as planned. This also included updating online classes and content resources in the LMSs. However, some of the planned learning designs were not successfully conducted due to design issues associated with technological affordances, costs, internet connectivity, and device ownership issues. Thus, a design-while-teaching approach was undertaken to solve the design challenges. In other words, these teachers undertook another redesign approach during the implementation stage.

The final stage was reflection. Here, the teachers undertook some techniques to reflect upon their course designs. The purpose was to identify areas for improvement. These teachers evaluated the implementation of the course designs, for example lesson activities could not be well delivered because of internet connectivity as the former technique. The last technique was future planning of learning designs for the upcoming student cohort. For instance, refinement of the quality of online modules and video lectures, and better ways to engage students in online discussions.

Unanticipated design issues in Bennett et. al., (2017)'s model

The design process, as undertaken by the teachers, resembled that described by Bennett et.al (2017). However, this design process model for university teachers does not specifically address the design issues that are often present in developing countries but are overlooked in developed countries. Some of these include technological affordances, costs, internet connectivity and device ownership issues. Although a common analysis stage (Branch, 2009) could be captured in the individual case studies, the participating teachers had more complex issues. This study has indicated that these environmental factors influenced teachers' design practices.

Institutional directives and support

The nature of the emergency online teaching was varied depending on a number of factors as follows:

1) ICT infrastructure influenced how the curriculum was designed and delivered. The teachers were mostly trained to use the institutional technological tools at a technical level rather than being trained to integrate this technology with their pedagogy. Some of the teachers received teacher training from the institutions. Other teachers sought support from other actors (i.e., professional communities outside university, and colleagues). The level of support provided, either internally or externally, dictated their success in designing learning.
2) There was a lack of pedagogical usability for some LMSs. Institutional LMSs could not be accessed by staff or students due to issues associated with the bandwidth capacity (i.e., overloaded servers) and incomplete features (i.e., lack of video conferencing tools, video file extensions). This required creative approaches from teachers, often involving the use of alternative technological tools.
3) Lack of access to appropriate bandwidth. Students and teachers struggled to access sufficient internet bandwidth to allow for all planned learning activities, including video conferencing and live lessons. It required teachers' efforts to overcome the technological affordances and economic costs.

Teachers' design practices impacted student learning

Students experienced different levels of readiness following the move to online learning. Senior students were better prepared. They showed independency and autonomous learning. Unlike senior students, junior students had to be carefully guided to follow instructions.

However, both students demonstrated low engagement in online discussions, either synchronously and asynchronously.

Discussion

Extended contextual analysis model

A new design process for university language teachers, an expansion of that described by Bennett et al. (2017) is a key finding of this research. This new model addresses some factors overlooked in the original model proposed. In this new model, the analysis phase of the ADDIE model (Branch, 2009) is also used to identify and plant to accommodate the contextual factors.

This model is called the *Expanded Contextual Analysis Model* (Figure 1). It has three phases: planning, implementation, and reflection. Each phase includes actions and tasks in order to visualise the tacit design process at each point. The actions are teachers' design decision-making regarding the environmental factors that should be aligned with course syllabus and semester lesson plans and requires teachers to analyse, design, develop, implement and evaluate their learning designs. The tasks show chronological design activities during design processes.

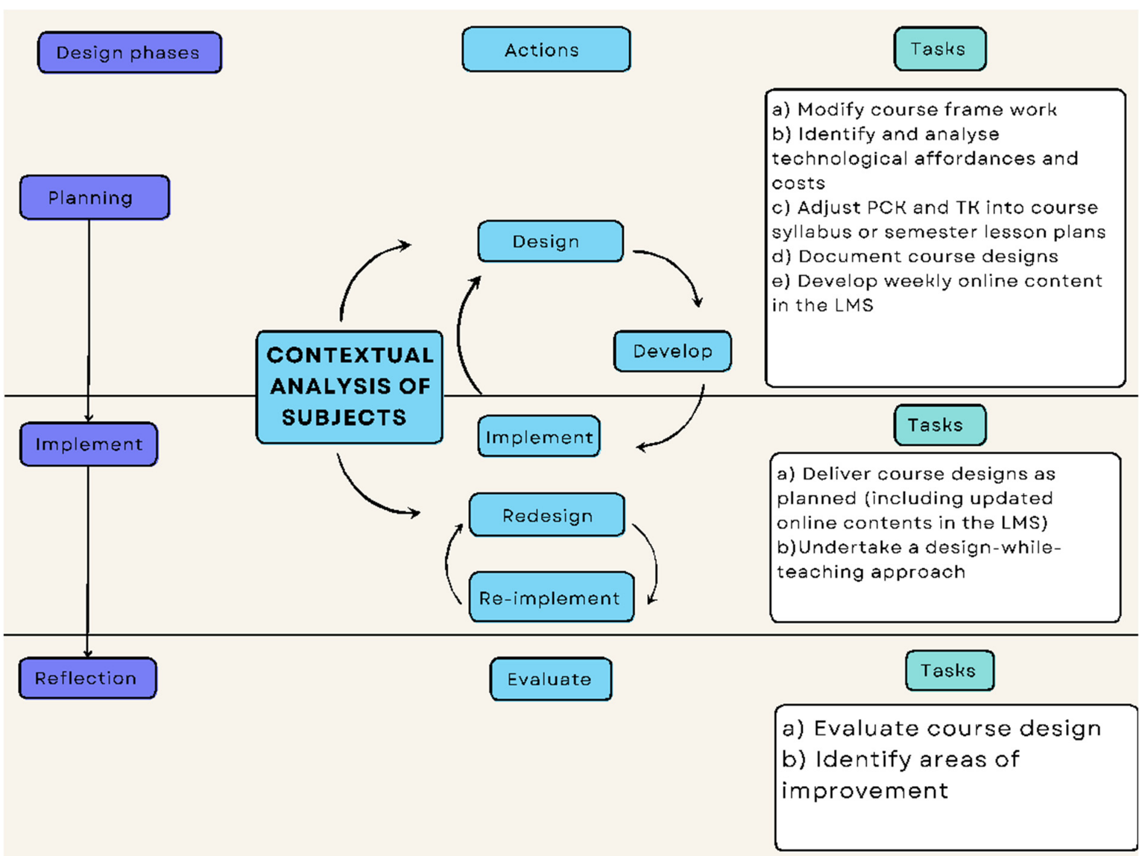

Figure 1: Expanded Contextual Analysis Model

Planning phase

Participating teachers' undertook frequent contextual analyses on the environmental factors as they affected their learning designs. This continued throughout the learning experience. To encapsulate that, this model has three actions within the planning phase.

1) Analysis
   An analysis of the environmental factors is taken to understand how they might impact the course framework (general ideas for course designs). The tasks are undertaken by modifying the course framework (i.e., ideas for activities and assessment strategies) and identifying/ analysing technological affordances and costs (i.e., ideas of technology used that are suitable with ideas for activities and assessment strategies).

2) Design
   A design phase is broken down into some tasks that require teachers to adjust their pedagogical content knowledge (PCK) and technological knowledge (TK) into course syllabus or semester lesson plans and document the planned course designs. More specific course designs such as content resources, class and assessment timetables, lesson activities and assessment descriptions can be decided. This task may need teachers to demonstrate their capacity to understand PCK and TK to align with the planned lesson activities and assessment descriptions. Then, documenting the course plan by using the existing template of course syllabus or semester lesson plans is essential.

3) Develop
   Teachers are required to develop weekly online content in the LMSs. Creating new or reproducing content resources that had been used from previous iterations of the subject are some alternatives for the task at this point.

Implementation Phase

There are three further actions in the implementation phase. This shows the need to re-design and re-implement, based on the contextual analysis and changing circumstances.

1) Implement
   Teachers deliver the course design as planned; sometimes, there are no obstacles to overcome. The task also includes updating weekly online content in the LMSs. If there are no obstacles, teachers would not need to continue to the next actions.

2) Analyse
   Another analysis should be undertaken because of some recently occurring design issues. Therefore, a design-while-teaching approach is suggested. Obstacles caused by environmental factors may occur. Teachers are required to analyse solutions to minimise these obstacles.

3) Redevelop-Reimplement
   This stage is recommended after teachers have undertaken the previous analysis phase. Teachers would need to redevelop the course designs by modifying or changing the planned courses. After deciding the redeveloped course plan, they need to reimplement it.

Reflection Phase

1) Evaluation
   Teachers are recommended to evaluate the course designs to reflect on their teaching experiences. The tasks, such as evaluating the course designs and identifying areas of improvement, are possible strategies of evaluation.

Conclusion

In general, technological affordances and costs influenced the design processes of the adoptions of online learning designs. The new model of the design processes has the capacity to understand the environmental factors influence teachers' design work as well as impact student learning.

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Impacts of Learning Instructional Design for Pre-service Teacher Education

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Abstract

We aim to investigate technological pedagogical content knowledge (TPACK), and mathematics teaching anxiety (MTA) components affect the instructional designs (IDs) of pre-service mathematics teachers. Thirty-three Japanese pre-service mathematics teachers participated in the research. Through learning ID theories, PCK of the TPACK components affected the ID of pre-service mathematics teachers. On the other hand, no MTA components affected the ID of the pre-service mathematics teachers. These results indicate that pre-service mathematics teachers can design lessons considering ID theories by acquiring PCK, not reducing MTAs.

Keywords: Pre-Service Teacher, Instructional Design, TPACK, Mathematics Teaching Anxiety

1. Introduction

1.1. Teachers' Anxieties Toward Teaching Mathematics

Teachers have anxieties when teaching mathematics. Peker (2006) explains these mathematics teaching anxieties (MTAs) as teachers' tension and anxiety while teaching mathematical concepts, theories, and formulas or during problem-solving. Hunt and Sari (2019) suggested two factors student- and teacher-directed mathematics teaching anxiety. The former MTA represents anxiety concerning pupils/students failing assessments or not reaching curriculum/school targets. The latter MTA represents a teacher's teaching practice and perceived ability. Therefore, mathematics teachers have anxieties toward not only students but also teachers themselves. Focusing on pre-service teachers' MTA, Patkin and Greenstein (2020) suggested that the mathematics teaching anxiety of pre-service teachers is higher than that of in-service teachers.

Moreover, the higher the teachers' mathematics teaching anxieties, the more the teachers use teacher-centered instructions. Therefore, there are need to lower teachers' mathematics teaching anxiety in the pre-service phase. We then aim to reduce pre-service teachers' anxiety by acquiring knowledge.

1.2. Technological Pedagogical and Content Knowledge (TPACK)

From the perspective of teachers' knowledge, TPACK represents a framework that teachers need to acquire. TPACK stands for technological, pedagogical, and content knowledge. The interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate technology use into teaching (Schmid et al., 2009. **Table 1** shows the TPACK components, definitions, and their examples.

Table 1. TPACK components and definitions (Hunt & Sari, 2020)

TPACK Components	Definitions	Examples
Pedagogical Knowledge (PK)	Knowledge about the process and practices or methods of teaching and learning and how it encompasses educational purposes, values, and aims.	Student learning, classroom managements, lesson plan development and implementation
Content Knowledge (CK)	Knowledge about the actual subject matter that is to be taught.	Central facts, concepts, theories, procedures
Technological Knowledge (TK)	Knowledge about standard technologies and how to operate them.	From books and chalkboards to the internet and digital video
Pedagogical Content Knowledge (PCK)	Knowledge of pedagogy that is applicable to the specific teaching content.	Knowing what teaching approaches fit the content, knowing how elements of content can be arranged for better teaching
Technological Pedagogical Knowledge (TPK)	Knowledge of how technology and content are reciprocally related.	Knowing that range of tools exist, ability to select based on fitness and knowledge of affordances of these tools for pedagogical practice
Technological Pedagogical Content Knowledge (TPCK)	Knowledge for good teaching with technology which requires understanding how technologies can support teaching subject matter	Knowing how technologies can help overcome problems in the processes of teaching and learning, and how they can be used for constructively content and pedagogy

Prior TPACK research revealed that much of the knowledge related to TK (i.e., TK, TPK, TCK, TPCK) is evident. For example, Schmid et al. (2021) suggested that pre-service STEM teachers obtain higher levels of TK and TCK. However, fewer kinds of research focus on the development related to PK (i.e., PK, PCK, TPK, TPCK).

1.3. Instructional Design in Pre-service Phase

Considering PK, in Japan, the Ministry of Education, Culture, Sports, Science, and Technology (MEXT; 2017) summarized the skills required in pre-service teacher-training courses of all Japanese universities as the core curriculum of pre-service teacher-training courses. For instance, the Instructional Methods of Specific Subject Course and the Instructional Design and Technology Course. Here, the latter course aims to acquire fundamental instructional design theories and practices. Therefore, pre-service teachers need to acquire instructional design (ID) theories.

Suzuki (2005) explains ID as the models and research fields that combine methods to foster educational activities' effectiveness, efficiency, and appeal. For example, in this research, ID theories represent Gagné's Nine Events of Instruction and the ARCS model for Attention, Relevance, Confidence, and Satisfaction. Gagné et al.'s (1974) theory is a nine-Step process based on an information processing model. In Japan, a lesson's procedure has three parts: introduction, body, and summary. However, Gagné's nine events of instruction theory are divided into nine events, from "Gaining attention" to "Enhancing retention and transfer." The ARCS model (Keller, 1987) is a problem-solving approach for designing motivational aspects of learning environments to stimulate and sustain students' motivation to learn. This model helps to design lessons considering learners' motivation.

2. Purpose

We aim to investigate TPACK and MTA components affect the instructional designs of pre-service mathematics teachers. We set two research questions: (1) Through learning ID theories, are pre-service mathematics teachers' PK, PCK, TPK, and TPCK affect their instructional design? and (2) Through learning ID theories, are pre-service mathematics teachers' mathematics teaching anxieties affect their instructional design?

3. Methods

Figure 1 shows the procedure of the research.

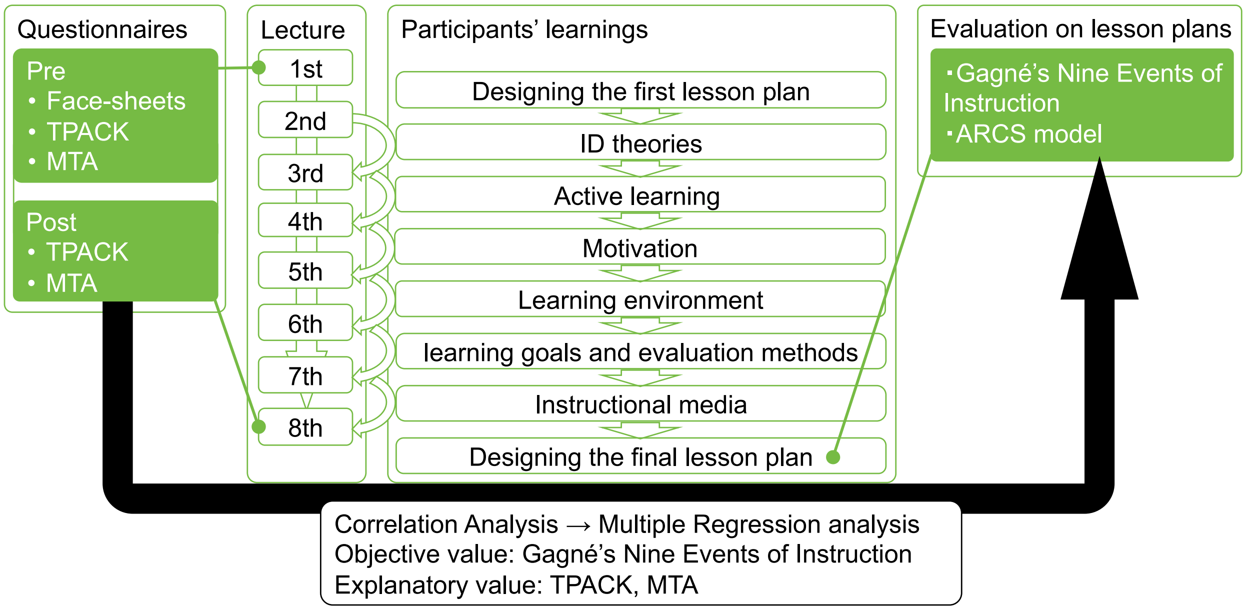

Figure 1. Procedure of Instructional Design and Technology Course and the participants' learning.

3.1. Participants

Participants are pre-service mathematics teachers at University A. This university is one of the oldest Japanese private science and technology universities. The participants took the "instructional design and technology course," a pre-service teacher-training course subject for juniors, from April to June 2021. Therefore, the participants have never been to education practice in primary and secondary education fields. Also, the participants never designed lesson plans or other instruction abilities based on the ID theories.

3.2. Instruments

The research instruments are questionnaires and lesson plans.

Questionnaires

We asked the participants about the face sheets, TPACK referred from the English 28-item TPACK scale "TPACK.xs" (Schmid et al., 2020), and MTA referred from the English 19-item MTA Scale "MTAS" (Hunt et al., 2019) to the participants using the measure developed from prior research translated into Japanese using a 5-point Likert scale.

Lesson Plans

3.3. Guidelines for Analysis

We conducted Pearson's correlation analysis to determine the correlation between TPACK, MTA, and ID. We then conducted the multiple regression analysis setting the score of Gagné's Nine Events of Instruction as an objective value and seven TPACK and two MTA components as the Explanatory value.

4. Results

In total, 33 pre-service mathematics teachers completed both questionnaires and lesson plans. The teachers did not answer questionnaires biased (i.e., SD $\neq$ 0) and were willing to be a teacher in the future,

4.1. Correlation between TPACK, MTA, and ID

We eliminated some items to maximize Cronbach's reliability coefficient α. α score of one of the TPACK components was =.28, then We eliminated one item to raise the α score. We eliminated one item for student-directed MTA, and three items for teacher-directed MTA likewise. The final descriptive statistics and coefficient α of the post-score are shown in **Table 2**.

Table 2. Descriptive statistics and α score of ID, TPACK, and MTA

Perspectives	Components	M_{Post}	SD_{Post}	α_{Post}
ID	Gagné's Nine Events of Instruction (Gagné)	5.94	1.64	-
	ARCS model (ARCS)	3.42	0.66	-
TPACK	PK	3.89	0.57	0.77
	CK	3.46	0.70	0.72
	TK	3.23	0.78	0.70
	PCK	3.66	0.61	0.76
	TPK	3.67	0.63	0.72
	TCK	2.92	0.88	0.84
	TPCK	3.73	0.58	0.74
MTA	Student-Directed MTA (MTA_S)	2.91	0.79	0.81
	Teacher-Directed MTA (MTA_T)	3.50	0.78	0.87

Note: *n* = 33. MTA: flipped

We found that both TPACK and MTA questionnaires were reliable as the adjusted α of each post-score was >.80. We then conducted the Pearson's correlation analysis to two ID, seven TPACK, two MTA components as shown in **Table 3**. Focusing on the ID perspective, Gagné's Nine Events positively correlate to PCK and TPCK. On the other hand, focusing on the MTA perspective, there were no correlations to both ID theories (i.e., Gagné's Nine Events of Instruction and the ARCS model). However, teacher-directed MTA positively correlates to PK, CK, and TPK.

Table 3 Pearson's correlation analysis of ID, TPACK, and MTA components

items	Pearson's r

	ID		TPACK							MTA
	Gagné	ARCS	PK	CK	TK	PCK	TPK	TCK	TPCK	MTA_S
Gagné										
ARCS	0.54***									
PK	0.24***	0.08***								
CK	0.09***	0.24***	0.45***							
TK	0.16***	0.24***	0.52***	0.37***						
PCK	0.38***	0.45***	0.50***	0.63***	0.69***					
TPK	0.30***	0.15***	0.71***	0.37***	0.57***	0.56***				
TCK	-0.04***	0.30***	0.50***	0.62***	0.70***	0.64***	0.33***			
TPCK	0.35***	0.29***	0.78***	0.52***	0.60***	0.59***	0.77***	0.45***		
MTA_S	-0.29***	-0.17***	0.13***	-0.14***	-0.13***	-0.19***	0.19***	-0.12***	-0.03***	
MTA_T	-0.11***	0.23***	0.42***	0.40***	0.03***	0.17***	0.34***	0.28***	0.32***	0.59***

Note: n = 33. MTA: flipped $^{*}p < .050$, $^{**}p < .010$, $^{***}p < .001$

4.2. Multiple Regression to the Gagné's Nine Events of Instruction

Table 4 shows the results of the multiple regression analysis using Gagné's Nine Events of Instruction as the objective value. Focusing on the TPACK components, the standardized coefficient of only PCK was significant. However, no MTA components have significant standardized coefficients.

Table 4. Multiple regression analysis

Descriptive Valuable (items)	*B*	*SEB*	Std. β	*VIF*
PK (4)	0.46	0.81	.16*	3.16
CK (4)	-0.57	0.60	-.25*	2.65
TK (4)	-0.37	0.66	-.17*	3.94
PCK (4)	1.76	0.73	.65*	2.92
TPK (3)	0.19	0.78	.07*	3.65
TCK (4)	-0.83	0.57	-.44*	3.72
TPCK (4)	0.51	0.93	.18*	4.28
MTA_S (6)	0.72	0.47	.37*	2.36
MTA_T (9)	-0.17	0.57	-.08*	2.95
intercept	-1.05	2.87		

Note: n = 33. Objective Value = Gagné, DW = 2.24 (*n.s.*), Adj. R_2 = .20 $^{*}p < .05$

5. Discussion

5.1. The impacts of learning ID theories to TPACK

The answer to the first research question, through learning ID theories, whether pre-service mathematics teachers' PK, PCK, TPK, and TPCK affect their instructional design is a partial yes, according to the results. Only PCK and TPCK had a significant positive correlation to Gagné's Nine Events of Instruction. Moreover, only PCK has a significant positive coefficient of the multiple regression analysis. We can say that pre-service teachers who acquire PCK are the only persons that can design instructions according to ID theories. In other words, acquiring the essential three TPACK components does not help pre-service mathematics teachers design instructions based on ID theories. This implication supports the TPACK framework's transformative model (Schmid et al., 2020).

5.1. The impacts of learning ID theories to MTA

The answer to the second research question, through learning ID theories, whether pre-service mathematics teachers' MTA affect their instructional design is no, according to the results.

6. Conclusion

This research identified the effects of Japanese pre-service mathematics teachers' learning ID theories. In conclusion, only PCK of the TPACK components affected the ID of pre-service mathematics teachers. On the other hand, no MTA components affected the ID of the pre-service mathematics teachers. These results indicate that pre-service mathematics teachers can design lessons considering ID theories by acquiring PCK, not reducing MTAs.

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Reviews of Research on Online Learners

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Abstract

Online teaching and learning are rapidly increasing across all the educational segments and, specifically, in higher education. Doo et al. (2020) noted that higher education is experiencing three interconnected trends according to Brown et al. (2020) including: (a) increased student diversity, (b) alternative pathways to education, and (c) the sustainable growth of online education. With the COVID-19 pandemic impact and transition to new pathways in online teaching and learning, e.g., HyFlex courses or universal design introduction, higher education online courses need more resources, opportunities, tools, and overall new online infrastructure because of current learners' preferences for flexible and self-directed online learning. This literature review is focused on the findings of the current studies in relation to existing trends and challenges in online teaching and learning. These findings will help researchers and practitioners understand what current online teaching and learning need to get effective and meaningful support to move forward.

Introduction

Online learning "happens when learners are active and engaged in learning at a distance and online" (Martin et al., 2022, p. 2). In this review, we follow Ally's (2004) definition that online learning is "the use of the Internet to access learning materials; to interact with the content, instructor, and other learners; and to obtain support during the learning process, in order to acquire knowledge, to construct personal meaning, and to grow from the learning experience" (p.5).

During the last decades, studies actively examined the effects of different types of online instructional approaches and learning technologies in order to support evidence-based online learning practices (Johnson & Lowenthal, 2022; West et al., 2017). Some studies systematically examined previous studies and used them as secondary data by retrieving, synthesizing, and assessing existing knowledge on a subject of online learning in a logical, transparent, and analytical manner (Martin et al., 2020; Sadaf et al., 2021). A systematic review of the literature synthesizes both qualitative and quantitative research using a systematic procedure to minimize biases, become reproducible and have high validity of review conclusions (Stratton, 2019).

To further develop online learning and understand how to serve online learners effectively, researchers conducted systematic reviews on a variety of research problems including cognitive presence in online learning (Moore & Miller, 2022; Sadaf et al., 2021); online student privacy in higher education (Kularski & Martin, 2022), digital citizenship (Richardson et al., 2021); synchronous online learning (Martin et al., 2017; Martin et al., 2021); online teaching and learning (Martin et al., 2020); learning analytics (Ifenthaler & Yau, 2020);

and Massive Open Online Course (MOOC) (Liyanagunawardena et al., 2013; Veletsianos & & Shepherdson, 2016; Zhu et al., 2018). In addition to conducting systematic review of research on online teaching and learning, some studies conducted a scoping literature review to understand extant research and develop new research questions to find answers on the effectiveness of online teaching and learning (Choi et al., 2021; Powers & Moore, 2021; Snelson & Hsu, 2020). For example, Choi et al (2021) reviewed the application of network analysis and found that this type of analysis was applicable in examining online environments to understand structural relationship, interaction and relational patterns of online learners. Researchers found that most studies using network analysis have been conducted in formal learning settings in higher education (Choi et al., 2021). Finally, in addition to conducting systematic review of research or a scoping review of literature, some studies also conducted meta-analysis to generalize the topics and themes on online teaching and learning as a result of synthesizing the findings across numerous research studies (Borenstein et al., 2009). For example, Richardson et al (2017) conducted a meta-analysis to examine social presence in relation to students' satisfaction and learning in the online environment. The researchers identified the patterns of student outcomes (e.g., perceived learning and satisfaction) in relation to social presence through scrutiny of differences between the studies. The study found that (a) the strength of the relationship between social presence and satisfaction was moderated by the course length, discipline area, and scale used to measure social presence; and (b) the relationship between social presence and perceived learning was moderated by the course length, discipline area, and target audience of the course (Richardson et al., 2017). Another study by Caskurlu and colleagues (2020) conducted a meta-analysis addressing the relationship between teaching presence and students' satisfaction and learning. The study reviewed the relationship between student outcomes and online teaching presence, and its three sub-dimensions (i.e., design and organization, facilitation, and direct instruction) and identified the conditions that moderate the strength of the relationships (Caskurlu et al., 2020). The study found that each dimension of teaching presence individually predicts student learning outcomes in fully online courses.

This literature review of research on online teaching and learning is focused on overviewing three and the most current studies on online learners conducted by Martin et al (2022), Doo et al. (2020), and Trespalacios et al. (2021). These three studies overviewed online teaching and learning from the perspectives of conducting a second-order meta-analysis by Martin et al (2022), a meta-analysis of scaffolding effects in online learning in higher education by Doo et al. (2020), and a scoping review of the literature on community and connectedness in online higher education by Trespalacios et al. (2021). All three studies are focused on higher education which was the main reason for selecting them for this paper.

Cognitive, Affective and Behavioral Outcomes in Online Learning

In the most current review of research on online learning "Examining Research on the Impact of Distance and Online Learning: A Second-Order Meta-Analysis Study", Martin et al., (2022) examined the impact of online learning on students' cognitive, affective and behavioral outcomes. (. The research findings revealed a statistically significant overall average effect size of distance learning impacting cognitive, affective and behavioral outcomes in comparison to face-to-face learning. The authors concluded that distance learning is effective when achieving learning outcomes, and that further careful investigation is needed on learning outcomes within each learning environment and delivery method.

In this second order meta-analysis, Martin et al (2022) identified 15 meta-analysis studies that examined cognitive outcomes (Allen et al., 2004; Jahng et al., 2007; Means et al., 2013), seven meta-analysis that examined affective outcomes and four studies with behavioral outcomes (Bernard et al., 2004; Rohwer et al., 2017; Zhao et al., 2005). In this paper, we provided examples of the studies that examined the higher education environment. Examples of cognitive outcomes that were included in the analysis were *achievement, knowledge and skills.* As for affective outcomes, the study included *reactions, satisfaction, or attitude,* and *retention rates* for behavioral outcomes.

Martin et al (2022) found that online learning had a statistically significant effect on cognitive outcome compared with face-to-face learning ($g = 0.214$, $p < .001$). There were no statistically significant effects on affective outcomes ($g = -0.030$, $p = .691$) or behavioral outcomes ($g = 0.347$, $p = .209$). Variances of effect sizes varied by statistically significant amounts in the reviewed meta-analysis studies. Further, the researchers also found that online learning did have a statistically significant, higher effect on cognitive outcomes than on affective outcomes (Q-value = 0.646, $p = .011$), but there was not a significant effect between cognitive and behavioral outcomes (Q-value = 0.221, $p = .638$) or between affective and behavioral outcomes (Q-value = 1.732, $p = .188$).

The findings suggests that distance learning appears to have a more robust effect on cognitive outcomes in comparison to affective and behavioral outcomes. Irrespective of the delivery method (online vs face-to-face), students work to meet the learning outcomes. However, according to the authors, this may not be the case in terms of affective or behavioral outcomes (Martin et al., 2022).

Conceptual, Meta-Cognitive, Procedural, and Strategic Scaffolding in Online Learning

One of the latest systematically conducted reviews of the research on online learners is the study "A Meta-Analysis of Scaffolding Effects in Online Learning in Higher Education" by Doo and colleagues published in 2020 (Doo et al., 2020). The authors examined the effects of scaffolding on learning outcomes in an online environment in higher education. Doo et al. (2020) referred to the Wood et al. (1976) definition of scaffolding which is "process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (p. 90). The authors also referred to the three features of scaffolding: (a) *contingency*, the need for an ongoing assessment of online learners' abilities with specific tasks so the instructor can provide scaffolding activities, (b) *intersubjectivity*, a temporarily shared collective understanding or common framework among online learner to easily exchange ideas, build new knowledge, and negotiate meaning, and (c) *transfer of responsibility*, encourages online learners to take responsibility for ownership of learning from those who provide scaffolding, i.e., instructor (Doo et al., 2020). The findings revealed that scaffolding in an online learning environment has a large and statistically significant effect on learning outcomes. The analysis revealed a larger effect size than did the affective and cognitive domains. Meta-cognitive scaffolding outnumbered other types of scaffolding. The authors recommended that future research include scaffolding studies published in local languages and identified specific instructional approaches that have been effective in online environments.

Following Doo et al. (2020), in this paper, we referred to Hannafin et al.'s (1999) work "Open Learning Environments: Foundations, methods, and Models" where the authors identified four types of scaffolding: a) *conceptual scaffolding* to help online learner identify essential themes and related knowledge; (b) *meta-cognitive scaffolding* to help online learners monitor and reflect on the learning process; (c) *strategic scaffolding* to help online learners locate alternative ways to work on a task; and (d) *procedural scaffolding* to help online learners use resources and tools for learning, such as providing an orientation to system functions and features.

By reviewing several studies on different types of scaffolding, Doo et al. (2020) noted that previous studies examined scaffolding strategies and found small to moderate effect size for meta-cognitive scaffolding and that the effect of scaffolding on student's cognitive learning was statistically significant (Belland et al., 2017; Kim et al., 2018). When Doo et al. (2020) conducted the meta-analysis of previous studies, they found that the effects of scaffolding on the meta-cognitive learning outcome ($g = 1.600$) were larger than the affective learning outcomes ($g = 0.672$) and cognitive learning outcomes ($g = 0.652$) (Q ($df = 2$) $= 16.493$, $p < .001$). The reason for the large effect size of Doo et al's. (2020) research may be explained by the population's characteristics, i.e., higher education. The authors' findings also support Belland et al (2017) as they find a larger effect size for scaffolded instruction with graduate students and adult learners.

Following Doo et al's (2020), we refer to the meta-cognitive learning outcomes as the "top knowledge about one's own cognitive processes of monitoring and controlling thoughts; this includes self-regulation of learner's cognitive, behavioral, and emotional goal-directed behavior during the learning process" (p.66). Doo et al. (2020) also found that meta-cognitive scaffolding ($g = 1.104$) and conceptual scaffolding ($g = 0.964$) had stronger effects on learning outcomes than did procedural scaffolding ($g = 0.393$) and strategic scaffolding ($g = .440$).

Therefore, as we can see that both Martin et al. (2022) and Doo et al. (2020) found that the affective domain of learning, i.e., emotions, motivations, values, satisfaction, and attitudes received less examination than cognitive outcomes in the reviewed studies. Studies that examined affective domain of learning (Bernard et al., 2004; Rohwer et al., 2017; Zhao et al., 2005) found that affective learning outcomes had smaller effect size than meta-cognitive learning (Doo et al., 2020). The affective domain still has less robust effects in online learning in comparison to cognitive outcomes (Martin et al., 2022). Online learners do not meet and learn in the same place and time, and this can lead to a sense of disconnectedness and feelings of isolation and loneliness (Garrison, 2007) and high attrition rate (Boston et al., 2011). That's why according to Trespalacios et al. (2021) "theorists, and researchers have demonstrated the importance of community in education" (p.6). Community and connectedness are two highly related concepts to explain online learners' feeling of belonging to one another and to others, spirit, trust, and interdependence (Trespalacios et al., 2021).

Community and Connectedness in Online Learning

Another review of the research in distance education "Qualitative Community and Connectedness in Online Higher Education: A Scoping Review of the Literature" was done by Trespalacios and colleagues in 2021. The researchers investigated the extent, range, and nature of research in community and connectedness in online higher education published from 2001 through 2018. The findings revealed that research on community and connectedness has focused on areas such as course design, technology tools, faculty, and students. They also highlighted the important role these concepts have played in the last two decades in online higher education. The researchers found that all studies were similar in identifying the intellectual growth of the class members based on their similar goals and interests as one of the important elements within the community and connectedness. The authors noted that further research is needed on the program types, technology, and course design that foster a sense of community and connectedness among online students and instructors.

Trespalacios et al. (2021) conducted a scoping review of the literature to examine community and connectedness and how studies interpreted both concepts. We follow Trespalacios and colleagues' (2021) note that a scoping review is a method used to "map the literature on a particular topic or research area and provide an opportunity to identify key concepts, gaps, types and sources of evidence to inform practice, policymakers, and research (Daudt et al., 2013, p.8). The authors found that previous studies used two frequently cited definitions of community and connectedness coined by Rovai's (2002) and McMillan and Chavis (1986). As Trespalacios et al. (2021) noted that Rovai (2002) was interested in examining community and was influenced to some degree by McMillan and Chavis work (1986). The authors proposed the following definition of community by Rovai (2002):

> A feeling that members have of belonging, a feeling that members matter to one another and to the group, that they have duties and obligations to each other and to the school, and that they possess shared expectations that members' educational needs will be met through their commitment to shared learning goals. One can, therefore, constitutively define classroom community as consisting of two components: feelings of connectedness among community members and commonality of learning expectations and goals. (Trespalacios et al., 2021, p. 12)

Strategies

To support online learners and create a sense of community and connectedness in online courses, Trespalacios et al. (2021) recommended the following strategies based on the reviewed studies:

1. Promote group activities such as social activities, extracurricular opportunities, orientation events, live synchronous sessions, and meetups in person.
2. Support membership and belonging such as cohort structure, promote a sense of identity with students' institutions.
3. Create communication opportunities such as personal introductions, frequent interactions, formal and informal discussions, online etiquette, a positive environment, and immediate feedback.
4. Structure classroom (online course) processes such as active learning, academic support, peer review and mentoring, assigned discussion roles, and required participation.

The authors also identified that more research on online discussion, role-based discussion, duration of discussion, synchronous sessions, in-person meetings, group activities, optimal levels of interaction, the establishment of mentoring relationships, and web pedagogy are needed.

Technology

To support online learners, Trespalacios et al. (2021) also noted that the effective use of information and communication technologies plays an important role to promote a sense of community and connectedness. Trespalacios et al. (2021) mentioned the following technologies: Web2.0, multimedia, discussion forums, chat tools, instant messaging, e-portfolios, email, audio feedback, online portals, e-learning systems, and course notification and communication tools.

However, more research is needed to examine Web2.0, virtual worlds, virtual field trips, multimedia, the interaction of technology and pedagogy, online portals, and learning management systems.

Students

Trespalacios et al. (2021) mentioned that research suggests that students' differences impact their sense of community and connectedness in online courses. To support online learners and promote community and connectedness, instructors should consider students' differences such as different needs, different communication and engagement preferences, cultural differences, gender differences, student interactions, student communication style, motivation, and satisfaction. More research is needed to explore students' differences such as age, gender, or culture, and examination of the relationships among variables such as community, satisfaction, cognitive learning, self-regulated learning, levels of community, motivation, and the impact on practice. It is also very important to examine different course designs to support different types of online learners.

Conclusion

These reviews of the literature shed light on important areas of research about online learners in distance education. Studies' findings were consistent in relation to the impact of online teaching and learning on cognitive learning outcomes than affective and behavioral outcomes. To enhance affective and behavioral learning outcomes in online teaching and learning, instructors need to create a sense of community and connectedness.

The scoping review conducted by Trespalacios et al. (2021) identified some examples of instructional strategies, the types of technologies, and students' characteristics to promote online community and connectedness – two interrelated concepts that can help increase retention rate and successful completion of online courses. More research is needed to examine relationships between cognitive outcomes and affective and behavioral outcomes, specifically, how different instructional strategies can be used to enhance all three types of learning outcomes (cognitive, affective and behavioral).

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Implementation Strategies for STEM Learning Using A Computer-Based Simulation

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Abstract

Educational Computer-based simulations (CBSs) can be applied to provide students with experiences they would not otherwise be able to have, given that realistic scenarios may not be possible due to expense, danger associated, or rare occurrence of the scenario (Smetana & Bell, 2012). Principles of Experiential Learning Theory (ExL) as identified by the National Society of Experiential Learning (NSEE, 1998) include intention, preparedness and planning, authenticity, reflection, orientation and training, monitoring and continuous improvement, assessment and evaluation, and acknowledgment. These principles served as a framework to develop an intervention designed to help teachers effectively implement CBSs. Using a qualitative approach, findings from a pre, post, and post-post survey and participant interviews indicate a shift in teachers' description and perception of effective implementation before and after a professional development and classroom implementation experience. The study also identified instructional strategies for implementing computer-based simulation in the classroom and goes on to describe professional development experiences to support the implementation of simulations.

Keywords: Teacher Education; Technology Integration

Introduction

Historically, simulations have been prevalent for educating students in fields such as healthcare, the military, and nuclear power to mitigate risk. In the 1960s and 1970s, computer-based simulation was restricted to high-performance computing systems. The continuously increasing capacity and reduced cost of desktop computers have made the adoption of simulations across disciplines easier (Beckett & Zalcman, n.d.). Simulations have been characterized as a model (de Jong & van Joolingen, 2008), a process (Durmaz et al., 2012), and a technique (Gaba, 2007). This study characterizes a simulation as a computer-based model and experiential.

A good deal of research has been done on the impacts of simulation on students' learning in middle school and higher education. Studies have focused on the extent to which simulations support learning, what students learn from simulations, comparisons of learning from computer simulations versus traditional laboratories, the features of simulations that lead to learning, and implementation strategies (Blikstein et al., 2016; Chen & Howard, 2010; Decker et al., 2008; Kim & Shin, 2016; National Research Council, 2012; Scalise, 2011b).

Simulations offer a constructive approach to learning where students actively interpret the external world and reflect on their interpretations. However, educators must recognize that CBSs are unintelligent and that their effective use to maximize outcomes for all students depends on effective implementation strategies. Implementation of simulations using a simply-follow-the-directions approach does not maximize educational productivity because the approach does not allow for negotiated learning with the technology and/or with others, provide for active construction of meaning, foster critical thinking, or provide for experiences that feel real and relevant to the learner (Lim, et al., 2012). In research conducted by Chen and Howard (2010), teacher presence played a positive role in student learning outcomes. Chen and Howard concluded that students' learning depends not only on how the simulation is designed and developed but also on how instructors implement them. The effective implementation of simulations requires the effort of teachers in a directed instructional manner (Foti & Ring, 2008). Hence, more research identifying effective implementation strategies is needed.

ExL principles framed our systematic literature review of implementation strategies that have been used in CBSs in the past two decades (2000 - 2020). The literature review led us to conclude that an intervention preparing teachers to apply ExL principles when implementing CBS needed to be developed and explored.

Purpose of the Study and Research Questions

Teaching approaches have evolved over the years, emphasizing different ways of learning: behavioral, and reflective. Simulations can be mindtools when they support reasoning and engage learners in critical thinking about a phenomenon while scaffolding their thinking process (Jonassen, 1998). In 1984, the constructivist theorist, David Kolb, published his theory of experiential learning, clarifying that knowledge is created through experience transformation. Kolb's theory was influenced by the works of Dewey, Lewin, and Piaget. He proposed that learning occurs when the learner experiences real-life scenarios, makes connections and reflects on those experiences. Learning and assimilation is an intentional and constructive act. The inter-relationship between teachers who are intentional with their teaching and the expectation of students and students who are given freedom is a recipe for dialectical rationality. D'Arcy (2014) claims that such an inter-relationship deploys competence in high-order interpretation of beliefs and actions to prioritize understanding of the world. Informing teachers regarding how to implement simulations effectively in classrooms can produce or improve learning outcomes and positive changes in students' abilities to think critically, computationally, and logically (Roehrig et al., 2007). This study was designed to address the following questions:

RQ1: How do middle school teachers describe effective implementation of computer-based simulation before and after a *professional development experience* covering the principles of experiential learning; and if descriptions change, in what ways?

RQ2: How do middle school teachers' perceptions about the most effective principles of experiential learning change after they experience their *classroom implementation* of computer-based simulations with middle school students?

RQ3: What perceptions do middle-school teachers have of the *influence of applying the principles of experiential learning on student engagement* when they implement computer-based simulations?

Method

The study was conducted in five different middle schools in the southwestern state of the USA. We used design-based research methods to explore the impact of an intervention preparing teachers to use the ExL model for implementing CBS in a single-subject case study (McKenney and Reeves, 2019). A single-subject case study uses a few participants to study the influence of a new procedure and participants are introduced to an intervention after baseline data is collected (McMillan, 2015).

The design-based research, Educational Design Research (EDR), consists of three main phases: Analysis and Exploration, Design and Construction, and Evaluation and Reflection. The researchers identified and defined the problem through needs assessment and literature review during the analysis and exploration phase. During the design and construction phase, the researchers explore potential solutions that can constitute an actual representation. The proposed solution to address the need is to design and construct an intervention that prepares teachers to implement CBS while applying the principles of experiential learning. After administering the intervention, in this case, professional development (PD) in ExL, phase three commenced through data collection with teachers before they participated in the professional development, during professional development, and after implementing a computer-based simulation with students.

Participants

Five middle school teachers participated as an ideal number for a qualitative case study (Creswell, 2014). From fifteen teachers who had implemented simulations for at least one semester and had experience with simulating in StarLogo Nova, an online agent-based simulation programming environment, five volunteered to participate. Participants identified as three females and two males. They have middle school teaching experience ranging between six and twenty-five years.

Instrument

Data sources included a *Pre-Teacher Perception of Implementation Survey*, *a Post-Teacher Perception of Implementation Survey*, a *Post-Post-Teacher Perception of Implementation Survey,* researcher observations and reflexive notes in a research journal, and teacher interviews. The surveys were designed and developed by researchers from data gathered during the literature review exploration during the first phase of EDR.

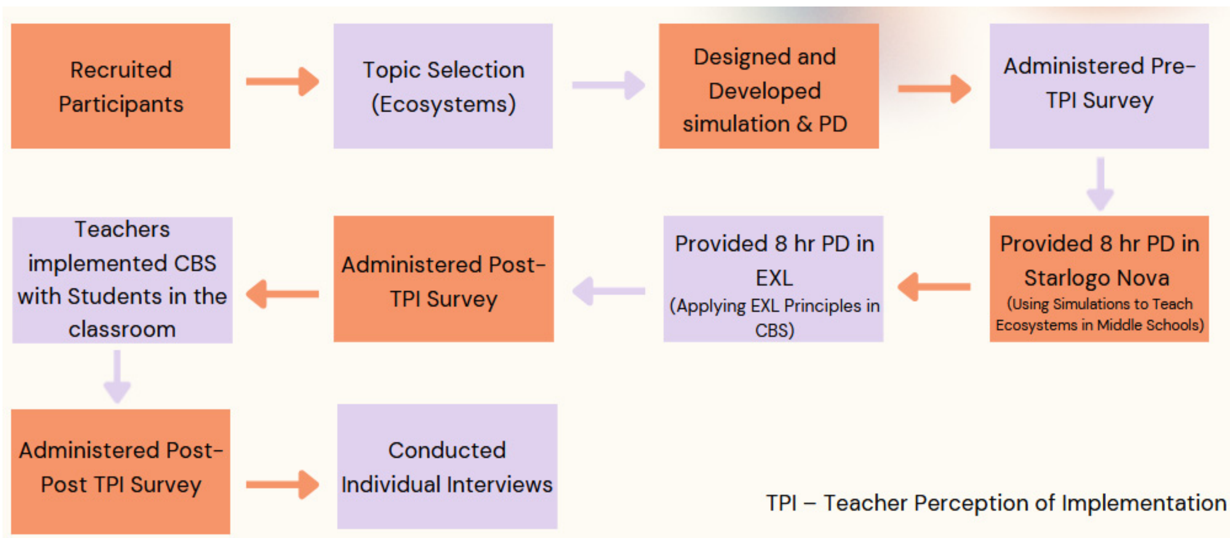
Procedure

Participants decided with the lead researcher that a simulation of ecosystems fit their curriculum. Then the researcher developed the CBS using StarLogoNova (https://www.slnova.org/) for participants to implement with their students. Next, the researcher designed the professional development intervention that embeds a scientific approach in using the simulation to teach ecosystems and the principles of ExL in explaining how to implement the CBS. The professional development administration were in two phases: the first PD supported teachers' understanding of using the simulation to teach ecosystems, and the second PD supported the application of EXL principles whiles using the simulation to teach ecosystems (See Figure 1).

Participants filled out the *Pre-Teacher Perception of Implementation Survey*, participated in the professional development intervention, filled out the *Post-Teacher Perception of*

Implementation Survey, implemented the ecosystems simulation with students in their classroom, and then completed the *Post-Post-Teacher Perception of Implementation Survey*. The lead researcher made notes in her journal about participants' processes as they implemented CBS. Then during participant interviews, the researcher took field notes which were recorded and transcribed for analysis. The researcher used descriptive and content analysis to analyze the survey data, and the framework method (Nicola et al., 2013) for analysis of the interview data and member checked to establish the trustworthiness and authenticity of the findings (Denzin & Lincoln, 2017).

Figure 1
Research Procedure



Analysis

Results from the surveys and the researcher's journal were analyzed using descriptive statistics and content analyses. Responses from the pre, post, and post-post TPI surveys were compared, and changes in participants' answers were analyzed. The researcher used the Framework Method to analyze the teacher interviews (Ritchie & Lewis, 2003) using the NVIVO qualitative data analysis software to organize and summarize data into categories and themes.

Findings

Middle school teachers perceived that by applying principles of ExL when implementing CBS, they felt high levels of organization and comfort in their teaching skills. When teachers were asked to rate their comfort level (1 being very comfortable and 5-Not at all comfortable) in teaching with the simulation before and after the intervention, all participants reported an improvement in their comfort level and teaching skills (See Table 1).

Table 1
Participants' Comfort Level Before and After Intervention

Participant ID	Pre-Comfort Level	Post-Comfort Level
1	2	1
2	4	2
4	4	2
5	5	2
6	2	1

Pre and post-surveys included a ranking order of statements that spoke to the six principles of ExL. The table below shows the mean ranking for each principle for the pre and post-survey. The results indicate that after participants have gone through the intervention and implemented the simulation with students, their perception of the value of each of the principles changed.

Table 2
Means of Survey Rankings of ExL Principles (N=5)

EXL Principle	**Pre-Survey Mean Score**	**Post Survey Mean Score**	**Diff. (Pre & Post)**	**SD (Pre & Post)**
Intention	3.40	2.57	.83	.94
Preparedness and Orientation	2.97	2.93	.04	.62
Authenticity	3.10	3.60	-0.5	1.27
Reflection and Acknowledgment	3.40	3.70	-0.3	.58
Monitoring and Continuous Improvement	3.37	3.90	-0.53	1.00
Assessment and Evaluation	4.77	4.30	0.47	.64

Post-post survey also included a ranking order (in a different order) of statements that spoke to the six principles of ExL. The table below shows the mean ranking for each principle for the post and post-post survey. The results indicate that after participants have gone through the intervention and implemented the simulation with students in the classroom, their perception of the value of each of the principles yet again changed.

Table 3
Means of Survey Rankings of ExL Principles (N=5)

EXL Principle	**Post Mean Score**	**Post-Post Mean Score**	**Diff. (Post & Post-Post Mean Score)**	**SD (Post & Post-Post)**
Intention	2.57	2.87	-0.30	.59

Preparedness and Orientation	2.93	3.90	-0.97	.90
Authenticity	3.60	2.83	0.77	.99
Reflection and Acknowledgment	3.70	3.17	0.53	.70
Monitoring and Continuous Improvement	3.90	3.73	0.17	1.76
Assessment and Evaluation	4.30	4.50	-0.20	1.45

Participants reported observable behaviors indicating students' engagement. They witnessed their participation and self-regulation, that is, their control over their own learning. According to participants, following the teachers' introductions to the simulation and directions, students were immediately engaged using the simulation tool. Teachers identified the principles that influenced and further supported students' engagement as— intention, authenticity, reflection, and monitoring and continuous improvement. They also believed that computer-based simulations by themselves promote student engagement for some students. They believed that introducing a new tool supported and encouraged some students who were technology oriented.

Other Emergent Findings

In addition to research findings that meet the objectives of the study, participants interviews revealed findings that are relevant to implementing CBS in the classroom:

- Time is a major barrier to implementing simulations in the classroom.
- Teacher attitudes towards using simulation with the principles of EXL affect classroom implementation practices and processes.
- Student attitude toward simulation affects their engagement. That is, students disengage until they start to connect with the simulation
- Dual language learners find it hard to express their reflections on their learning, leading to teachers not necessarily realizing what students have learned or not.
- Some students need to overcome an initial barrier to starting the simulation, especially if they feel they might "mess up" the simulation.

Discussion and Conclusion

The potential for using computer-based simulation in the classroom is substantial. One way to ensure the successful use of CBS is for teachers to apply implementation strategies that have been demonstrated to be effective. Teachers require both technological and pedagogical knowledge to support students as they infuse CBS with their content to meet standards while improving students' learning and engagement.

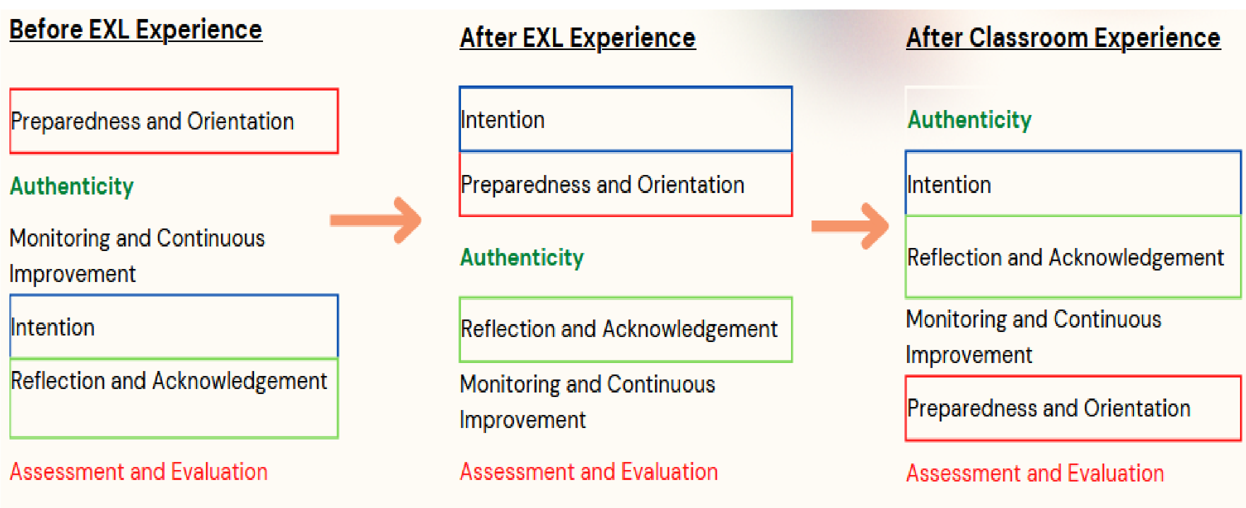
Each of the teachers expressed that all experiential learning principles are essential. However, the ranking of each principle according to the level of importance changed following professional development experiences and again following actual experience implementing the simulation with students in the classroom (See Figure 2). The teachers' survey responses before the instruction on EXL principles reflected teachers' perception that their preparedness and provision of orientation for students were most important. This is not surprising as activities related to the preparation and being experts in teacher content areas align with what is commonly emphasized in teacher preparation instruction and student teaching. Following the instruction on the principles of experiential learning, teachers identified the most important principle as having an intention. This was a dramatic shift from the fourth most important to the most important principle of experiential learning. Although having an intention also has to do with setting instructional methods that prepare the teacher for the classroom, intention and activities supporting intentions are more student-centered.

In addition to setting an intention for effective implementation, teacher interviews provided insight into other considerations. To sustain the adoption of simulations in their classrooms, teachers recommended early and continuous adoption of the simulation tool, scaffolding students' abilities to use the software, content mapping of concepts in the simulations, core standard integration, and adopting authentic simulations. Topics regarding simulation as content scaffolds have been extensively studied and addressed (Renken et al., 2016). In addition, scaffolding was relevant not only in the context of content but in learning the simulation itself. Learners need to be introduced to the simulation tool in simple incremental steps. The lack of a simplified and directed instructional manner can present an obstacle to learning and engagement.

While not declaring them as unimportant, teachers ranked assessing and evaluating students as the least important principle before and after the professional development experiences and after implementing the simulation in their classrooms. This finding is not surprising as others have also found that assessment and evaluation are frequently secondary concerns for teachers. This is also true for teachers, who conduct simulations in their classrooms (Raymond & Usherwood, 2013).

Figure 2

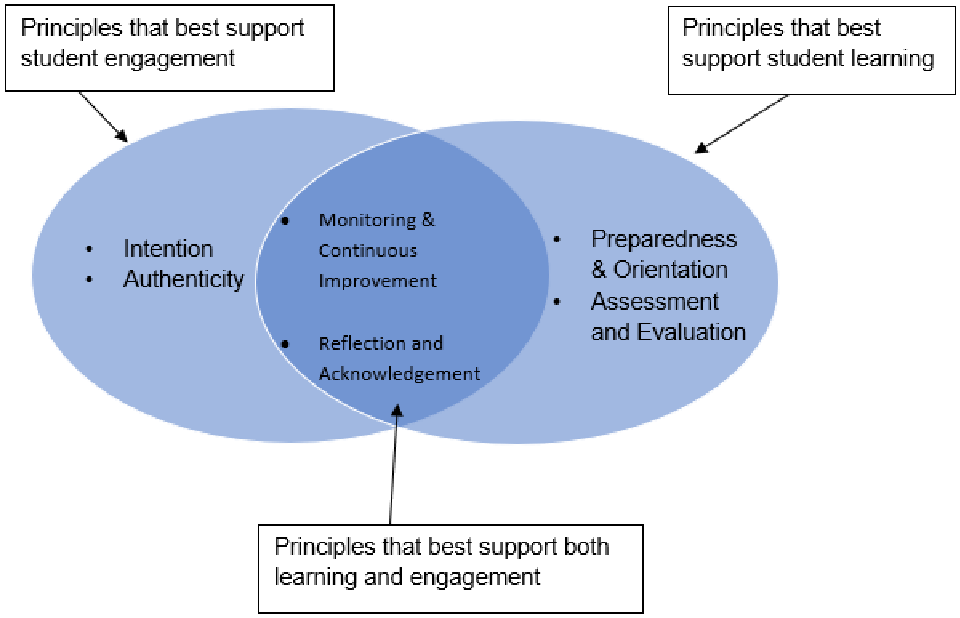
The teachers' shifting rankings of EXL principles based on their experiences



According to the teachers, the principles that best-supported engagement was Intention, Authenticity, and Monitoring and Continuous Improvement. They regarded the principles of Monitoring and Continuous Improvement, Reflection, Preparedness and Orientation, and Assessment and Evaluation as helpful when supporting students' learning using simulations (See Figure 3). Observable behaviors, emotional aspects, cognitive engagement, and self-regulation define student engagement (Fredricks et al., 2011) and teachers are an excellent judge of what engages their students in learning (Harris et al., 2022).

Figure 3

Teachers' Perceptions of EXL Principles that Best Support Learning and Engagement



This study revealed that the professional development and classroom implementation experiences resulted in a change in the teachers' views of the EXL principles as they apply to the implementation of simulations. Experiences are central to a transformative learning process for learners. However, discovering strategies that make experiences profound is difficult due to the holistic nature of learning. What we know from this study is that teachers' professional development experiences should include formal strategy or process such as EXL facilitating successful implementation in the classroom.

The study involved a small number of participants, limited time in classroom implementation, and does not explore students' perspectives on their engagement. We recommend future studies to replicate this study with a larger sample for a generalizable qualitative result, extend the research to include students' perspectives with assessments that can determine student learning and engagement, and extend the study for at least an academic year to explore the impact of the results.

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A Survey of User's Backgrounds and Experience for the Design of UX and UI of the Virtual Studio Learning Environment

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Abstract

Virtual studio environment is an online learning environment the activities of which emphasize sharing and reflecting upon ideas through both learner-learner and the learner-instructor discussions to get feedback for further improvements or learning. Virtual studio environment is where learners are allowed to learn from their mistakes through a high flexible learning and through real-life situations or problems (West, 2014; McDonald et al., 2020). Due to the ongoing COVID-19 pandemic, learning styles have been seen to adapt accordingly, resulting in more flexible learning and more online learning, especially via mobile devices. Virtual studio environment is therefore seen to answer the mentioned needs, considering the following features: (1) a space for learners' personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners' real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, and feedback for both learners and instructors. This research study aims to conduct a survey on users' backgrounds and experiences, along with the factors leading to high school learners' technology acceptance, in the hope that it can be used to promote learners' creativity in learning science. The data collection involves the questionnaires conducted among 128 high school students, including 65 female students (50.8%) and 63 male students (49.2%). The findings revealed that factors regarding perceived usefulness and perceived ease of use have an influence on the learners' attitudes towards the use, while factors regarding technology complexity and social relationship in terms of communicating and sharing ideas with others play no roles in learners' attitudes towards the use. Therefore, in the stage of designing the virtual studio environment to support learners' scientific creativity, what should be highlighted is the use of technology and tools in the activities. Moreover, it is necessary to provide the learners with the space for personal learning as well as sharing ideas in order for them to learn and do activities of their interest based upon their real-life situations. Apart from that, other important points are learning through practicing, giving feedback, and sharing ideas between learners and instructors. By addressing these aspects, learners can improve their products and ideas in the carefully designed flexible learning environment which can be accessed by different devices.

Keywords: virtual learning environment, virtual studio environment, creativity in science

Introduction

In the era of digital transformation where technology has a major role in different sectors, the Independent Committee for Education Reform (ICER) proposed a program for the education and learning reform which emphasizes digitalization, big data, and learning through online platforms to enhance ubiquitous learning, along with adjustments to accommodate the changes in 21^{st} century. Regarding the consequences of COVID-19 pandemic on education, what could be observed is the growing trend towards digital learning or online learning, the characteristic of which is that students can take control over their own learning both in synchronous and asynchronous manners (OECD, 2020). To this end, virtual learning environment is particularly advantageous in that it is flexible in terms of both time and place. It also supports collaborative learning, knowledge sharing, interactions among the learners and the instructors, as well as giving and receiving feedback (Phungsuk, Viriyavejakul, and Ratanaolarn, 2017; Khlaisang and Songkram, 2019; Aslan and Duruhan 2020; Sus et al., 2020; Shyr et al., 2021).

The virtual studio environment is an online learning environment which highlights idea sharing and reflective thinking both between the instructor and learners and among the learners themselves. It is aimed to help students to improve their performance or their learning from the given feedback. It provides the opportunity for the learners to learn from their mistakes or from real life situations (West, 2014; McDonald et al., 2020). This learning environment is particularly favored among the practitioners in the field of architecture. Nowadays, however, it is seen to be increasingly adopted in the fields other than architecture, for example, in engineering education (Thekinen and Grogan, 2021; Nespoli, Hurst, and Gero, 2021). One notable example was the study by West et al. (2021), who developed a chemistry lesson during the COIVD-19 pandemic by integrating inquiry learning and STEM education in the form of virtual studio. The study aimed to help learners to generate various solutions to the problem through collaborative synchronous and asynchronous discussions among the learners. Similarly, Loudon (2019) asserted that the obstacles to the development of learners' creativity is the fear of making mistakes. This went in accordance with the study by Walker and Kafai (2021), who applied the virtual studio environment to secondary students in their biology classes. They fostered the students' creativity and imagination by allowing them to create and present their own works, claiming that such environment focuses on designing, collaborating, presenting, giving, and receiving feedback from both their peers and their instructors.

Furthermore, the COVID-19 pandemic has driven the change of modes of instruction into online, especially through mobile devices and flexible learning approaches. Therefore, this study aims to explore the backgrounds of the users in terms of their genders, ages, learning programs, and user experience which includes equipment readiness and their experience in using technology. The key features of the virtual studio environment are (1) a space for learners' personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners' real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, feedback for both learners and instructors, and the study of relevant factors affecting the attitudes in using technology for learning. These aspects would be taken into account in order to improve the UX and UI of the virtual studio environment and to enhance learners' creativity in science learning.

Literature Reviews

Virtual studio environment

Virtual studio environment is a type of virtual learning environment which is conducted online. It encompasses learning flexibility in terms of time and place. In virtual studio environments, instructors can present information as well as design various types of activities through digital technology so that the learners can construct their knowledge and develop their skills. Similarly, what could also be emphasized is collaborative learning and learner-learner and learner-instructor interactions, both synchronous and asynchronous. In this way, the instructors could give feedback and evaluate their students' learning using various tools and techniques. The advantages of the virtual learning environment are essentially its learning flexibility, accessibility, and its emphasis on 21st century learning skills including creativity, critical thinking, collaborative working, and problem-solving skills, among others, through the exchanges of ideas and information they have found, presumably leading to higher rate of success in learning.

Virtual studio environment is the organization of both physical and social environments regarding learning and instruction. It promotes learners' interactions and learning through the exchange of ideas and reflections among learners and instructors. This space opens for learners to think, learn by doing, and reflect upon practices. The exchange of learning would lead to the learners getting the feedback to improve their work as well as their potentials to think creatively (Loudon, 2019; McDonald et al., 2020; Jones, Lotz, and Holden, 2021; Iranmanesh and Onur, 2021). The environment emphasizes exchange of ideas and the exploration of new ideas from the works or from learners' real-life situation so as to see different perspectives. The virtual studio environment consists of the following key features: (1) a space for learners' personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners' real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, feedback for both learners and instructors (Walker, Boyer, and Benson, 2019; Loudon, 2019; Fleischmann, 2020; Walker and Kafai, 2021).

Scientific creativity

The creative thinking skill is the ability to generate new ideas, new possibilities, or inventions, which could be in the form of works or even abstract ideas. It consists of two key components, namely novelty and appropriateness (Gu, Dijksterhuis, and Ritter, 2019; Sun, Wang, and Wegerif, 2020; Ozkan and Umdu Topsakal, 2021; Koc and Buyuk, 2021). As for scientific creativity, it encompasses creative thinking in the contexts specifically relating to science (Wiyanto and Hidayah, 2021; Yildiz and Guler Yildiz, 2021). It is considered essential competency for future innovation and sustainability (Aschauer, Haim, and Weber, 2021). Hu and Adey (2002) claimed that scientific creativity is different from creativity in the general sense in that it involves creativity in science experiments, creative science problem finding and solving, and creative science activities. Scientific creativity is the ability which could be affected by a number of non-intellectual factors. It is known to rely on science knowledge and skills. Moreover, Dwikoranto et al. (2020) asserted that scientific creativity is the ability to generate ideas, concepts, or new products which are relevant to the context, by means of scientific methods. Likewise, Sun, Wang, and Wegerif (2020) maintained that scientific creativity is necessary for science in order to find new problems and solve them with new solutions which could be new ideas or methods. Scientific creativity consists of the following elements: (1) the ability to generate various creative ideas, which entails fluency, flexibility, and original thinking, known as divergent thinking, and (2) the ability to locate the problems and achieve appropriate solutions through analysis and synthesis, which is termed convergent thinking (Yang et al., 2019; Oh, 2021; Wiyanto and Hidayah, 2021; Atesgoz and Sak, 2021; Zhou, 2021).

Objectives

1. To study the backgrounds, namely genders, academic achievements, programs, and experiences in using technology in upper secondary levels in order to develop virtual studio environment to improve learners' scientific creativity
2. To study the effects of user experience, namely technology usage, perceived usefulness, perceived ease of use, technology complexity, and social relationship on the attitudes towards uses of learning technology to use as guidelines for designing virtual studio environments for further improvements of scientific creativity.

Methodology

This study explores the users' background, experience, and other factors that could affect attitudes towards the use of learning technology in order to find the guidelines for designing virtual studio environment to enhance learners' scientific creativity.

Population and sample

The population of the study is the upper-secondary school students in both public and private schools under the supervision of the Office of Basic Education Commission. The sample of the study consists of 128 upper-secondary school students, with 65 female students (50.8%) and 63 male students (49.2%). The number of the students who were studying in grade 10 was 23 (18%), while for grade 11 and grade 12 the numbers were 42 (32.8%) and 63 (49.2%) respectively. The average age of the students was 17 years old (SD = .969). The number of students in science-mathematics program was 103 (80.65%), which was considered the majority of the samples. The number of the students who were in the arts-mathematics and arts-languages was 25 (19.5%). The majority of the students, 91 students (71.1%), had the average grades in the range of 3.51-4.00. Following this were 28 students (21.9%), whose average grades were in the range of 3.01-3.5. The data derived from the surveys using quota sampling method among public and private schools.

Research Instruments

The instruments in this study are the survey of user experience about virtual studio environment for the improvement of scientific creativity among upper-secondary students. The survey consists of two sections. The first section investigates general information of the respondents of this survey. It is divided into sections according to the features of virtual studio environments: (1) a space for learners' personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners' real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, feedback for learners, instructors, and learning activities designed to promote scientific creativity. The second section is the study of technology acceptance in teaching and learning, consisting of perceived usefulness, perceived ease of use, technology complexity, social relationships, and attitude towards use, adopting a 5-point rating scale.

Data analysis

Data analysis employed percentage, average, and standard deviation to describe the general information and user experience. Multiple regression was employed to analyze the factors which affect the technology acceptance in learning and teaching.

Results

The results of this study consist of three sections: (1) experience in using technology, (2) technological tools in managing virtual studio environments to enhance learners' scientific creativity, and (3) factors affecting technology acceptance.

Experience in using technology

The results reveal that most of the learners (74.4%) owned a computer, 84.5% of which could get access to the Internet. One hundred percent of the learners could get access to the Internet via their smartphone. In regard to tablets, about 70.5% of the learners did not have their own tablets. The operating system of the majority of the tablets/smartphones is android (58.1%) while the percentage is 52.7 for iOS.

In regard to the experience in using computers, most of the learners had more than 10-year experience (60.5%), followed by those who had 7–10-year experience in using computers (12.3%). As for the experience in using tablets and smartphones, it is found that most of the learners had 7–10-year experience (82.4%), followed by those with 4–6-year experience (8.8%). For the experience in using the Internet, 70.2% of the learners had 7–10-year experience, followed by 15.8%, which was the percentage of the learners who had over 10-year experience of using the Internet.

As for the ability to use applications, according to Figure 1, it is found that the majority of the learners (99.1%) could use social media applications, followed by those who could use search engines (95.6%), and those who use the learning management systems such as Google classroom, MOOC, Moodle (90.4%), respectively. In regard to online learning tools, learning management systems were found to be with the highest percentage of users (94.7%), followed by social media (64%) and websites (53.5%) respectively, according to Figure 2.

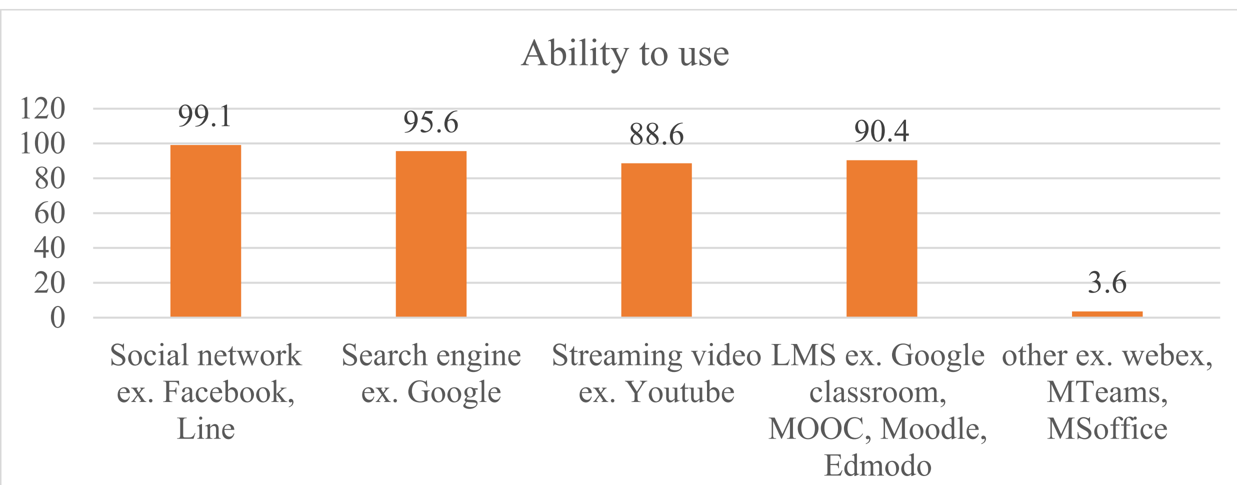

Figure 1. Ability to use technology

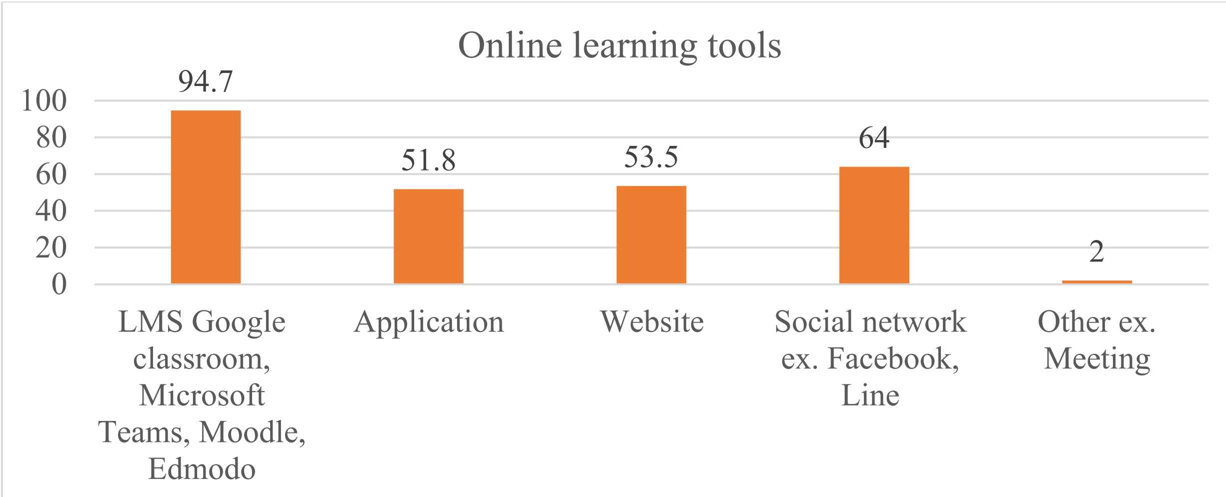

Figure 2. Online learning tools during COVID-19 Pandemic

Technological tools in organizing virtual studio environments to enhance learners' scientific creativity

The technological tools in organizing virtual studio environments to enhance learners' scientific creativity could be categorized according to different learning environments of the virtual studio. (1) a space for learners' personal learning or activities: The findings revealed that the most suitable tool is the search engine, namely Google (73.7%), followed by cloud technology (58.8%), video streaming (53.5%), and blog writing as a way to summarize their own learning (28.9%), respectively. (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas: The most suitable tool in providing such space is video conference such as Google Meet, Microsoft Teams, or Zoom (78.1%), followed by modes of personal communication among learners or between learners and instructors, such as chat applications (71.9%), and platforms for idea sharing among learners or between learners and instructors, such as discussion boards or other ways to give public comments (54.4%). Apart from this, it was found that virtual studio environment also employed the tools for brainstorming, metaverse, and VRChat. (3) learning activities based on learners' real-life situations: The most suitable tool is social media (79.8%), followed by search engines (72.8%), and brainstorming tools (43%), respectively. (4) a space for learners to showcase their works: The most suitable tool is the tools for students to create their works, such as Canva, Video maker, 3D, VR, and AR (78.1%), followed by video conference, such as Google Meet, Microsoft Teams, and Zoom (71.1%), and presentation tools, such as social media and Pinterest (69.3%), respectively. (5) evaluation, reflection, feedback for both learners and instructors: The most suitable tool is modes of personal communication among learners or between learners and instructors, such as chat applications (77.2%), followed by platforms for idea sharing among learners or between learners and instructors, such as discussion boards or other ways to give public comments (64%), and the like and share buttons to support or share the works (45.6%), respectively.

The other aspect is learning activities which supported scientific creativity. According to the results from the section in which the learners are asked to prioritize different activities, the learners placed the ability to choose to work on the topic of their interest as their priority. The second rank was the involvement in the activities and practices. The flexibility in terms of time and places in learning was the third rank. The fourth was getting feedback during the learning activities, followed by cooperative working, which was the fifth rank.

Factors of technology acceptance among learners

Factors of technology acceptance consist of (1) perceived usefulness, with an average of 3.09 (SD = .850), (2) perceived ease of use, with an average of 3.48 (SD = .923), (3) technology complexity, with an average of 3.53 (SD = .882), (4) social relationships, with an average of 3.47 (SD = .661) and (5) attitudes towards use, with an average of 2.78 (SD = .971).

By studying the factors of technology acceptance through stepwise multiple regression analysis, including perceived usefulness, perceived ease of use, technology complexity, social relationships, and attitudes towards use of learning technologies among upper-secondary learners, two models were constructed. The first model suggested that perceived usefulness affected attitudes towards the use of learning technology among the learners at the significance level of .05. To illustrate, perceived usefulness had the greatest impact on attitudes towards uses (Beta = .710) and can be used to predict the attitudes for 50.5%. The second model suggested that perceived usefulness and perceived ease of use had an impact on attitudes towards uses of learning technology among the learners at the significance level of .05. Perceived usefulness was found to have the greatest impact on attitudes towards use (Beta = .547) and could be used to predict such attitudes for 56.3%. Further details are shown in the Table 1 below.

Table 1. Stepwise multiple regression

	Perceived Usefulness	**Perceived ease of use**	**Constant**	**R^2**	**Adjusted R^2**	**F-value**
Model 1	.710* (.076)		.349	.505	.500	106.973
Model 2	.547* (.087)	.291* (.081)	-.157	.563	.554	66.913

N = 128; p < .05

The results of the stepwise multiple regression could form the following prediction equations for the attitudes towards uses of the learning technology.

Model 1: Attitudes towards use = .349 + (.785) (perceived usefulness)

Model 2: Attitudes towards uses = -.157 + (.605) (perceived usefulness) + (.302) (perceived ease of use)

Discussion

In regard to the experience in using the technology, it was found that most of the learners had their own computers which can connect to the Internet. Moreover, the learners were found to have personal smartphones. Considering the duration of experience, the result shows that most of the learners had more than 10-year experience in using computers and 7-10-year experience in using smartphones, tablets, and/or the Internet. Turning to the ability to use the applications, during the COVID-19 pandemic, it was shown that most of the learners relied on social media, search engines, and learning management systems. In this respect, Bawack and Kala Kamdjoug (2020) stated that factors pertaining to the economic status and support from the family play an important role in the difference in terms of user experience in using learning technology. Therefore, throughout the process of designing virtual studio environments, it is necessary to take into account the readiness of technology uses among learners. In particular, such learning environments should emphasize the accessibility via different types of technological devices such as laptops, tablets, and smartphones. It is also crucial to consider the designs, operations, controls, and optimization to create user-friendly interface. This went in accordance with Cardona-Reyes et al. (2021) who claimed that studying UX and UI would improve the effectiveness and understanding of learning activities among learners, especially in the learning environment during the pandemic.

Technological tools used in virtual studio environment to enhance scientific creativity among learners can be categorized according to different elements of virtual studio environments. (1) A space for learners' personal learning or activities involves such tools as search engines, cloud technology, video streaming, and blog writing as a means to summarize their own learning. For (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, the suggested tools are video conference, personal communication among learners or between learners and instructors, such as chat applications, platforms for idea sharing among learners or between learners and instructors, such as discussion boards or other ways to give public comments, as well as the tools for brainstorming, metaverse, and VRChat. For (3) learning activities based on learners' real-life situations, this study suggests social media, search engines, and tools for brainstorming. The fourth aspect is (4) a space for learners to showcase their works. The suggested tools are the platforms for the learners to create their works, such as Canva, Video maker, 3D, VR, and AR, as well as video conference and presentation tools. The last element is (5) evaluation, reflection, feedback for learners, instructors, and learning activities designed to promote scientific creativity. The suggested tools for the fifth aspect are chat applications, discussion boards or other ways to give public comments, along with the like and share buttons to support or share the works. It can be seen that among the lists of the technological tools used to support scientific creativity in such environments, there are tools which support personal learning and those which are suitable for collaborative learning, and the tools which promote idea sharing and giving feedback throughout the learning process. This was supported by Walker, Boyer, and Benson (2019), who claimed that virtual studio environments could promote creativity and innovations among learners through receiving feedback during their learning which could be used for further development of their work or designs. And through presentation sessions and further research, learners can learn from other presented works, reflect upon their own work, and apply the insights to their own works. These are regarded as ways of learning through interacting with others in the space specially designed for knowledge sharing, presentation, and learner-learner and learner-instructor interactions. Nespoli, Hurst, and Gero (2021) explained that virtual studio environments feature flexibility in both personal and collaborative learning, with instructors functioning as a mentor throughout the learning process.

According to the results from the session in which the learners were asked to prioritize different aspects of the activity, it was found that the learners prioritize the ability to choose the topic of their interest, followed by the participation and involvement in the activities. The third rank went to the flexibility in terms of time and place in learning, while receiving feedback during the learning process was ranked at the fourth place, and collaboration at the fifth. This is in accordance with Fleischmann (2020, who claimed that virtual studio environments place emphasis on interaction, reflection, and idea sharing among learners and instructors, by preparing the open space for learners to think, learn by doing, and reflect upon practices. The exchange of learning would lead to the learners getting the feedback to improve their work as well as their potentials to think creatively based on their interests (Chittum et al., 2017; Loudon, 2019; Iranmanesh and Onur, 2021).

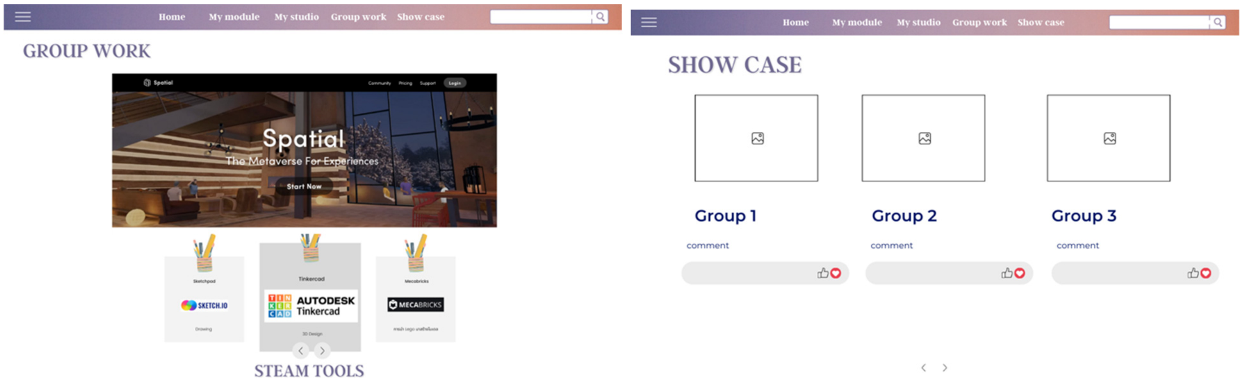

Figure 3. Wireframe of Virtual studio

Turning to the factors which affected the technology acceptance, the result shows that perceived usefulness and perceived ease of use affect learners' attitudes towards uses. However, factors relating to technology complexity and social relationships have no effect on learners' attitudes towards uses, which implies that the learners are ready to use or learn new technologies despite possible complexity in usage. This is also supported by Huang, Teo, and Guo (2021), who studied the complexity when bringing learning technology to an online English lesson. In that study, technology complexity did not affect the perceived ease of use or attitudes towards use. Therefore, when designing the user experience and user interface, what should be emphasized are the space for learners' personal learning, the accessibility to the learning activities, as well as personalized learning. Learners should also be allowed to choose the topic in which they are interested. Such topics should be based on real-life situations, allowing them to plan for and engage in their own learning, in order to foster their scientific creativity.

Summary

In the process of designing the virtual studio environment to promote scientific creativity of the learners, it is important to pay attention to technological tools to be used in the learning activities as well as the space for personal and collaborative learning. It should allow the students to choose the topic of their interest, which should be based upon real-life scenarios. The learners should be encouraged to learn through practice, feedback, and knowledge sharing between learners and instructors. These would ultimately get the students to finetune their own works or concepts. Further aspect to emphasize includes the accessibility to the environment through different types of devices and the flexibility in learning.

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A tool for measuring student skills in a successful entrepreneurship curriculum

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Abstract

This study describes a partnership to teach the Startup Generation entrepreneurship curriculum while measuring the growth of 21st century workforce skills. We use a framework that has proven useful in numerous studies (Hixson, Ravitz & Whisman, 2014) and provide a factor analysis with evidence supporting more recently developed student measures. Analysis of outcomes and processes suggests the curriculum provides meaningful learning opportunities, the measurement tools are helpful, and interactive dashboards can support more effective coaching.

Program Overview

Startup Generation employs a project-based and deliverables-based methodology that creates conditions for participants to learn entrepreneurial start-up skills. It is designed for middle school, high school, adult learners, or people outside of school to open doors to higher education and employability. Students learn advantageous skills for ideation, project/product development, research, team-building, collaboration, networking and presentation skills. These are skills valued by schools, universities and employers.

The curriculum transitions from simulations and games to real-world entrepreneurial tasks. Learners form teams to build early-stage businesses based on best practices and gain support from a network of seasoned entrepreneurs. The curriculum, completed in one semester, is facilitated by trained coaches and is available in both face-to-face and remote formats, currently in Google Classroom with a Canvas implementation under development.

Teams complete “deliverables” (e.g., a Founders Agreement, a Market Validation Report) and move through essential steps for launching a new product or service, such as market research, prototype development, product testing, marketing strategies, and financing. This culminates with a business proposal “pitch” to a panel of local entrepreneurs and business owners. Some prize money of ~$500 is available for winning teams and participants can decide to pursue their new venture or use what they’ve learned in their career development.

Program facilitators learn to deliver the curriculum using the same hands-on methods, led by Startup Generation leaders, in a sped-up version of the curriculum that includes forming teams, creating business ideas, conducting market research, designing prototypes, developing business models, and delivering an investor pitch. During program delivery, these facilitators (or coaches) participate in weekly online support meetings with Startup Generation leaders. Weekly meetings are informed by data-driven, participant self-reflections built around a validated framework of workforce skills and opportunities for peer check-ins, reflection and coaching.

Coaches and teams are working in creative ways to address learner needs and manage cases to promote workforce readiness in hard-to-serve, low-income populations in New Mexico. The program is currently running for its fourth cohort with early results presented to the Eastern New Mexico Workforce Board (Ravitz, 2020) and results shared with The Forum of the National Workforce Board (Serim & Elias, 2022).

A proven measurement framework for workforce skills

Measures used in Startup Generation use a pre-post student survey built on survey measures created by the lead author for the West Virginia Department of Education (Hixson, Ravitz & Whisman, 2012). The teacher skills survey, as self-published by Ravitz (2014), has become a #1 search result in Google and it has been widely replicated in Europe (Bray & Bauer, 2017), Canada (Sinay, Resendes & Graikinis, 2015); Philippines (Tindowen, Bassig, & Cagurangan, 2017) and many other locales.

> *"This teacher survey is available for re-use in studies of 21st century teaching and learning. It has demonstrated excellent reliability, improving on reliable measures from previous studies (std. alpha > .90, inter-item correlations > .58). Support for content validity is based on a review of existing frameworks and measures. Support for concurrent validity includes strong relationships to time spent using project-based learning" (Ravitz, 2014).*

The new student survey represents a long-awaited departure, with items revised based on earlier analyses, rewritten for easier reading level, and updated to represent more relevant practices. In order to use it with New Mexico educators, students and parents the survey was re-written for easier comprehension and translated into Spanish for use in piloting "datacasting" solutions to lack of broadband access (Ravitz, 2022).

As in the teacher study, the focus is on understanding and identifying "opportunities to learn" based on well-understood framework of 8 skills : critical thinking (CT), collaboration (CO), communication (CM), creativity & innovation (CR), self-direction (SD), global cultural connections (GC), local connections (LC), and using technology for learning (UT) – with increasing emphasis being paid to whether learners claim they have evidence of these skills.

Methods

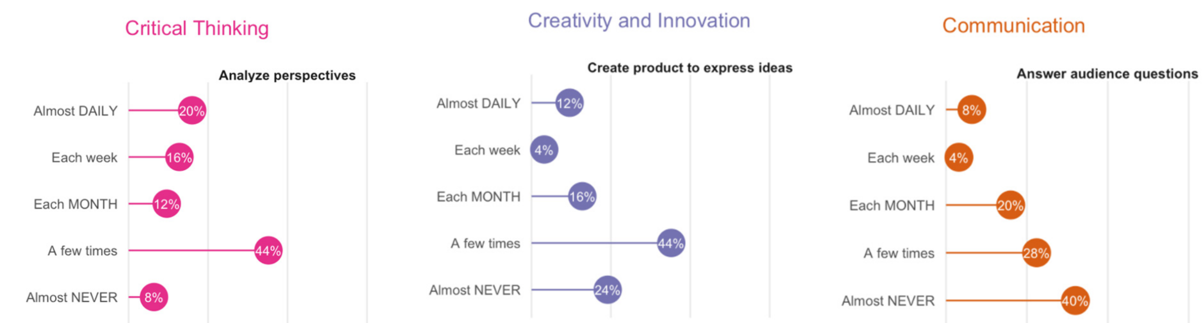
The student start of program self-reflection (pre-survey) marks each learner's official entry into the program, effectively guaranteeing a 100% response rate. This was completed by 26 students in the Fall 2021 cohort (Aug - Dec 2021), with a course completion rate of 77% (N=20). The post-survey response rate was 70% (N=14).

For the factor analysis, below, we increased the number of cases by utilizing data from two earlier cohorts and coaches courses, both pre- and post-surveys. This produced a total of N=81 responses representing pre (N=63) and post (N=18) surveys. These data were used to produce principal component (PCA) scores via a regression strategy, varimax rotation, and pairwise replacement of missing values (defaults for "principal" in R-psych package, 11/30/21).

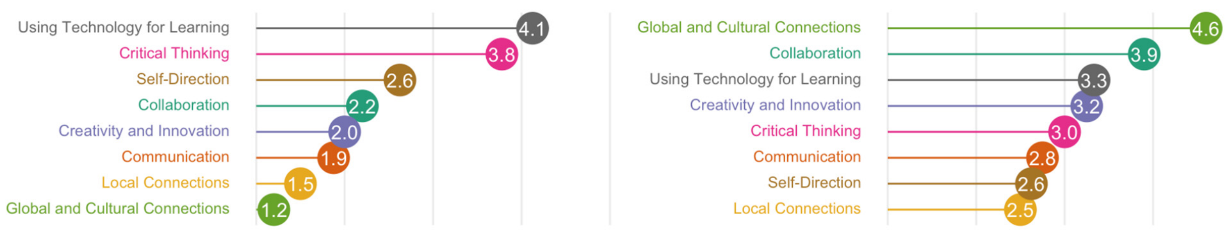
Results

The pre-survey has proven useful to Startup Generation and coaches, because it provides information on group responses and individual profiles. The following are screenshots of the pre-survey dashboard output that each coach sees. Guidance to coaches include several specific suggestions – such as giving those with less experience explicit encouragement or providing low-risk opportunities to exercise skills.

Group Responses



Individual Profiles

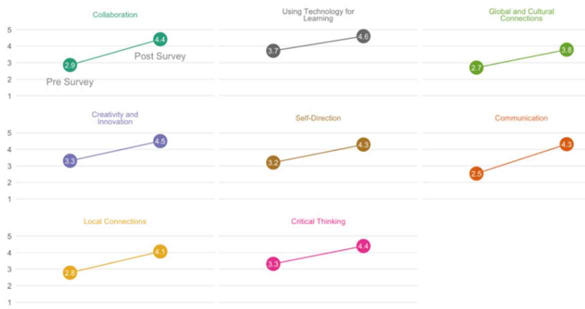


The spreading out of students (individual profiles, above) for different skills suggests that there is not just a positive response bias and, in fact, the measures are effectively allowing students to reflect on differences in experiences, opportunities to learn, and their likelihood of having evidence of their skills.

Pre-Post Scores

The post-survey as an indicator of change over time has been particularly useful for funders and the program, because it highlights growth in skills overall. To help interpret average score gains, the tool for accessing these data includes pre-post "diverging lollipop" charts that allows easy calculation of differences. Pre-post changes for individual items and learners are available in the coach and program dashboards (as shown in Ravitz, Bakhshaei, Hardy & Seylar, 2020), while overall gains are provided to funders, as highlighted seen for two recent cohorts below.

Spring 2021 (N=12)



Fall 2021 (N=14)

To illustrate these results, the findings for Fall 2021 Startup Generation reveal that the proportion reporting they had learned collaboration skills to "a very great extent" jumped from 5% to 55%, while those reporting having evidence of collaboration skills "to a great extent" increased from 10% to 82%. Similarly, the proportion who said they had learned creativity and innovation skills "to a very great extent" increased substantially from 7% to 67%. For opportunities to learn communication skills, those who said they conveyed ideas in forms other than writing "almost daily" increased from 4% to 58%.

In addition to these pre-post survey results, coaches in Startup Generation utilize four (4) check-in surveys that allow reflection on team functioning, challenges, accomplishments, and use of the skills at key points in the curriculum for each skill (e.g., collaboration after team formation). Based on informal conversations with coaches in weekly meetings, learner responses in these team check-ins have closely reflected what they were seeing in their class interactions. Having these data has prompted rich discussions of ways to support teams and learners better and are used by coaches to support assessments of students (and badging) on course completion.

Factor Analysis

A key result of this work is a student survey for identifying skills. The ability to spread students out and respond to treatment indicates that the measures are serving their purpose. The factor analysis more specifically addresses the measurement qualities of the new instrument and the relative independence of each skill as an aggregate measure or construct. These analyses suggest the student version may effectively measure distinct skills, even more cleanly than the widely-used teacher version which showed areas of overlap in the first "4C" skills (Hixson, Ravitz & Whisman, 2012, p. 63).

For the new student survey, scree plot and principal components loadings seemed to confirm measures of up to 7 distinct skills, very nearly as expected. The largely as-predicted factor loadings had only a few exceptions. Specifically, the Self-Direction items were most closely associated with the set of Critical Thinking items, and two Creativity and Innovation items loaded more strongly with Using Technology for Learning. These results are summarized here, and shown in detail in the Appendix below.

All Items Loaded Together on the same Factor

- Critical Thinking
- Collaboration
- Communication
- Global Connections
- Local Connections
- Using Technology for Learning

All Items Loaded Together, except 2

- Creativity and Innovation (except 2 loaded with Using Technology for Learning)

Not Loading Together

- Self-Direction (5 with Critical Thinking, 1 with Collaboration, 1 alone)

Limitations

There are some limitations to these analyses that future research might address. As with the teacher survey, there may be potential bias in how the survey presents each set of skills. These are listed as a distinct set of learning opportunities. However, failures to predict how a few items perform (like self-direction or items in the teacher study) suggest this pattern of presenting questions is not overly deterministic.

A more serious concern is that the number of cases is small for such a complex model, and using responses from people who answered both pre-and post-surveys could inflate reliability. Despite these issues, confidence in use is building as results are appearing to be valid and useful across several cohorts and replications including Ravitz (2022) and through the combining of data from several Startup Generation cohorts here.

The factor analyses did not include items about perceptions of skills (tried to learn, learned, or have evidence). The analyses focused on the frequency of learning opportunities, but our attention is turning more and more to where evidence of learning is being claimed (by learners, teachers or even parents) as a result. This gives visibility not just to who has engaged in learning, but what evidence of skills can be investigated, assessed, and shared for learning purposes.

Discussion

The results strongly support continued use of these measures. Even the individual items that are less well-aligned with others (including for self-direction), can still carry qualitative meaning and prove worthwhile if they provide a key part of the picture (as the potential value of a single item is discussed by Ravitz, 2002). The combination of items and how they correlate to each other (reflected in the varied factor loadings) can also promote new understandings and conversations. Certainly there is potential for streamlining further and having fewer measures drawing from these items.

What is especially useful for research and measurement purposes, however, is the overall confirmation that the items, by and large, correlate as expected with each other. Based on these results, with past performance never being a guarantee, these measures are very likely to provide reliable and robust measures, in fact for all 8 skills. Even though as not distinct from critical thinking as we would like, the self-direction items still loaded together with each other and are all reasonably strongly correlated. In short, the student measures have shown themselves to be at least as reliable and valid as the teacher measures, which have been used to generate findings in many dozens of studies.

Another strength shared with the teacher survey is that technology is not a requirement for exercising any of the skills, except the last – Using Technology for Learning. This is different from technology-focused studies that have effectively used the same framework as a starting point, but set these in the context of technology applications only (Bakhshaei, Hardy, Ravitz & Seylar, 2020; Ravitz, Bakhshaei, Hardy & Seylar, 2020). Particularly in the New Mexico setting, where limited access to technology is often a substantial barrier to learning already (Ravitz, 2022), requiring technology use to demonstrate these skills would not honor what students actually know as called for by anti-racist assessment scholars (e.g., Sul, 2019).

Conclusion

Due to the heavy engagement exhibited by those who complete Startup Generation, there is no guarantee results like those we see in Startup Generation will apply in other contexts. However, the measurement qualities of the instrument are likely to remain strong and the value of the dashboards – for understanding the experiences of individual learners and groups, and making their learning of skills more visible – is only beginning to be explored. Overall, the results are very encouraging for the continued use of the student measures by teachers, programs and funders. Coupled with real-time access for teachers, coaches and staff, having a dashboard of learning experiences and perceptions of learning outcomes for each skill offers a useful tool for further development and study.

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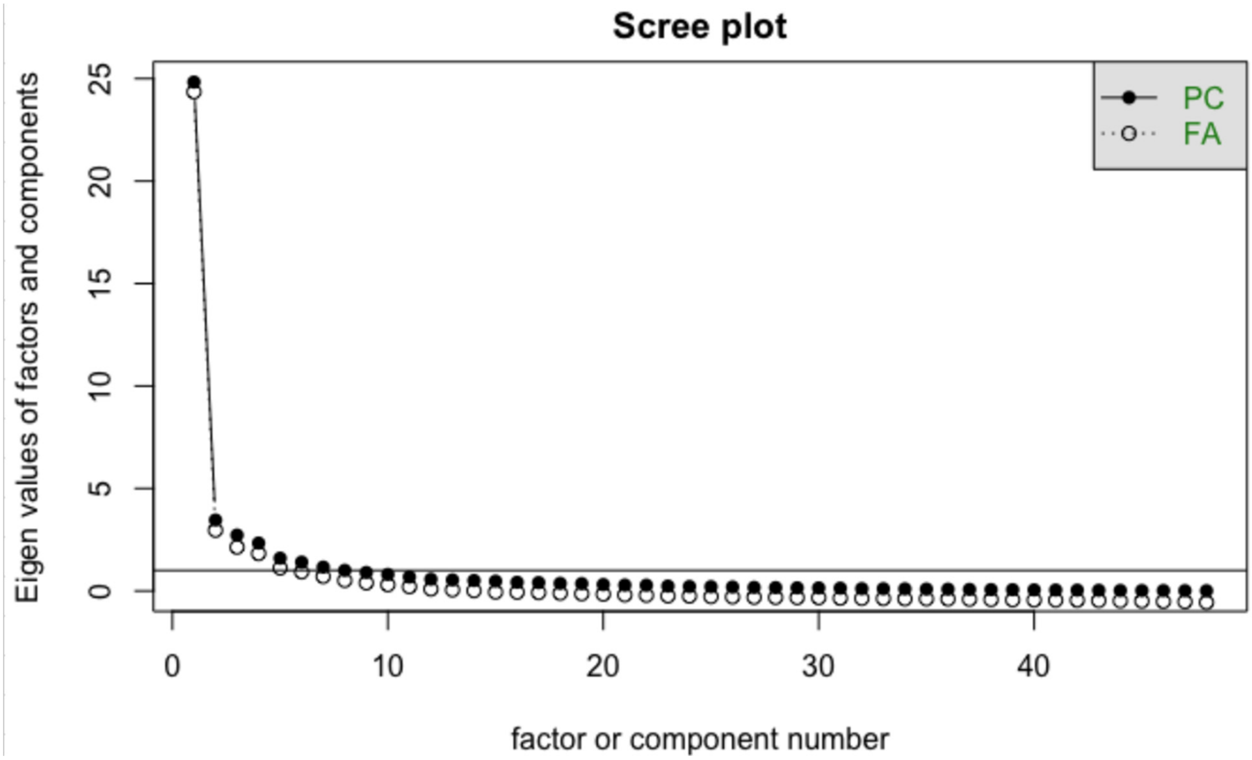
Appendices

Appendix A. Scree Plot for Practices Items (Student Version, Opportunity to Learn)



Appendix B. Factor Analysis of Student Skills Survey

How often did you...	1:Using Tech (UT + 2 CR)	2:Collaboration (CO + 1 SD)	3:Global/ Cultura Connect GC)	4:Critical Thinking (CT + SD)	5:Local Connect (LC)	6:Communication (CM)	7:Creativity and Innovation (CR)	8:Self-Direction (1 SD)
UT2.select.tech	**.83**	.17	.16	.29	.17	.09	.21	-.02
UT1.self.instructional	**.78**	.08	-.03	.20	.03	.25	.11	.11
UT5.share.multimedia	**.78**	.00	.23	.23	.26	.18	.13	.06
UT8.tech.for.tracking	**.77**	.38	.14	.17	.14	.01	.08	.10
UT4.use.tech.to.analyze	**.73**	.07	.20	.31	.31	.13	.15	.17
UT6.online.team.tools	**.72**	.31	.18	.12	.32	.19	.00	.06
UT3.evaluate.tech	**.68**	.15	.31	.26	.19	.08	.35	.06
UT7.tech.interactions	**.51**	.36	.23	.08	**.42**	**.46**	.00	-.01
CR2.generate.solutions	**.51**	.04	.26	.25	.15	.34	**.42**	.01
CR1.idea.creation	**.49**	.11	.31	.38	.26	.15	**.41**	.34
CR4.invent.new.ways	.37	.34	.20	.25	.19	.17	**.67**	.13
CR3.test.ideas	**.42**	.27	.30	.19	.16	.21	**.65**	.05
CR5.create.something	.28	.33	.24	.19	.19	.26	**.55**	.11
CO1.pair.work	.25	**.85**	.12	.17	.14	.16	.10	-.02
CO2.make.team.work	.22	**.78**	.09	.20	.26	.14	.16	-.02
CO6.give.feedback	.06	**.74**	.35	.21	.24	.20	.03	.21
CO5.use.feedback.team	.20	**.73**	.28	.06	.27	.27	.16	.10
CO3.create	.05	**.70**	.06	.12	.37	.34	.12	.07
CO4.present.group.work	.02	**.66**	.12	.11	.26	**.45**	.18	-.01
SD7.use.feedback.self *	.30	**.62**	.21	.17	.04	.13	.06	**.53**
GC5.study.geography	.07	.19	**.83**	.05	.20	.19	.06	.09
GC6.connect.issues	.16	.11	**.83**	.13	.23	.16	.02	.04
GC4.understand	.20	.16	**.80**	.16	.12	.06	.20	.18
GC2.use.info	.17	.18	**.78**	.23	.12	.11	.22	.09
GC1.study.countries	.14	.19	**.76**	.18	.08	.20	.04	-.03
GC3.discuss.topics	.13	.04	**.76**	.19	.19	.09	.13	.02

Continued on the next page…

Appendix B. Factor Analysis of Student Skills Survey (continued…)

How often did you...	**1:Using Tech (UT + 2 CR)**	**2:Collaboration (CO + 1 SD)**	**3:Global/ Cultural Connect (GC)**	**4:Critical Thinking (CT + SD)**	**5:Local Connect (LC)**	**6:Communication (CM)**	**7:Creativity and Innovation (CR)**	**8:Self-Direction (1 SD)**
CT4.analyze	.26	.26	.26	**.78**	.16	.03	.18	-.01
CT2.draw.conclusions	.23	-.02	.11	**.78**	.07	.25	.12	.23
CT3.summarize	.35	.21	.30	**.75**	.10	.11	-.06	-.09
CT5.develop	.30	.27	.18	**.72**	.19	.09	.29	-.11
CT1.compare	.10	.14	.08	**.70**	.10	.30	-.01	.33
CT6.solve	.36	.21	.18	**.58**	-.02	**.41**	.21	-.14
SD6.assess.own.work	.21	.30	.18	**.50**	.36	.21	.20	.41
SD1.take.initiative	.28	.14	.32	**.49**	.24	.25	.38	.17
SD2.choose.topic	.21	.01	.36	**.46**	.11	.30	.31	.39
SD4.choose.examples	**.41**	.16	.26	**.46**	.39	.17	.09	.33
SD5.monitor.self	.31	.17	.25	**.45**	**.41**	.34	.13	.30
SD3.plan.for.self	.31	.12	.25	**.40**	**.40**	.08	.29	**.49**
LC2.apply.learning	.23	.19	.20	.23	**.74**	.11	.11	.04
LC3.talk.to	.20	.39	.20	.15	**.73**	.27	.02	.09
LC4.analyze	.24	**.45**	.26	.09	**.70**	.14	.12	.03
LC5.weigh	.26	.32	.22	.05	**.70**	.23	.17	.06
LC1.investigate	.27	.25	.32	.13	**.61**	.04	.15	.08
CM3.prepare	.14	.29	.16	.25	.19	**.72**	.24	-.06
CM4.answer	.28	.27	.24	.22	.19	**.71**	.10	-.04
CM5.decide	.25	.24	.31	.17	.16	**.71**	.03	.08
CM1.structure	.16	.34	.12	.21	.12	**.69**	.18	.30
CM2.convey	.11	.31	.17	.28	.14	**.62**	**.40**	.09

Note. Loadings of .40 or higher are bolded to assist with interpretation.

How does disruption disrupt award-winning faculty's instructional decision-making?

Zeenar Salim[1] & Dr. Tiffany A. Koszalka[2]

Shortened Abstract:

Abstract

Covid-19 disruption fueled the frequency of instructional decisions. Our study found that faculty embraced online tools to deliver instruction when left without a choice. While justifying instructional decisions, faculty reported choosing the strategies that best reflected their instructional principles and capitalizing on their technological repertoire, instead of changing their instructional principles, strategies, and tools completely or seeking additional help. Recommendations for faculty development are shared.

Introduction and Background

Instruction is a purposeful and systematically planned sequence of events intended to address a performance gap, defined as a lack of skills and/or knowledge. Instruction includes "all the events that may have a direct effect on human learning of a human being, not just those set in motion by an individual who is a teacher" (p. 3) (Gagne, Briggs, Wager, 1974). Instruction is delivered by teachers, computer software, self-help manual, job aid, workbooks, etc. In higher education institutions, faculty plan, implement, and evaluate instruction and employ supplemental instructional materials such as software, textbook, etc. Instructional decision-making is the process of choosing an option between alternative instructional approaches. Faculty make instructional decisions pre-, during, and post-implementation of instruction. These instructional decisions determine and affect learning goals, content, activities, assessments, and instructional tools and resources (Gordon et al., 2020; Johnson et al., 2020).

This study focuses on tenured faculty members' instructional decisions during significant disruption caused by the spread of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV-2) resulting in a global pandemic affecting millions of people around the world (Centers for Disease Control and Prevention, 2022). COVID disrupted multiple dimensions of human life including health, industry, economy, politics, education, personal, professional, social life, and education. To halt the transmission of COVID at physical campuses, many higher education institutions immediately switched to remote instruction in replacement of face-to-face instruction. Gradually, campuses re-opened for hybrid and face-to-face with on-campus public health safety protocols such as mask mandates, social distancing, testing, and quarantine requirements. In addition to facing economic, health, and family-related challenges; all stakeholders in higher education had to adapt to first online and then the hybrid medium of instruction and work (Bonk, 2020).

Faculty were forced to change their instruction to online and/or blended formats, despite differences in preferences, skill sets, and knowledge about the new technologies, being employed such as online conferencing software like Zoom and MS Teams (Gallagher & Palmer, 2020). During this significant disruption, faculty made rapid instructional decisions to adapt to the unanticipated online teaching, followed by hybrid and socially distanced face-to-face instruction though often unplanned in advance (Gallagher & Palmer, 2020). Examples of instructional decisions included changes in content of teaching, technological tools, instructional activities, and assessments (Crawford et al., 2020; Gordon et al., 2020; Johnson et al., 2020).

Theoretical Framework

Jonassen presents two approaches to decision-making: (a) normative (rational) and (b) naturalistic approaches (Jonassen, 2012) (see Figure 2). Normative approaches assume that humans are rational beings, and therefore, they make decisions after evaluating utility, costs/risks, and benefits. In contrast, naturalistic approaches assume "decisions are often made or influenced by unconscious drives and emotions as well as previous experiences." (Jonassen, 2012, p. 333). Human decision-making is more naturalistic than normative, whereby decisions are influenced by multiple personal and societal factors, in addition to the individual's consideration of concrete available information, cause and effect of the decision, and rewards available (Jonassen, 2012).

Purpose of the study

The purpose of this qualitative interview-based study was to investigate university-based award-winning tenured faculty's instructional decisions regarding their instructional methods and corresponding factors that influenced their instructional decision-making. The study was conducted at a private research university in New York State conducted in the Spring 2021.

Three faculty members out of 22 award-winning faculty at the university, who received the award in the past 10 years, volunteered to participate in the study. Nine online interviews were conducted with three award-winning faculty members, over the semester period. Three interviews were conducted with each faculty member: first at the beginning, second in the middle, and third at the end of the semester. Award-winning faculty members were chosen because they are likely to better articulate instructional decisions and their justifications.

Findings

Participants Demographics

Three participating faculty (named PC, SC, TC) were full professors from varied disciplinary backgrounds: public administration, public health and anthropology, and geography. By the requirement of the award applications, all faculty members were tenured when applying for the award. All faculty had a doctorate degree from the United States in their area of teaching and had more than 20 years of experience teaching undergraduate and graduate courses. Participants did not have formal degrees in teaching or instructional design. PC and SC had experienced teaching at multiple institutions and TC joined the current university and continued teaching at the current university. SC and TC had used technological tools such as zoom and blackboard in their teaching, however, PC had used multiple data analysis tools such as GitHub and personal websites featuring the instructional units even before COVID. None of the faculty members had taught fully online courses.

Faculty selected the course that they were currently teaching so that their instructional decision-making could be studied over the period of the semester. Information about their courses is mentioned in Table 1. All three participating faculty taught graduate-level courses and redesigned their courses from face-to-face to online during Spring 2021. Participants did not have formal qualifications in teaching or instruction. Two of the three faculty (SC & PC) initiated their course design and one faculty member (TC) redesigned most of the instruction (including the readings, sequence, and instructional strategies) used in the course that he inherited from the previous faculty while retaining the core concepts from previous year's course syllabi.

Participants and their courses

Characteristics	Participant 1 (TC)	Participant 2 (PC)	Participant 3 (SC)
Gender	Male	Male	Female
Institutional Rank	Professor	Professor	Professor
Discipline	Geography & Environment	Public Administration & International Affairs	Public Health & Anthropology
Years of Teaching Experience	21 years	30 years	29 years
Terminal Degree	Ph.D. Geography	Ph.D. Economics	Ph.D. Medical Anthropology
Courses	Research Design in Geography	Data Analytics	Public Health Ethics
Created/ Redesigned	Redesigned Course	Created Course	Created Course
Student Level	Graduate	Graduate	Graduate
Class Size	6 students	55 students	50 students
Key instructional strategies	Workshopping a proposal and peer feedback	Problem sets and ongoing feedback	Community members as guest speakers
Instructional Tools	Learning Management System Zoom	Open-access website for sharing learning resources Slack Google Classroom Zoom	Learning Management System Zoom

Instructional Decisions

Faculty reported several factors that influenced their instructional choices as they switched their instructional medium from face-to-face to completely online in Fall 2020. This paper will concentrate on the instructional decisions related to the choice of instructional strategies and tools the instructions and the corresponding factors, to keep the paper focused and comprehensive. Other choices and corresponding factors will be discussed in future publications.

The instructional strategies that faculty members used include "workshopping the write-up" (TC), inviting community-based guest speakers (SL), and using problem-sets and in-class exercises (PC).

TC engaged students through "workshopping the write-up" which implies that students read multiple research proposals during the semester. Prior to covid-19, these workshops were held in a room where students sat on tables, however, due to social distancing and masking requirements, zoom synchronous discussions were used. Corresponding to the instructional topic of the class, they wrote segments of the proposal each week such as research epistemology, problem statement, research aim, research methods, and ethical underpinning. Students shared their writeups every week with their peers and faculty member in the synchronous session and received iterative and intensive faculty and peer feedback facilitating the improvisation of the paper before the final submission.

TC justified his instructional decision-making by sharing his instructional beliefs, stating students learn best when real-life situations such as drafting a National Science Foundation style proposal are required from them – thus asking them *to transfer learning to real-life problems*, and *iterative cycles of instructor and peer feedback* are provided by peers and instructors. He noted that the proposal develops in a phased approach, where students write a component of the research proposal per week such as research epistemology, problem statement, research aim, research methods, ethical underpinning, etc. He believed that the structure of the proposal and moving from simple elements to complex whole helped students to make significant progress. He reported learning these principles from trial and error in the classroom, observing his own instructors, and reflection on his instruction. He also subscribed his skills in using conferencing software such as zoom to the attendance of professional work meetings and participation in online conferences.

PC engaged students in online problem-based discussion and provided varied in-class "temperature check" exercises through google classroom to engage students in problem-solving during class, in replacement of face-to-face paper-based problem exercises. Students uploaded in-class exercises and programming assignments on Google Classroom to minimize the exchange of documents between the students and the faculty member. In parallel to in-class exercises, students also completed multiple programming assignments on a weekly basis and regularly sought feedback from the instructor via Slack (a messaging application) – the asynchronous messaging via messaging application served as an alternative to in-person office hours. Some questions that students asked included: where to get the data from? how to analyze the data? what are the issues in the coding? He reported fewer messages were around the issues in installing the programming software on their computers compared to the interpretation or correctness of results of the given problem.

PC justified his instructional decisions of using problem-based exercises and in-class exercises (which he called "temperature checks") by iterating that students learn from iterative feedback on exercises. He explained that he uses problem-based discussion because problems mirror real-life situations that students encounter currently or will encounter in the future. This helps them transfer their conceptual learning to practice and apply it to solve problems. He also reported that using problem-based exercises helps stimulate student attention and sustain it until the solution of the problem. In addition, he reported the provision of iterative feedback on problem exercises helps students learn the concepts better.

He explained that he selected digital tools such as slack (a messaging app), GitHub for sharing problem sets, Google-classroom for in-class exercises, and zoom for synchronous online instruction because he has seen these tools have been used in workplaces, and always wanted to try it out and see if they work in the classroom settings. He explained that covid provided him an opportunity to test these tools and to his surprise, students used the tools and found them useful in continuing their learning when in-person sessions were not possible.

SC designed a community-engagement experience for the students in replacement of face-to-face community bus tours. She redesigned the bus tour into an invited community member led discussions. She prepared community members for their discussions. Community members joined the class virtually and presented their lived experiences through synchronous zoom-session. SC stated,

> *So, there are topics that lend themselves to working with community members. For every such course, I link with community members. In the Public Health course, we have this bus tour of a city in Upstate New York. bus tours led by community members so that the students all learn about places where there's excess lead poisoning, places where there's been violence, food deserts, etc. For the online offering of the course, I helped community members to prepare presentations so that they can share their experiences in the class (SC, Interview 4, June 23, 2021).*

SC anchored her decision of engaging community members in teaching the session because she believed that community members can better speak for themselves and share their experiences, given their living experiences and strong affiliation with the community. She believed that community-engagement exercises engage students in understanding and solving real-life problems with community members allowing students to transfer their learning to practice.

SC teaching as advocacy because of her affiliation with public health discipline, where there is a high rise need for understanding issues of community and clearly communicating with them to improve health outcomes. SC learned about community-based approaches in education through her visits to Middle East where she was awarded a ford foundation grant to study problem-based education in medical sciences. She also described that her experiences of working with and for communities have inspired her to figure out ways to engage students in co-creating solutions with the community to real-life problems.

Faculty justified their rapid instructional decisions through their tried-and-tested instructional principles instead of developing abrupt instruction. Even during disruption, they continued to choose the instructional tools and strategies that (i) stimulate attention and sustain motivation, (ii) determine instructional goals, (iii) activate prior knowledge, (iv) present the information in a clear, logical, and engaging way, (v) promote collaboration, (vi) transfer learning to real-life problems, (vii) guide through feedback, (viii) assess learners' performance in varied situations, (ix) involve students in instructional tasks, (xi) build relevance of instructional tasks with learners' professional and personal lives (xii) exhibit problem deconstruction, and (xiii) allow co-creation of solutions to community-based problems with community members. All 13 instructional principles are largely supported by the evidence-based literature in instructional design (Ambrose, 2010; Boettcher and Conrad, 2021; Gagne & Briggs, 1974; Merrill, 2000). Faculty reported learning these principles mostly from observing their own teachers, trial and error during instruction, engaging with disciplinary ways of thinking, and reflecting on instruction. In a few instances, faculty also justified their instructional decisions through their prior readings in adult learning and exploring different technological applications. None of the faculty reported seeking help from their peers or the center for teaching and learning to explore tools and strategies that could help them achieve their learning outcomes, in an enhanced manner, perhaps because of their self-confidence to thrive through the disruption, independently.

Conclusion

Catastrophic events, for example, wars, pandemics, sharp decline in institutional funding, advancements in technology, changes in labor markets, trends in demand for graduates, and the emergence of new fields of study are inevitable. Therefore, it is important to investigate how individuals make instructional decisions in these times and develop support mechanisms to support faculty in making evidence-based and effective instructional decisions, even in emergency situations.

Implications of the study suggest that the award-winning faculty developed instructional beliefs while undertaking personal journeys into understanding and experiencing instruction, however, the time and effort spent by new faculty on designing evidence-informed instructional decisions can be reduced by supporting them to articulate their principles, corroborating their principles with the evidence-base in instructional design, and hook their instructional decisions in the principled approaches to instruction.

Faculty development programs focusing on online instruction must help faculty to make instructional decisions underpinned by personally relevant and evidence-based instructional principles. These principles are likely to serve as an anchor, motivation, and justification for faculty to learn new instructional strategies and tools that help achieve instructional outcomes (Darling-Hammond & Oakes, 2021; Green et. al. 2013; Haras, 2018). Besides, continuous engagement of award-winning faculty as peer facilitators in faculty development workshops may increase senior faculty's engagement in learning more about teaching, while mentoring new faculty to use time-tested and evidence-based instructional principles and investigate their practice for continuous improvement.

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Examining Students' Perceptions and Preferences for Traditional Paper vs. Multiple-Choice Question Generation Assignments

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Abstract

This paper presents an action research study that describes the perceptions of 41 students about the implementation of a renewable assignment, specifically a quiz question creation and review assignment as an alternative to guided paper assignment conventionally taught in an undergraduate psychology course. After completing the assignments, students were asked to share their perceptions of several aspects of this particular approach, including their preferences, experiences, expectations, reasons, and confidence in completing the assignments. Results indicated that students prefer the Multiple-choice question generation assignment, which helped them better understand the content and prepare for the exams. In addition, students had a higher level of confidence in creating quiz questions while creating quiz questions actually took more mental effort. It was clear that students valued autonomy, including having an opportunity to choose the type of assignment and being able to create quiz questions potentially being used for upcoming exams.

Keywords: Open Pedagogy; Student-Generated Quiz Questions, OER-enabled Pedagogy, Non-disposable Assignment

Introduction

To support and assist students in learning and success, educators have developed, implemented, and advocated various learning and teaching theories and pedagogies along with the sociocultural changes and technological development, with open pedagogy being one of them. The term open pedagogy was coined decades ago, and with the popularity of open education and open education resources in the 2010s, this method has drawn attention again (DeRosa & Jhangiani, 2017).

Open pedagogy refers to a concept used to establish a pedagogical practice which allows the instruction to be more student-centered and access-orientated and empower students to engage in public knowledge creation during the learning process while following the "R's" of open educational resources (OERs), which allows resources to be revised, remixed, reused, or redistributed (DeRosa & Jhangiani, 2017; University of Texas Arlington Libraries, n.d.; Wiley, 2013). Most importantly, there is a shift from a reciprocal learning experience to a more process-oriented experience (Paskevicius & Irvine, 2019).

Wiley (2013, 2018) further asserted the implementation of OERs to transform pedagogy, and advocated 'OER-Enable Pedagogy.' One of the key characteristics of open pedagogy is to get students more engaged by creating real-world products such as wiki projects, whole or partial e-textbooks, videos materials, and other supplements, instead of "disposable assignments" (Wiley, 2013), which have a limited use that does not reach beyond the scope or timeframe of the course.

There is growing research on how open pedagogy works and the impact revealed from empirical research (Baran & AlZoubi, 2020; Bloom, 2019; Cooney, 2017; Hilton et. al. 2019; Werth, & Williams, 2021). Open pedagogy allows students to use, adapt or remix, build, curate, and ask critical questions about OERs (DeRosa & Jhangiani, 2019) and can provide a robust basis for student-centered learning through engaging students in real-world projects that allow students to interact and contribute to a larger community (DeRosa & Robison, 2017). The present research, as part of our OER-enabled pedagogy implementation, is another step in the process to better understand how and in what ways students, instructors, and instructional designers accomplished their goals and objectives with this approach and what students feel about this new approach.

Specifically, the present project focuses on implementing a renewable assignment in replacing paper writing assignments. Renewable assignments, an idea introduced by Wiley and Hilton in contrast to disposable assignments, are "assignments which both support an individual student's learning and result in new or improved open educational resources that provide a lasting benefit to the broader community of learners" (Wiley & Hilton, 2018, p. 137).

The purpose of the present paper is to describe an action research study aimed at examining the implementation of a renewable assignment in an undergraduate psychology course as part of open pedagogy. There are many types of renewable assignments, such as wiki projects, creating open educational resources (syllabus, revising open book or OER, etc.) and creating quiz questions for a quiz bank. The type of renewable assignment for our project was quiz question creation aimed at contributing to a quiz bank that can be used by others in the future.

In this paper, we describe our project that developed and implemented a renewable assignment in an undergraduate psychology course in Georgia. Then we discuss the merits of traditional paper writing assignments versus a question-creation and review (QCR) assignment, where students make ongoing contributions to a quiz bank that faculty can use in future courses. The presentation/paper is aimed toward instructional designers, faculty members, and those interested in learning more about open pedagogy assignments.

As mentioned, the purpose of the present study is to examine student perceptions of the renewable assignment implemented as an alternative option in an undergraduate psychology in Georgia. The overall research questions for this study are:

1. What are students' overall learning experience of a renewable assignment, specifically the QCR assignment?

2. What is students' preference if given an option between a paper assignment and QCR assignment?

Research Design

The Context of the Study

The context of the study was in an introductory undergraduate psychology course, Human Growth and Development, with 41 students enrolled using an open textbook. Students in the course completed five assignments: a paper assignment, a QCR assignment, and a choice between a paper or a QCR for assignments three to five.

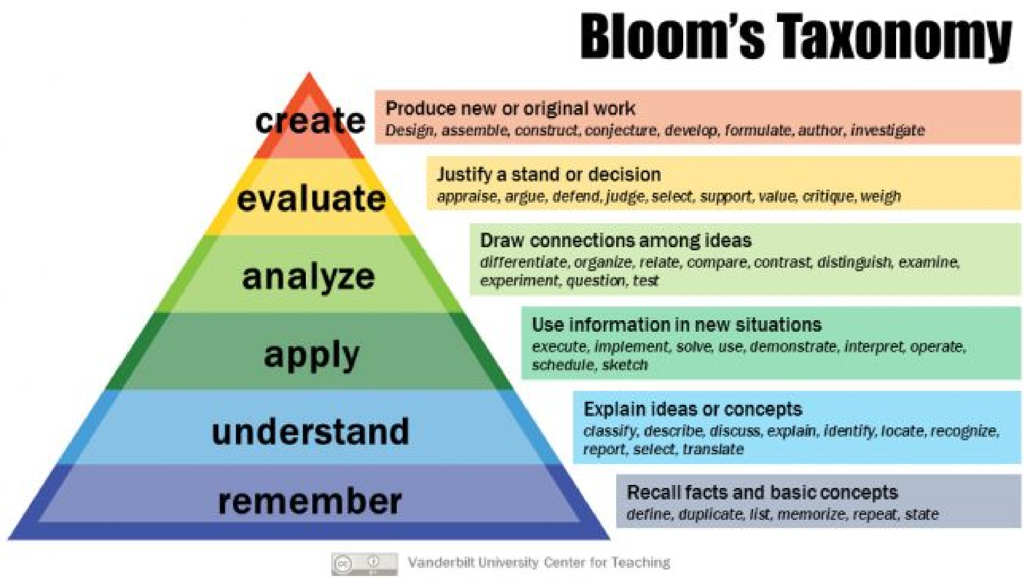
The renewable assignment, QCR assignment, was introduced to the class with a purpose of potentially contributing to a quiz bank that can be used by other people in the future as well as for the upcoming exams. The assignment consisted of two parts. The first part was to create three Multiple-Choice Questions (MCQ) based on the given text/textbook chapters. The second part was to review MCQ created by other students. The QCR assignment served an alternative to the guided paper assignment so students could choose either one for the assignments three to five.

Data Collection

The primary sources of data were three survey questionnaires. There were total of three surveys: two of them were one-question surveys and were collected mid-semester and the third survey was distributed at the end of semester. The first survey was distributed right after homework assignment #2 (QCR assignment) and asked them how they felt about the QCR assignment. The second survey was distributed after they completed homework assignment #3, for which students could choose between the QCR and paper assignment. The survey asked students which assignment they chose and why. The third and the final survey asked students about their overall learning experiences with the assignments. The number of responses for each survey were various because all surveys were anonymous and voluntary.

Another source of data we examined were the students work/homework assignments. We rated the level of Bloom's Taxonomy [Figure 1] for each question that students created across each homework assignment. Bloom's Taxonomy (1956) is a classification for learning outcomes and objectives that instructors can use to assess student learning and that students can use to determine their level of knowledge. Bloom's Taxonomy can be used in creating assessments, including MCQs. In our study we analyzed the MCQs that students created to determine the level at which students were thinking about the material when creating the MCQs.

Figure 1. Bloom's Taxonomy



Data Analysis

Descriptive analysis and ANOVA were used for survey data analysis. The collected survey data were cleaned up and imported into SPSS. The descriptive analysis was used to present students' general perceptions about the QCR assignment, preferences between the two assignments, and the efforts they perceived in completing assignments. ANOVA was applied for further examination to see if there were any statistical differences between the means of each aspect.

For the Bloom's Taxonomy rating, we coded each question that students created for Homework 2-5 on the following levels: Level 1- Remember/Recall; Level 2- Understand; Level 3- Apply. No questions were coded beyond Level 3 due to no students creating questions beyond that level. After students submitted their assignments, all multiple-choice questions were examined and rated by two reviewers, who each assessed the questions' composition and decided whether the question was focused on remembering/recall, understanding, or application. If a disagreement occurred between the two raters, a third person would share their judgment. A discussion would follow among the three individuals until a consensus was reached.

Results & Discussion

Student Perceptions and Preference

Initial Experience (first survey)

After students experienced both type of assignments (paper and QCR), the first survey asked students how they felt about QCR compared to paper assignment. Data from the first survey (N=35) showed the majority of students (65.7%) indicated that the QCR assignment was better than the paper assignment, while 10 students (28.6%) felt they were the same, and two students (5.8%) felt the QCR assignment was worse than the paper assignment (see Table 1).

Table 1
Perception about QCR or Paper Assignment at 1st Survey (n=35)

	Frequency	%
QCR assignment was better	23	65.7
About the same	10	28.6
Paper assignment was better	2	5.8

The students who felt QCR assignment was better indicated that it was fun, creative, and helped them study. One student (S1-33) wrote "This was a simple, yet in my opinion, effective assignment to do. You must know material to make a test question about it so it was helpful." Another student (S1-19) wrote "It allowed me to be a little more creative and was definitive It also forced me to read the book. Something I should do but don't.".

Those students who indicated both type of assignments were about the same felt "it has the same effect (S1-2)" on [learning] and engagement. One student (S1-7) wrote "It got me engaged about the same amount as the paper assignment, I just enjoyed the paper assignment more because it was the first time I've really been interested in what I was writing down." Those students who felt QCR was worse felt the structure of assignment was complicated and one wrote "format was too complicated, could've been done in a more simple fashion." (S1-24)

Preference on the Type of Assignment (second survey)

The second survey (N=33) asked students which assignment, Paper or QCR, they chose and why they chose. As shown in Table 2, three respondents (9.1%) chose to write a paper assignment over creating quiz questions, while 30 respondents (90.9%) chose creating quiz questions. Those who chose QCR felt that QCR assignment was helpful to study. One student (S2-3) wrote "I really enjoy the making questions step, having to look at information in a new way to present it as a question is really cool to me." A representative comment of this cohort of student was, "Creating and reviewing the questions helps me retain the information." (S2-15)

Only three students chose paper assignment. Student 9 (S2-9) chose paper because of the topic and wrote "I was interested in the topic and I love writing about stuff that actually interests me." Student 22 chose the paper assignment because of time consumption, "Creating the questions were time consuming versus doing the standard writing a paper." The third student (S2-29) felt "more comfortable with writing paper than constructing questions."

Table 2
Preference for QCR or Paper Assignment at 2nd Survey (n=33)

Assignment	Frequency	%
QCR	30	90.9
Paper	3	9.1

Helpfulness and Confidence

The third survey (N=34) asked students to compare each type of assignment on its helpfulness in learning the content, exploration of the concepts, and preparation for the exams, as well as the level of effort required and confidence, they had to complete the assignments.

As shown in Table 3, more students reported that QCR assignments were more helpful to prepare for the exam and to learn the content in depth, whereas the paper writing assignments were more helpful to explore the topic/content. However, repeated measures ANOVA did not reveal a significant difference in helpfulness.

As for the confidence in completing assignments, results of repeated measures ANOVA showed there was a significant difference in confidence to complete a good quality assignment between paper and QCR assignment ($F(1,33) = 10.38$, $p = .003$). In other words, students were more confident in coming up with good quiz questions than writing a good paper.

Table 3
Means and Standard Deviations for the Helpfulness and Confidence Regarding Assignments (n=34)

	Helpfulness						Confidence	
	Examination Preparation		Learning Content Deeply		Concept Exploration		Good Quality Assignment	
Assignment	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Paper	7.40	2.166	8.00	2.074	8.29	1.733	7.32	2.371
QCR	8.21	2.147	7.93	1.939	8.06	2.373	8.65	1.535

***Mental Effort and Time Spen*t**

As shown in Table 4, nearly half the students (47.1%; 16 out of 34) felt the mental effort they made on QCR assignments was about the same compared to paper assignment, 35.3% of the students felt the mental effort of QCR assignments was less than paper assignment, while 17.6% of respondents thought QCR assignments took more mental effort than paper assignment. About 50% of students felt that time effort to complete a QCR assignment was less than expected, compared to paper assignments.

Table 4
Comparison of Mental Effort on QCR Assignment and Paper Assignment (n=34)

	Frequency	%
More mental effort to complete QCR assignment	6	17.6
About the same	16	47.1
More mental effort to complete Paper assignment	12	35.3

Preferences on the Proportion of Assignment

In terms of preference on the type of assignments, most of the students (85.3%) preferred to have more QCR assignments than paper assignments, and the majority of students (82.4%) would like to have some kind of combination of both types of assignments. None selected all paper assignments while six (17.6%) students selected all QCR assignments. In short, students recognize that each assignment brings different merits and they prefer to have a mix of both assignments. They also appreciate to have a choice.

Table 5
Preference for QCR or Paper Assignment, by Proportion (n=34)

Proportion of Assignment	Frequency	%
100% QCR assignment	6	17.6
80% QCR assignment, 20% Papers	14	41.2
60% QCR assignment, 40% Papers	9	26.5
40% QCR assignment, 60% Papers	4	11.4
20% QCR assignment, 80% Papers	1	2.9

Bloom's Taxonomy Levels of Student-Generated Questions

Table 6 outlines the number of student-generated multiple-choice questions at each level of Bloom's Taxonomy. At first, on HW 2, most questions (90.8%) that students created were at the lowest level of the taxonomy, Remember/Recall. No questions on HW 2 were coded beyond the second level (Level 2, Understand). The instructor provided feedback to the students following HW 2, prompting them to create questions that included examples (and therefore would be coded on a higher Bloom's Taxonomy level). Following this discussion, on HW 3 more students created questions that were coded at Bloom's Taxonomy's second level, Understand (7.8%). Even more students created questions coded at the Understand level (Level 2) on HW 4 (16.2%). However, Bloom's taxonomy Level 2 (Understand) decreased on HW 5 (4.3%), with rates returning close to that of HW 2. Based on the authors' reviews of the questions, most of the questions on HW 5 dealt with ages (e.g., "What is the age range of late adulthood?") or specific stages of development, which were on the lowest taxonomy level (Remember/Recall).

Table 6
Bloom's Taxonomy Rating

	HW 2		HW 3		HW 4		HW 5	
BT rating	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Level 1	90	90.8	94	92.8	82	83.2	89	95.7
Level 2	3	3.2	8	7.8	16	16.2	4	4.3
Level 3	0	0	0	0	1	0.6	0	0

Note: Level 1 = Remember/Recall; Level 2 = Understand; Level 3 = Apply

The Bloom's taxonomy ratings illustrated that students were thinking about the material on a surface-level, focusing on remembering definition and important facts about the material. However, with some feedback from the instructor about creating more questions that were applied (e.g., examples that illustrated the concepts), we noticed that there was an uptick in the number of responses that were on higher levels of Bloom's Taxonomy, including "Understand" and "Apply." Of interest, we noticed a decrease in the number of questions that were rated on higher levels of Bloom's taxonomy for the final homework assignment. There are several possible explanations, including the material covered or possibly that students rushed through the assignment because it was later in the semester when they may have had less time to complete it due to other course assessment, assignments, and projects.

Instructor's feedback/reflection

The instructor (Grissett) observed that students were engaged throughout the assignment, in part because of the different stages and components of the assignment, rather than a "one and done" paper assignment. Students are used to writing papers, but the QCR assignment was new for many students and therefore appeared to allow students to do something different, and therefore more engaging. The instructor also noticed that students created surface-level questions and feedback on the first assignment. Therefore, she provided feedback in class and online for students to provide richer feedback to their peers and to create questions that were more applied (e.g., example-based questions). Finally, the instructor enjoyed the assignment, as well. Having read and graded many papers over the years, this was a new and engaging pedagogical activity that she enjoyed. In the future, the instructor will consider prompting students to create higher level questions on Bloom's taxonomy, providing sample questions for students to model, allowing students to create questions in class to get peer and instructor feedback, or incorporating the questions students create into more formative assessments or in-class activities, such as quiz games.

Conclusion

Overall, based on the survey results, students liked having two types of assignments but preferred QCR more than paper assignment writing. In general, students considered writing the paper assignment to be more helpful to explore the topic and content and to learn the content intensively, while creating quiz questions was more beneficial to study the content and prepare for the exam. Additionally, students had a higher level of confidence in creating quiz questions while creating quiz questions actually took more mental effort. It was clear that students valued autonomy, including having an opportunity to choose the type of assignment and being able to create quiz questions potentially being used for upcoming exams.

Further, although student generated testing items were not always on high cognitive skill level, we can expect that the quality of student generated MCQ can improve with instructor's feedback or investment.

Further research is necessary to determine the efficacy of OER-enabled pedagogy beyond student perceptions, and also to determine which types of open pedagogy are most efficacious, including examining changes in learning and engagement of various type of assignments.

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The Effectiveness of Engineering Design Based Instruction on Problem-Solving Actions in High School Information Class

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Abstract

This study focuses on the teaching of problem solving in “Information” in Japan. One of the issues is that the retention of problem-solving skills in information science has not been explained, and it is not known what kind of problem-solving framework is effective in teaching problem-solving skills. In this study, we developed a problem-solving framework based on engineering design. We have proposed a problem-solving model that explicitly instructs students to search for information to solve problems and to select and use information that they can use when teaching the problem-solving framework. It is necessary to design lessons using this model and to verify its effectiveness for learners.

Keywords: Problem-solving, Information, Engineering Design, Information Problem-solving

1. Introduction

1.1. Problem-solving ability

Various definitions of the abilities that we want to develop in children of the future include 21st century skills, key competencies, and so on. For example, 21st century skills and key competencies are listed, and the 21st century skills list ten skills in four areas that children should develop. One of these is problem-solving ability (Griffin et al., 2013). The key competency is the ability to deal with complex problems. These indicate that children are required to develop problem-solving skills.

This problem-solving ability is defined in many places. For example, the OECD (2012) defines problem-solving skills as "To understand problems for which solutions are not immediately apparent, cognitive processing to generate a solution, and a proactive approach to solving problems.”

A distinction is also made in terms of the problem to be solved (Jonassen, 2000). distinguishes between well-defined and ill-defined problems. A well-defined problem is one for which the solution and the process leading to it are clear. Poorly defined problems are those for which there are multiple possible solutions or processes leading to a solution, or for which no single solution has been determined. In contrast to good-definition problems such as mathematical problem solving, there has not been much research on ill-defined problems, suggesting that we should focus on problem solving for ill-defined problems, since problem solving is the ability to solve problems that do not yet have solutions, according to the OECD and 21st Century Skills. This suggests that the focus should be on problem solving for ill-defined problems.

1.2. Problem-solving ability in Japan

In response to international trends, problem-solving skills are also being emphasized in Japan. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) (2018) has identified language skills, information use skills, and problem-solving skills as the abilities that form the foundation of learning. MEXT indicated that it aims to develop these abilities through school education.

In particular, “Information” is a subject that fosters problem-solving abilities. The goals of this subject are to acquire the problem-solving skills necessary for problem solving and to utilize information and information technology for problem solving.

Efforts are being made to develop problem-solving skills in information science. For example, Murai and Ito (2004) used Excel to solve problems at a school festival based on the problem-solving content generally presented in textbooks. Yoshida and Nakai (2009) taught the PDCA cycle as a problem-solving flow and conducted problem-solving using an information system. Nagai and Kikuchi (2009) solved local problems by utilizing big data. These practices were conducted as problem-solving in the information science course, and the students' motivation for problem-solving was found to have improved. In addition, knowledge of the subject matter was improved. However, the improvement of problem-solving skills was not evaluated. Therefore, these studies do not reveal whether learners are actually able to solve problems. Nor do they provide instruction in problem-solving skills. In fact, a comparison of Japanese “Information” textbooks shows that some do not teach problem-solving skills, suggesting that teaching methods are not well-defined.

These findings suggest that there is a need for teaching problem-solving skills in informatics in Japan. However, it is not clear what should be taught for problem-solving skills when teaching problem-solving. It is necessary to clarify the framework of problem solving and how to teach it in order to develop problem solving skills.

1.3. Problem-solving Framework

Many studies have been conducted on problem-solving frameworks. For example, Polya's (1945) mathematical problem solving and Schoenfeld's (2013) mathematical problem solving are based on problem solving for mathematical problems. These summarize solutions to mathematical problems. They are also considered to be applicable to problem solving in everyday life. From the perspective of cognitive psychology, there is also a model called the Geneplore model (Finke, 1999), which summarizes research on human creativity and models the process of creative emergence (Figure 1). The model divides the cognitive process of problem solving into two stages: generation and exploration. In Preinventive Exploration and Interpretation, the images created in A are interpreted and explored to make them meaningful. These two processes are repeated, and the final image is created through a cycle of modification and revision. These two structures provide constraints on the image. There is also the IDEAL problem-solving step. This is a summary of the five steps of problem solving: I; Identifying Problems, D; Defining problems, E; Exploring alternative approaches, A; Acting on a plan, L; Looking at the effects.

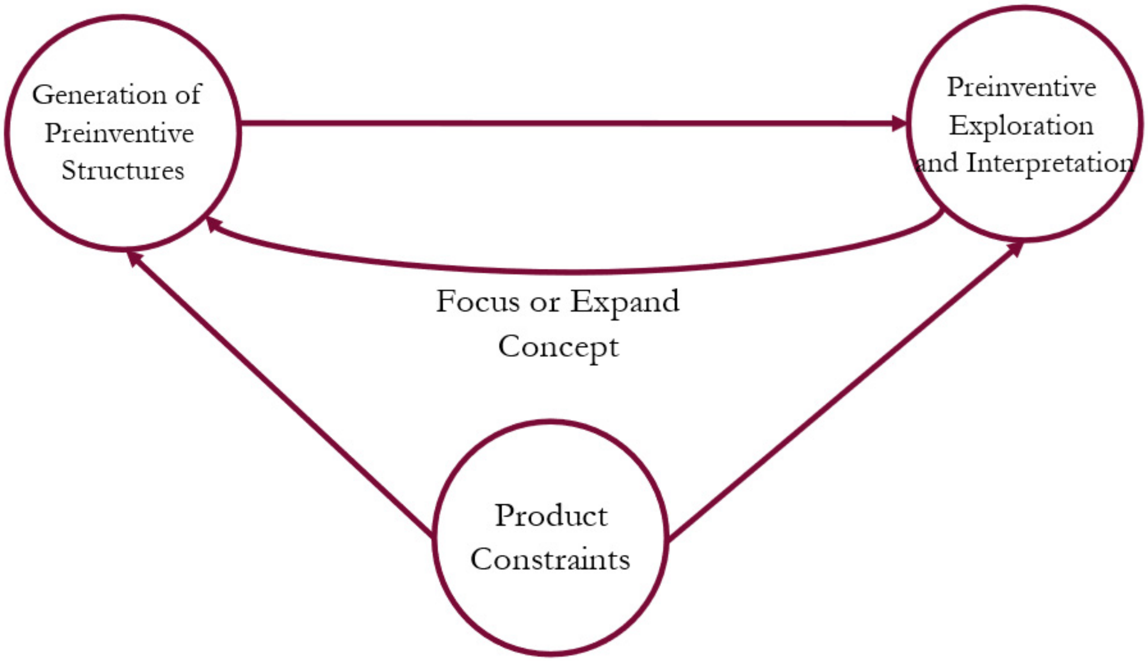

Figure 1. Geneplore model

Thus, efforts are being made to capture the framework of human problem solving from various perspectives. In this study, we would like to use a framework in which problem solving can be taught as a skill. The NRC (2013) emphasizes that engineering design is a problem-solving skill that should be taught to all children.

The NGSS (2013) defines engineering design as (A) Defining and delimiting engineering problems (B) Designing solutions to engineering problems (C) Optimizing engineering problems These problem-solving actions are considered to be iterative until the problem is solved (Table 1). The effectiveness of teaching this engineering design has also been studied.

Atman and Bursic (1996) showed that, using a textbook, learners who learned engineering design showed more sophisticated problem-solving behavior than learners who did not learn engineering design, although they took longer to solve problems. Furthermore, Atman et al. (2007) reported that when problem solving according to engineering design, proficient problem solvers spend more time on problem definition and information gathering problem solving behaviors. In addition, Li et al. (2016) demonstrated that engineering design can support problem-solving behavior by having learners practice designing a crane and a fan with LEGO bricks according to an engineering design, showing the potential of engineering design to enhance problem-solving skills. Based on these results, we hypothesized that teaching engineering design as a framework for problem solving may lead to the acquisition of problem solving skills by learners.

Table1. Engineering Design skills

Define	Defining a simple problem to solve that meets your needs, considering success and constraints ・Define problems that can be solved to meet your needs ・When defining, be able to clarify what can be resolved and succeed ・When defining, be able to clarify the constraints of the situation to be solved
Develop	Generate multiple solutions and compare how well the success conditions and constraints are met ・Generate multiple solutions ・Compare solutions based on success and constraints ・Improve your solution by sharing your ideas
Optimize	Investigate the improvement points of the solution and optimize the solution based on the improvement points by the success condition/constraint condition ・Discover solution improvements ・Improve the solution based on the improvements ・Plan and execute surveys so that you can find improvements to the solution

Tamaki and Watanabe (2021) taught engineering design as a framework for problem solving in an information science course in Japan. They conducted a class by specifying the problem-solving skills that enable the problem-solving behaviors included in engineering design. Before and after the class, groups of four or five students engaged in problem-solving activities, and the difference between the two problem-solving behaviors was investigated. The results showed that the problem-solving behavior was refined. However, it was found that there were differences between the groups due to the teaching of engineering design. One of the reasons for this is that the group that actively searched for information considered necessary for problem solving tended to have more sophisticated problem solving behavior. Therefore, it is considered necessary to provide additional guidance on the use of information for problem solving in addition to engineering design.

1.4. Information Problem Solving

Information Problem-solving The concept of information problem-solving is described as combining the skills needed to access and use information. It is described as a concept that combines the skills needed to access and use information(Gruwel et al, 2009). The IPS-I model summarizes this IPS, which consists of (a) defining information problem, (b) searching information, (c) scanning information, (d) processing information, (e) organizing and presenting information. From these five, it is said to be able to search for information to be used for problem solving and to process information until it can be used for problem solving.

2. Purpose

To develop a problem-solving framework to improve problem-solving skills for teaching information science in Japanese high schools. Based on Tamaki and Watanabe (2021), we will investigate the impact of teaching engineering design, including information retrieval, on learners' problem-solving skills.

3. Methods

We determined the problem-solving process based on the engineering design. We divided the problem-solving process into four categories: (A)Define Problem (B)Develop Solutions (C)Select the Solution (D)Predict Solution's result. The skills required for each problem-solving process are listed (Table). The relationship between the problem-solving process and IPS is modeled (Figure). (Fig.) We believe that teaching these skills will help learners refine their problem-solving processes and improve their problem-solving skills.

The first problem-solving situation is Define Problem. This problem-solving behavior is a problem-solving behavior in which the learner defines what the problem is based on the situation in which the learner is engaged in problem-solving. Specifically, it is a behavior in which the learner discovers and clarifies what the problem is that needs to be solved and how to successfully solve the problem. In addition, we also define the constraints for problem solving.

The second problem-solving situation is Develop Solutions. This problem-solving behavior is to generate solutions to the defined problems. The solution is not a single solution, but rather multiple solution ideas that are thought to solve the defined problem. It is also possible to generate new solution ideas by combining multiple solution ideas. It also includes identifying the effects of the generated solutions on problems other than the defined one.

The third problem-solving behavior is Select Solution. This is the process of comparing, examining, and deciding which of the solutions will bring the solution closest to a successful state.

The fourth problem-solving behavior is Predict Solution's Result. This problem-solving behavior is to predict the outcome of the generated solution, identify points for improvement, and optimize the solution. The solution is improved by either anticipating the future with the solution implemented or by prototyping and implementing the solution. Based on these improvements, the solution is optimized.

It has been shown that problem solving is not a linear approach, but an iterative one. Therefore, these problem solving actions are repeated by the learner, as needed, until a solution to the problem is determined.

In each of these problem-solving activities, it is assumed that knowledge and information that they do not know will be needed. At that time, they are required to search for and utilize information as indicated in the IPS-I model. They are required to search for information they need using the Internet, etc., and to select information that they can use themselves. It involves not only searching for information, but also cross-checking multiple pieces of information to see if the information is reliable, collecting correct information, and processing the information into information that can be used by the learners themselves.

Tabel2. Problem-solving skills

Define Problem	**Define the problem to be solved and the constraints of the problem** ・ Define the problem to be solved ・ Identify constraints to consider when solving problems
Develop Solutions	**Develop solutions to problems** ・Generate ideas that satisfy the definitions, constraints, as much as possible from knowledge and experience ・Creating new ideas by combining multiple ideas
Select Solution	**Select the solution that is considered most optimal** ・Comparing ideas and evaluating better ideas
Predict Solution's Result	**Make predictions using the solution** ・Identify improvements based on predicts ・Improve solutions based on improvements

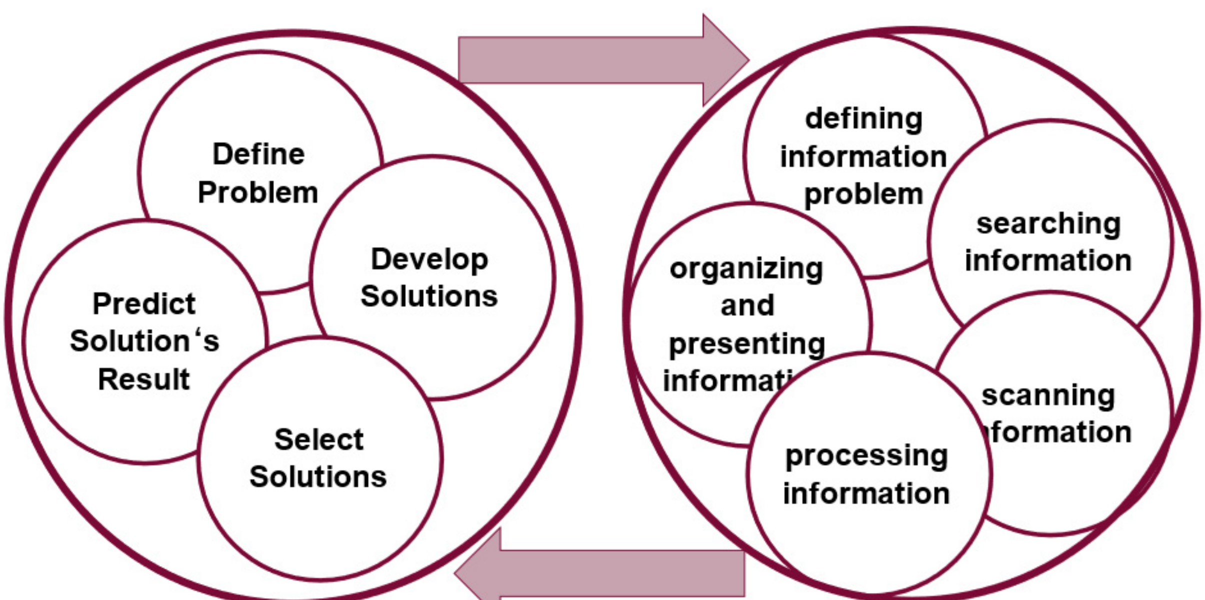

Figure 2. Problem-solving model

4. Conclusion

In this study, we proposed a problem-solving model based on engineering design. In addition, the problem-solving skills considered necessary for each problem-solving behavior were specified. These models were developed based on previous research, but have not yet been verified by a survey. In the future, it is necessary to verify the effectiveness of the model by implementing it in many classroom situations, such as information science classes in Japan.

It is also necessary to consider how to design classes in which this problem-solving framework is actually taught. It is believed that complex skills such as problem solving cannot be acquired immediately. Therefore, it is necessary to design classes in such a way that learners can acquire them without fail.

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Intercultual online learning experiences of Chinese college students

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Abstract

This study uses a quantitative methodology to examine the feasibility of intercultural online learning in higher education. Post-course assessments sought to investigate students' satisfaction with this course, including learner-learner interactions, learner-content interactions, learner-instructor interactions, learner-technology interaction, academic culture satisfaction, general courses satisfaction, and general program satisfaction. Researchers invited 19 college students who had never been exposed to higher education in the U.S. from one Chinese university from various grades and majors to participate in the study. The findings indicate the feasibility of future online courses as described in this project to be offered in higher education institutions in China. However, the student-centered teaching pedagogy and English proficiency presented challenges during their learning. The results shed light on the future practice of intercultural online learning in higher education institutions that provide optional academic language training courses and sufficient learning materials, such as articles, slides, and videos, to cope with language barriers and combine teacher-centered and student-centered pedagogies to improve students' adaptability and enrich learning activities.

Introduction

Political and economic globalization had caused higher education institutions to recognize the significance of cultivating their graduates with intercultural competencies (Gregersen-Hermans, 2017). The most critical strategies for building and enhancing relevant competencies are providing opportunities for students to visit and communicate with individuals from other countries, creating a scholarly environment with international cultures, and internationalizing the college curriculum. By the end of 2019, there were more than six million international students worldwide who chose to pursue all or part of their higher education abroad and emigrate to another country to study (UNESCO Institute for Statistics, 2021). Among them, China ranks first in the number of overseas students (Textor, 2021).

Since 2008, China has been the largest source of international students to the U.S. (Institute of International Education, 2020), accounting for 35% of all international students in the United States (Opendoors, 2020). The number of Chinese students studying in the U.S. in the 2020-21 school year was 15% lower than the previous year due to the impact of COVID-19 but still ranked first among international students from all countries (Silver, 2021). Most of the drop was among new students who had not enrolled in a program at a U.S. higher education institution in the past year (U.S. Immigration and Customs Enforcement, 2021).

The rapid development of online learning in various countries due to the impact of COVID-19 has provided college students with new opportunities to improve intercultural literacy through international communications (World Economic Forum, 2020). However, there are few studies on the influence of students who have never studied internationally via online learning and intercultural learning satisfaction. This study investigates the satisfaction of Chinese students who have never studied abroad with intercultural online learning and sheds light on future similar programs. The following research questions guide this study:

- How do students in higher education institutions in China evaluate LMS MOODLE for cross-cultural learning opportunities?
- How do students in higher education institutions in China evaluate online learning experiences in a cross-cultural learning opportunity?
- How does intercultural exposure influence students' online learning experience in higher education institutions?

Method

A quantitative survey research approach was used to investigate students’ perceptions of online learning, learning with LMS, and intercultural impact on online learning experiences. The researchers designed an 11-week micro-credential program consisting of two online courses (Project Management; Multimedia Learning) adapted from the courses taught at a university in the midwestern United States. During the 11 weeks, students were required to participate in weekly one-hour synchronized lectures via Zoom video conferencing software, participate in online discussions with their classmates and the professor, and complete individual and group projects. Course completers received a participation or achievement certificate based on their final grade.

To assess the learning experiences, researchers invited the enrolled students to participate in an online survey, which was adapted from Strachota’s (2003) *Student Satisfaction Survey* (Appendix 1), posted in the MOODLE classroom. The collected survey data were transferred to Microsoft Excel for analysis and calculated as percentages. All course instructional materials and the assessment survey were delivered in English.

19 participants were recruited with a convenience sampling method. Among them, there were 16 females and three males. Eighteen students were aged 17-24, and one student was between 24-36 years old. In terms of majors, seven of them were computer science, four were economics, three were information science, and one each in accounting, English, mechanical engineering, and logistics. In terms of college classification, the participants included two sophomores, ten juniors, five seniors, and two graduate students.

Course Design

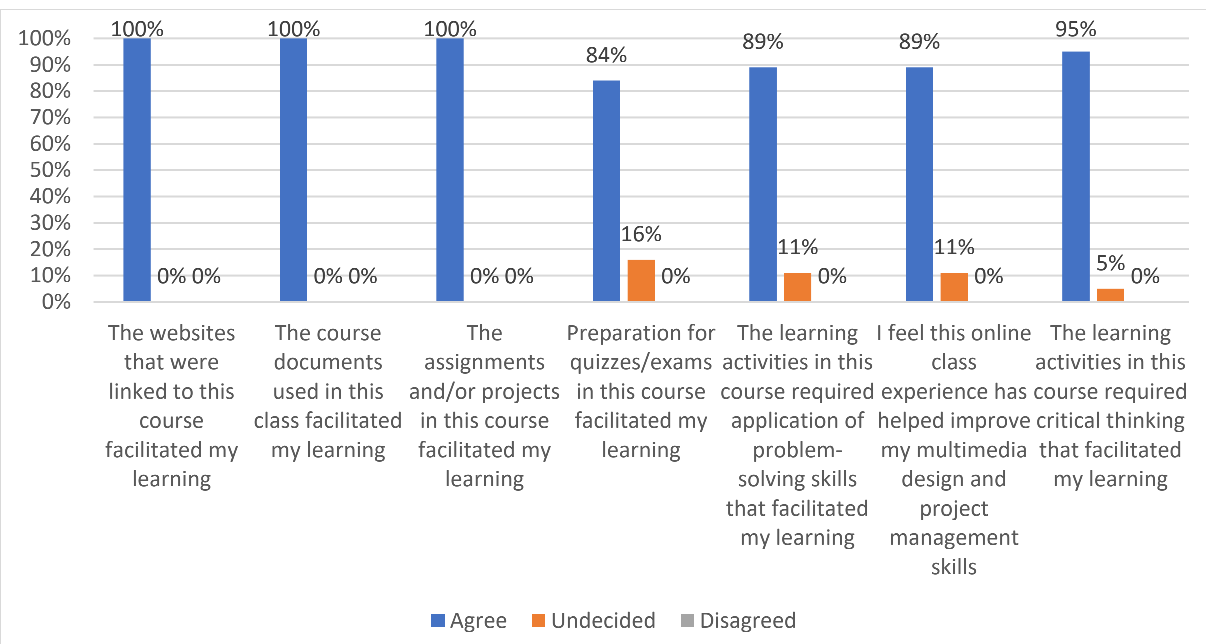
The design of the two courses in the micro-credential program, used as the focus of this case study, followed Bosch’s (2017) Blending with Pedagogical Purpose Model. MOODLE LMS was the platform for carrying course contents and learning activities. Students log on to MOODLE to read academic journal articles and related websites and watch relevant videos uploaded by the instructor and post on discussion boards to reflect students' understanding of the reading materials and videos. The weekly synchronous Zoom Session provided social and emotional communication and connections between students and the instructor. During the Zoom sessions, instructors introduced the following week's learning objectives and answered students' questions. Instructors also provided students with the opportunities to ask questions freely during one Zoom session to help students better understand U.S. culture. Students showed tremendous enthusiasm and asked diverse questions, such as what life was like on a farm in the U.S. or what life is like as an undergraduate student at a university in the U.S.

At the end of the two courses, students needed to submit an instructional video developed by the group based on the content of both courses. The final project included four parts—submission of proposal and storyboard, production of the first version of the video, peer evaluation and modification of the video according to suggestions, submission of the second version and final evaluation by the instructor. The final grades of the two courses were composed of the weekly discussion board postings and final project submission. Weekly Zoom session attendance was not part of the final grades.

Results

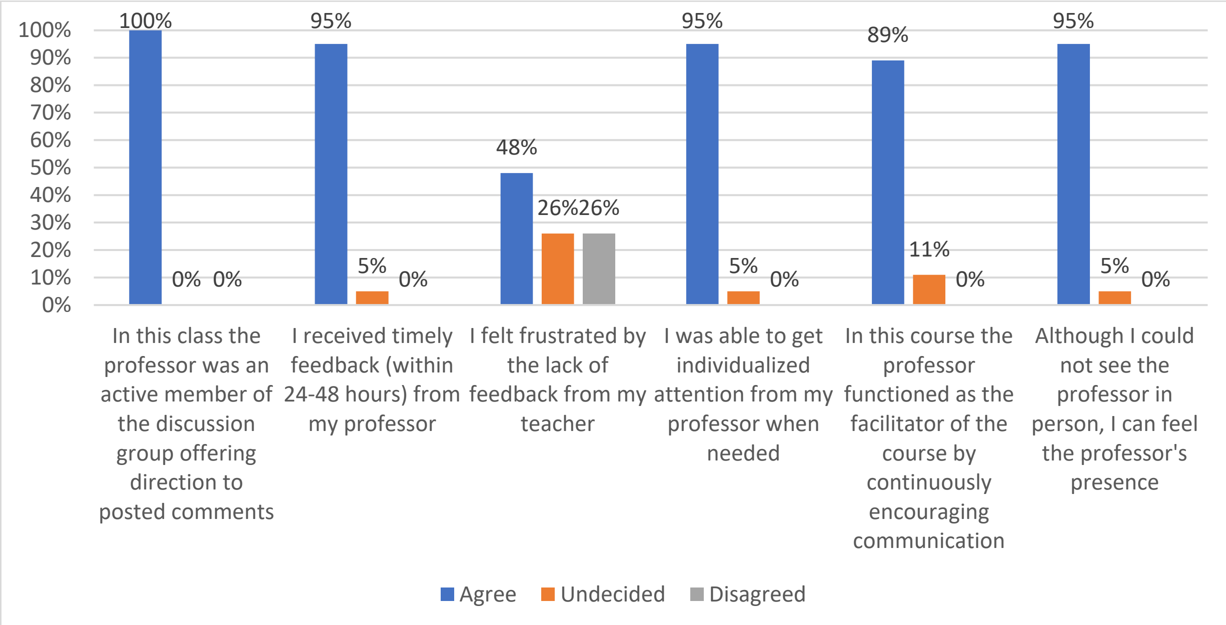
The survey responses revealed that seven (7) participants preferred face-to-face learning, three (3) preferred online learning, and nine (9) preferred hybrid learning. Four (4) participants rated their English proficiency as excellent, 12 moderate, and three (3) poor. Over 80% of participants evaluated the course content facilitated learning when evaluating the interactions between learners and learning content. All students agreed that the website, course documents, and assignments and projects provided in the two courses facilitated their learning (Figure 1).

Figure 1. Learner-content Interaction.



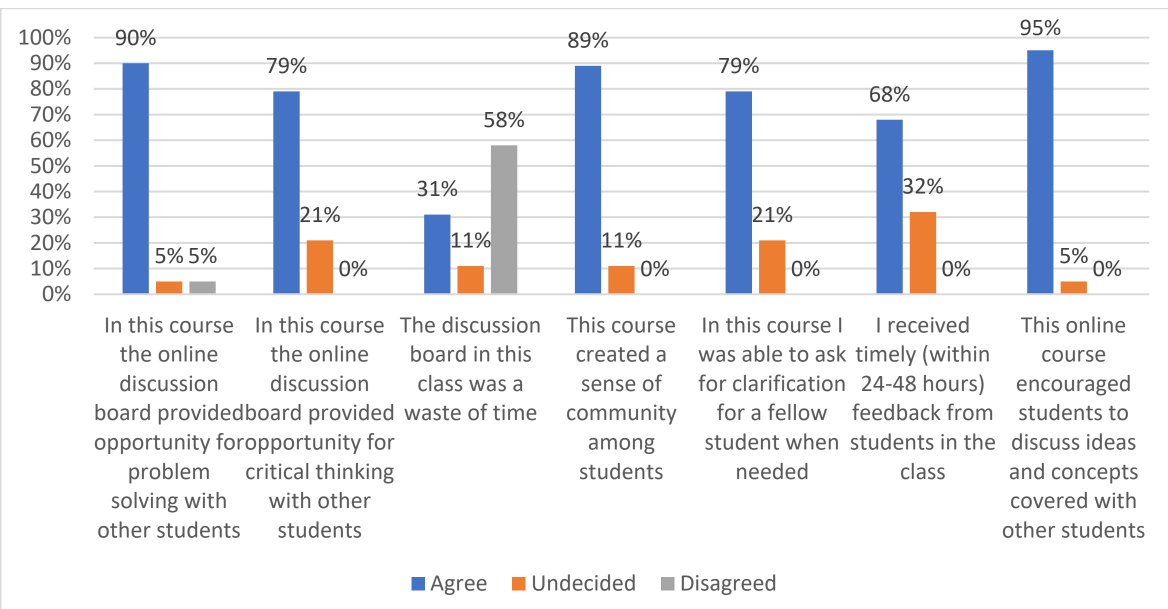
Participants rated most of the learner-instructor interactions positive. Nearly half (48%) of them expressed frustration because of lacking feedback from the professor, but around 90% of them could receive timely feedback, gain attention from the professor, facilitate communication, and feel the professor's presence (Figure 2).

Figure 2. Learner-instructor Interaction



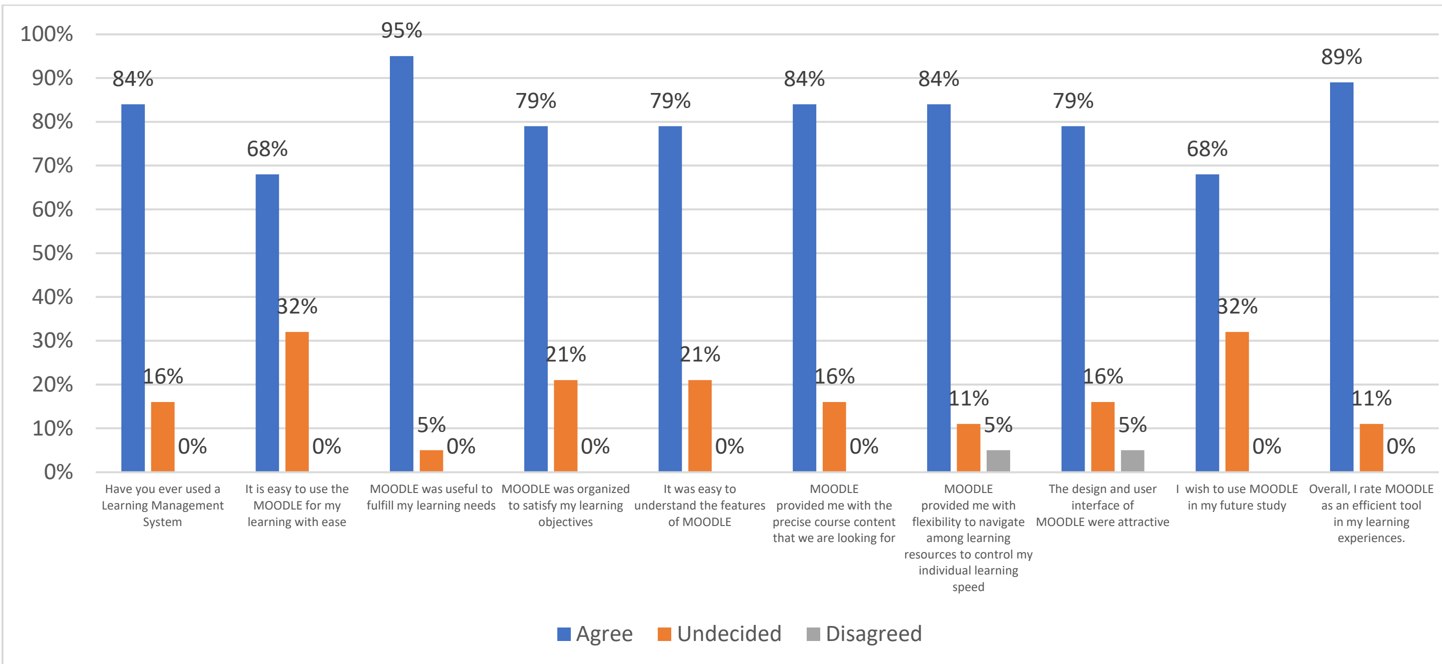
Most participants believed the online discussion board was an effective tool for providing problem solutions to other students (90%) and opportunities for critical thinking with other students (79%), asking for clarification for peers (79%), and discussing ideas with peers (95%). A small portion of participants expressed that the online discussion board was a waste of time (31%) and that they did not receive timely feedback from peers (32%) (Figure 3).

Figure 3. Learner-learner Interaction



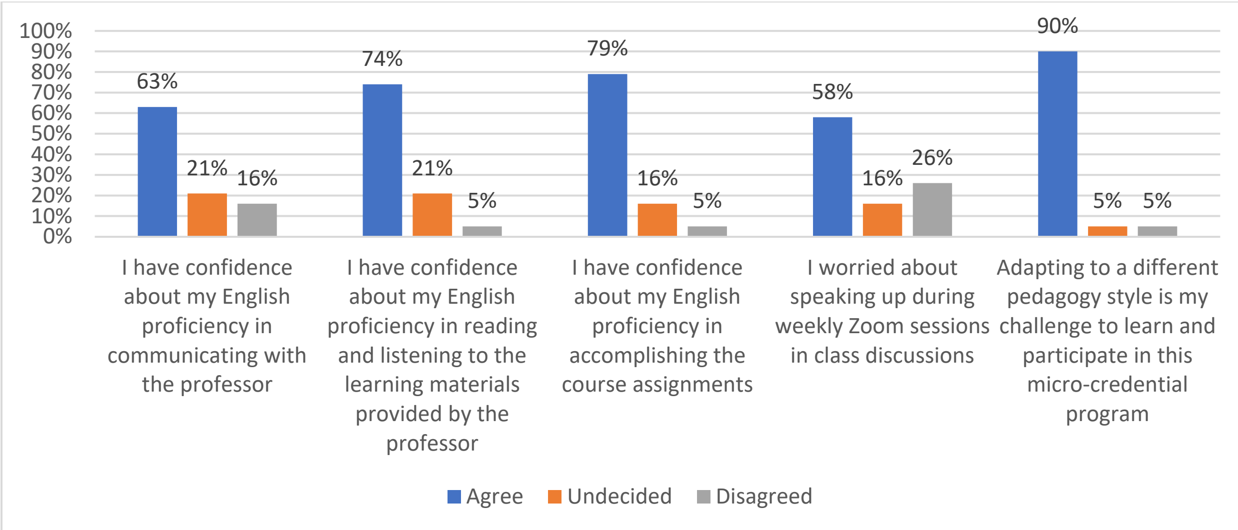
Most participants (89%) rated Moodle positively as a tool facilitating online learning, including ease to understand MOODLE features (79%), useful for fulfilling learning needs (95%), well organized to satisfy learning objectives (79%), and provide precise course content (84%) and flexibility to navigate among learning resources according to individual learning speed (84%). Fewer participants (68%) expressed the ease of using MOODLE for learning and willingness to use MOODLE in a future study. Participants explained that the open-ended questioning used in this study was sometimes slow in loading contents (Figure 4).

Figure 4. Learner-technology Interaction



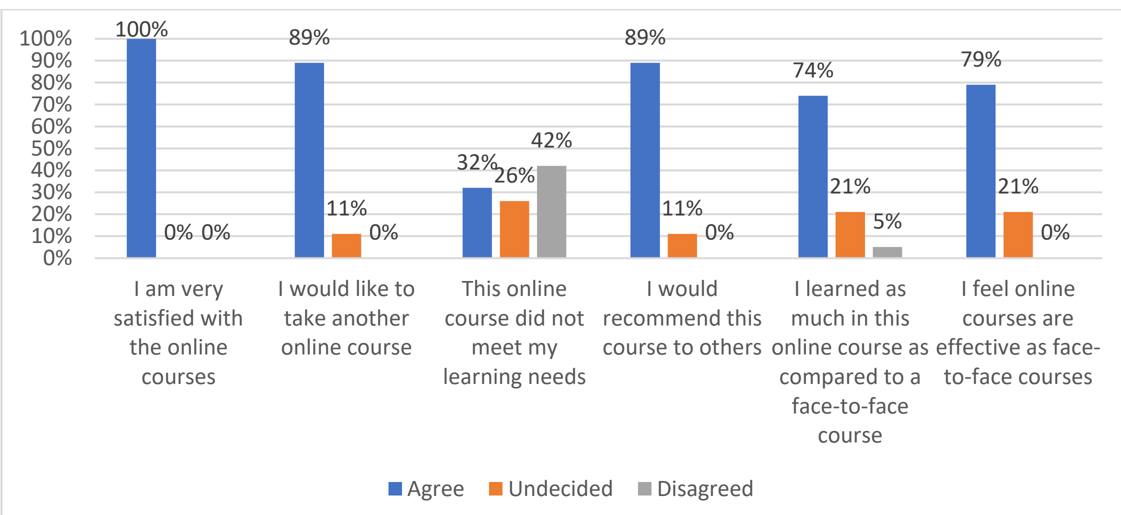
In terms of the impact of academic culture on online learning experiences, most participants agreed that they have confidence about their English proficiency in communicating with professors (63%), reading and listening to the learning materials provided by the professor (74%), and accomplishing the course assignments (79%). However, over half of the participants (58%) worried about speaking up during weekly Zoom sessions in class discussions. Adapting to a different pedagogy style was the major challenge to learning and participating in the two courses (90%) (Figure 5).

Figure 5. Academic culture satisfaction



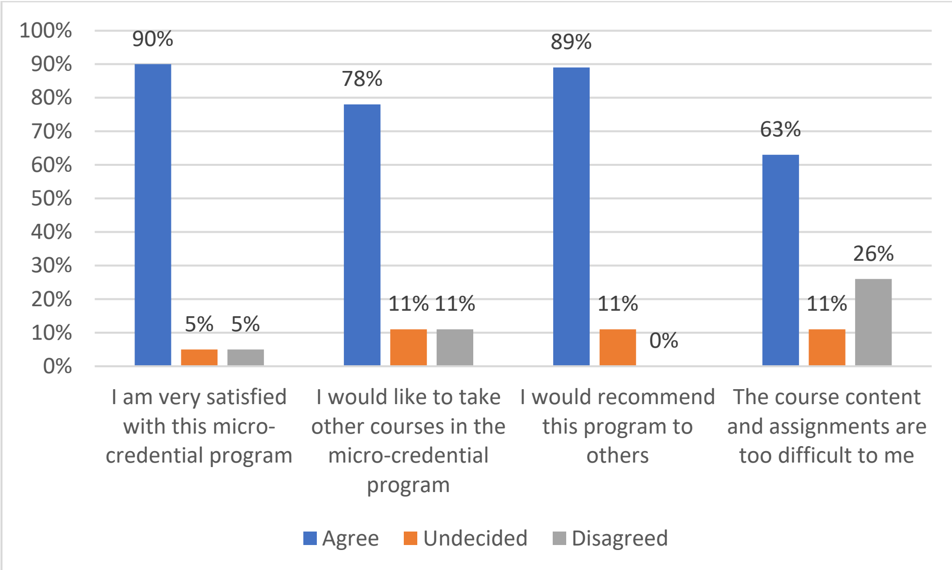
All participants were satisfied with the two online courses. Most participants would like to take another similar online course (89%), recommend this course to others (89%), and believe they learned as much in the online courses as in a face-to-face course (74%) and felt it was as effective as face-to-face courses (79%). However, below half of the participants stated that the two online courses meet their learning needs (Figure 6). Participants in the open-ended questions explained their expectations on more oral communication, group projects, and richer learning content and materials.

Figure 6. General Course Satisfaction



In the assessment of the micro-credential program, most participants were satisfied with the program (90%) and would like to take other courses in the micro-credential program (78%) and recommend this program to others (89%). Most participants expressed difficulties with the course content and assignments (Figure 7).

Figure 7. Program Satisfaction



For the open-ended questions, participants mentioned that their primary motivation to enroll in the micro-credential courses was to understand foreign cultures, experience western pedagogy, and improve their English proficiency through communication with an American professor. When discussing the program's learning outcomes, participants described various ones, including a preliminary understanding of American culture, improved English proficiency, mastered practical skills, and changed thinking mode via experiencing different pedagogy.

Echoing the motivations, participants encountered challenges during online learning, such as inadequate English proficiency to interact with the professor and learning materials and incompatibility with a learner-centered learning approach. In response to the challenges, the participants suggested extending the weekly Zoom sessions to increase in-class discussions and improve oral English skills, providing course handouts for self-study after class, and increasing group assignments and practice opportunities.

Discussions

For years, various scholars have discussed higher education online learning (Anderson, 2004; Dumford 7 Miller, 2018; Hiltz & Turoff, 2005) and cultural competency (Frawley et al., 2020; Helms, 2003; Rogers-Sirin & Sirin, 2009). The continuous development of information technology and the global COVID-19 pandemic provide new opportunities and challenges for the two widely discussed topics. This study combines the two to observe the intercultural impact of online learning by offering courses to Chinese college students who had never been exposed to higher education in the U.S. through an online learning platform. Students who participated in the survey gave positive feedback on the program and the courses. They expressed their willingness to enroll in similar online courses and recommend them to others. As an initial exploration, this present study indicates the feasibility of future online courses such as these described in this project to be offered in higher education institutions in China based on participating students' reported satisfaction.

It is essential to support online learning by providing students with sufficient course-related learning materials, such as readings (e.g., textbooks, websites, journal articles), videos, PowerPoint slides, and handouts, on the platform of an LMS. Due to the difference between cognitive academic language competence and language used in social situations (Cummins, 1980), terminologies appeared in the subject courses, and relating learning materials may be difficult for students who speak English as a second language to understand (Cuevas, 1984). Therefore, students need to reflect and deepen their understanding after class by looking at, and translating into their first language, if necessary, readable learning materials consistent with the content of the synchronous discussion.

Most higher education institutions in the U.S. apply student-centered pedagogy that emphasizes teamwork, class participation, critical thinking, independent learning, and student perspectives (Gu, 2008; Kingston & Forland, 2008; Parris-Kidd & Barnett, 2011; Yan & Berliner, 2009). On the other hand, Chinese universities apply more teacher-centered pedagogy, emphasizing the teacher's authority in the classroom (Li et al., 2014). It leads to Chinese college students being unable to adapt to western pedagogy and face academic challenges at the beginning of the program. Even though being familiar with western pedagogy was one of the main motivations of the students who participated in the program, they still expressed discomfort with the pedagogy and obstacles to their learning process.

Awacorach et al. (2021) proposed an approach to combine the two pedagogies and enhance students' understanding of knowledge, interest in learning activities, and teamwork abilities through community-based group practice activities combined with the instructor's continuous indoctrination of knowledge from textbooks. Take the group assignment of the program as an example, which asked students to work in groups to make an instructional video. Based on Awacorch's (2021) suggestions, in future programs, group assignments can be designed as, for instance, asking students to create an instructional video about smart devices use for community seniors according to interview results, Zoom lectures, and reading materials (e.g., multimedia design principles). Students can transform their efforts into social knowledge wealth, provide convenience for the community, and understand classroom knowledge comprehensively. It also meets the learning needs expressed by students about more variable group projects and learning activities.

Echoing Yi's (2001) and Griner and Sobol's (2014) findings, the primary purposes of students participating in the micro-credential program were to experience foreign cultures and different pedagogies. However, students in the program also have their peculiarities, such as the potential relatively insufficient English proficiencies, compared with those who traditionally emigrate to other countries for part or all of higher education. It explained why the students also attend the program to improve their English skills, expect more opportunities for oral English communication during learning, and believe English was one of the academic obstacles. Meanwhile, it further emphasized the significance of providing students with consistent reading materials during the online synchronous sessions. Also, many universities in the U.S. often offer English training programs to international students with insufficient English proficiency before entering regular undergraduate or graduate programs to facilitate students' academic success (Andrade, 2006; Sherry et al., 2010). Future online interculture programs can also take similar measures to meet students' learning needs and reduce relevant academic barriers.

Limitations and Conclusions

Limitations of this study lie in the uneven distribution of participants' gender, which may lead to the lack of representativeness of survey results and bias. The diversity of participants' majors and their inconsistencies with the courses offered by the micro-credential program may also lead to bias in their perceptions of the program. The smaller sample size may also lead to the results' lack of generality.

COVID-19 has a negative impact on cultural and academic communications among students in higher education institutions by visiting and participating in foreign universities and relevant academic activities. However, the rapid development of information technology has provided new opportunities for online academic and cultural communications. This study indicated that participating students rated the micro-credential program positively, were willing to recommend it to others, and participate in similar academic programs in the future. During future programs, instructors can provide students with rich learning materials to help them understand the content and combine student-centered and teacher-centered pedagogy to improve students' learning outcomes.

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Learning of Older Adults with Technology: Implications for Future Research

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Abstract: With the rapid development of technologies and continuing aging of the world population, lifelong learning of older adults with technology has attracted more attention in recent years. Using a systematic review approach, we reviewed research addressing the lifelong learning of older adults using technology from 2010 to 2021 to reveal the research characteristics and themes. We determined possible gaps in the existing body of literature and recommend future research developments in lifelong learning of our global aging population with technology. In the study, we found educators, academic researchers, and social work practitioners' increased interest in promoting formal and experiential lifelong learning opportunities and digital inclusion for older adults. With a clear understanding of reviewed research, we provide evidence-based suggestions for future research and the practice of lifelong learning by tapping into the power of technology with more precise and meaningful approaches.

Key Words: Lifelong learning, older adults, technology

With the pervasiveness of technology throughout all aspects of modern society, it is essential that people of all age groups have equal opportunities to be digitally included and enjoy the same benefits brought by digital technologies. However, due to inadequate digital skills and other structural barriers, many older adults cannot use digital technologies to their full potential as most young people do. Technologies promote social connectivity through communication, lifelong learning and personal growth, and participation in daily activities such as online banking, shopping, entertainment, or e-health services (Ihm & Hsieh, 2015; Schreurs et al., 2017). A cluster analysis from the Pew Research Center shows that older adults have lower levels of "digital readiness" and lower levels of personal learning activity, which is connected to levels of education and socio-economic status (Horrigan, 2016).

The European Union has proposed that social and economic inclusion and quality of life for an aging population can be achieved through innovative solutions incorporating ICT (European Economic and Social Commission, 2010). Similarly, to bridge the digital divide, the Australian government committed to investing $50 million to ensure that older adults would be equipped with the skills and knowledge to participate in the modern digital economy (Commonwealth of Australia, 2015). Also, one of the goals of the United Nations in its 2030 Agenda for Sustainable Development (United Nations, 2021) is to ensure inclusive and equitable quality education and to promote lifelong learning opportunities for all, increasing the proportion of youth and adults with ICT skills.

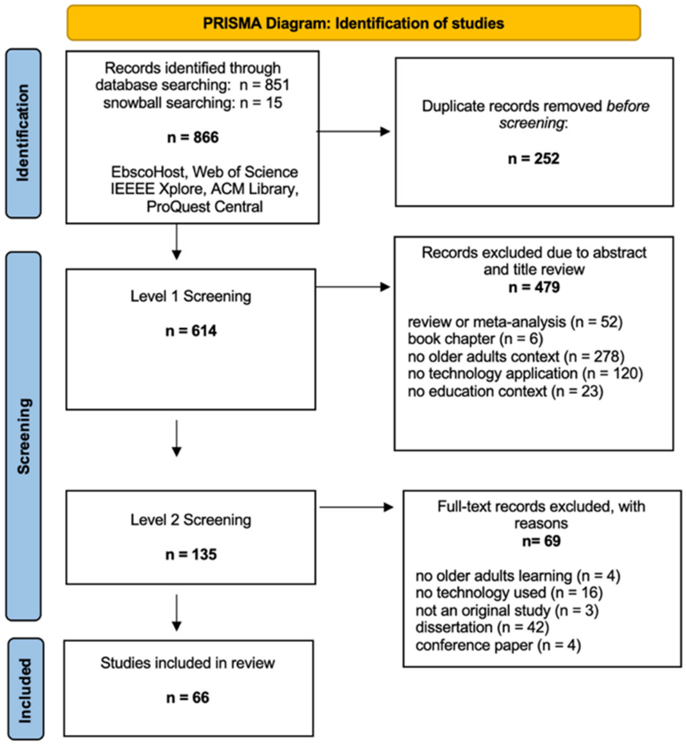
Lifelong learning, which resides in sociology and gerontology while intersecting with many other disciplines such as education, social work, and health care, aligns well with this U.N. goal. Scholars have conducted theoretical and empirical research on the technology used to promote learning, including studies of technology used to combat social isolation (Baker et al., 2018); technology acceptance in general by seniors (Peek et al., 2014); and reviews on the use of assistive technology for seniors within healthcare settings (Ramprasad et al., 2019; Yusif et al., 2016). Despite researchers' enthusiasm, there are few or no current systematic literature reviews of research on the intersection of lifelong learning of older adults and technology.

To fill the research gap, we conducted a systematic literature review of original, peer-reviewed research studies on the learning of older adults or seniors with technology that used quantitative, qualitative, and mixed-methods approaches. This systematic review aimed to achieve the following objectives: (1) to gain a deeper understanding of characteristics and themes, (2) to identify challenges and gaps, and (3) to seek the future direction of research on the intersection of learning of older adults and technology. The review results will inform educators, social workers, and policymakers about the current state of learning of older adults with technology and possible future research and social services for improved aging and independent and active living.

Review Methodology

Guided by systematic literature reviews (Moher et al., 2009), we searched for articles published in English between 2010 and July 2021 from the following databases: EbscoHost, Web of Science, IEEEE Explore, ACM Library, and ProQuest Central. We used different combinations of terms which generated eight search strings. Further snowball searching generated more records for a total of 866. All search results were logged into the reference-management software Zotero, and after duplicates were removed, we had 614 records to screen. We performed two levels of screening and identified 66 studies by researchers in 28 countries/regions with sample populations of adult learners aged 50 years and older (Figure 1).

Figure 1. *The PRISMA Flow Diagram for the Systematic Review*



Research Questions

Three research questions guided this review to provide a comprehensive picture of the targeted research (2010-2021) on the learning of older adults with technology. *Older Adults* are defined by the United Nations (2017) as those individuals aged 60 years or over. In this review, however, some samples of older adults in the articles reviewed were 50 years and older.

1. What are the characteristics and themes of research on the learning of older adults with technology as reflected through peer-reviewed publications (2010-2021)?
2. What are the challenges and gaps in research on the learning of older adults with technology as reflected through peer-reviewed publications (2010-2021)?
3. What implications can be drawn from the review results for future research and practice?

Some sub-questions were also generated to guide and facilitate this systematic review:

- (RQ1) What journals publish research on the learning of older adults with technology?
- (RQ2) What are the countries/regions of authors researching the learning of older adults with technology?
- (RQ3) What are the most frequently published research topics on older adults learning with technology?
- (RQ4) In what ways have the topic trends of this research changed over time, as revealed by the keywords?
- (RQ5) What research methodologies are used in the research on the learning of older adults with technology?

- (RQ6) What types of technology are used in research on the learning of older adults with technology?
- (RQ7) What is the demographic information of participants in research on the learning of older adults with technology?
- (RQ8) What are the common limitations, challenges, and gaps in research on the learning of older adults with technology?

Data Extraction and Analysis

A template in Excel was used to guide the extraction process to retrieve the relevant data from each article matching the inclusion criteria. The template covered different aspects of the studies, including keywords, research questions or purpose of study, the sample (e.g., sample size, age range), methodology and design, data analysis, theoretical framework, key findings, recommendations for practice, future research, limitations, and suggestions for future research. The two researchers coded a few articles independently and then compared their results to ensure the instrument's reliability and validity. In the case of qualitative studies and data from mixed methods studies, themes were also coded; for quantitative data, we coded the variables into numbers for descriptive analysis. Thematic analysis was used to review each article's results and discussion sections to synthesize common ideas to identify gaps and potential areas for further research.

Results

We synthesized and summarized key findings from the selected articles, which presented results to answer research questions and the thematic analysis results from the selected research.

Characteristics and Themes of the Selected Research

(RQ1) What journals publish research on the learning of older adults with technology? Our systematic review included studies published in 66 journals. Table 2 shows the journals that were included more than once, the number of articles, the impact factor, the publisher, and the country of publication. Almost one-quarter of the articles (14 out of 66 or 21.2%) were published in *Educational Gerontology*, followed by *Computers in Human Behavior* in the United Kingdom. Out of 66 journal articles, 30 (45.45%) were published by the seven journals dispin Table 1.

(RQ2) What are the countries/regions of authors researching the learning of older adults with technology? Among the selected articles, most of the authors were from the United States (26), followed by Spain (6), Taiwan, China (5), and the United Kingdom (4), which reflects the authors' locations and very likely, the locations where these studies were conducted. Four articles (Anikeeva et al., 2019; Blažun et al., 2012; Tsai et al., 2015; Tsai et al., 2019) were written by authors in two different countries.

(RQ3) What are the most frequently published research topics on older adults learning with technology? We analyzed the 474 keywords from 52 of our 66 articles to determine the most frequently published topics. It must also be mentioned that ICT, the acronym for "information communication technology," is commonly used to describe various digital technologies to access information, such as the Internet, wireless networks, mobile devices, and other modes of communication. Table 2 lists the top ten keywords according to their frequency

in the selected articles. The high frequency of these keywords reflects researchers' degree of interest in these topics.

Table 1. *Journals Included More than One Time in the Review and Their Information*

Journals in Review	Number of Articles	Impact Factor	Publisher	Country
Educational Gerontology	14	0.490	Routledge	UK
Computers in Human Behavior	4	6.829	Elsevier	U.K.
Gerontology & Geriatrics Education	3	1.170	Routledge	US
International Journal of Lifelong Education	3	0.620	Routledge	UK
Computers & Education	2	8.538	Elsevier	U.K.
Journal of Extension	2	0.240	Extension Journal, Inc.	U.S.
New Media & Society	2	8.061	Sage	UK

Table 2. *Frequency of Key Words from the Reviewed Studies*

Key Word	Frequency
older adults	18
technology	15
learning	15
digital	12
social	12
internet	7
ICT	5
lifelong	5
computer	4
divide	4

(RQ4) In what ways have the topic trends of this research changed over time, as revealed by the keywords? VOSviewer (Van Eck & Waltman, 2010), a software package for visualizing the connection between terms and creating and exploring maps based on network data, was used for analysis. We input the title and abstract data from all 66 articles and opted for the co-occurrence of keywords, resulting in 114 items grouped into 6 clusters, with 1430 links between them. Links indicate the number of publications in which two terms occur together. The network visualization (Figure 2) shows terms with a greater weight with more prominent labels and circles, such as "older adults," "lifelong learning," and "computer attitudes." The color coding indicates publication dates, and it is apparent that in more recent years, there has been an emphasis on topics such as digital inclusion, loneliness, and social participation.

Figure 2. *Network Visualization of Keyword Co-occurrence*

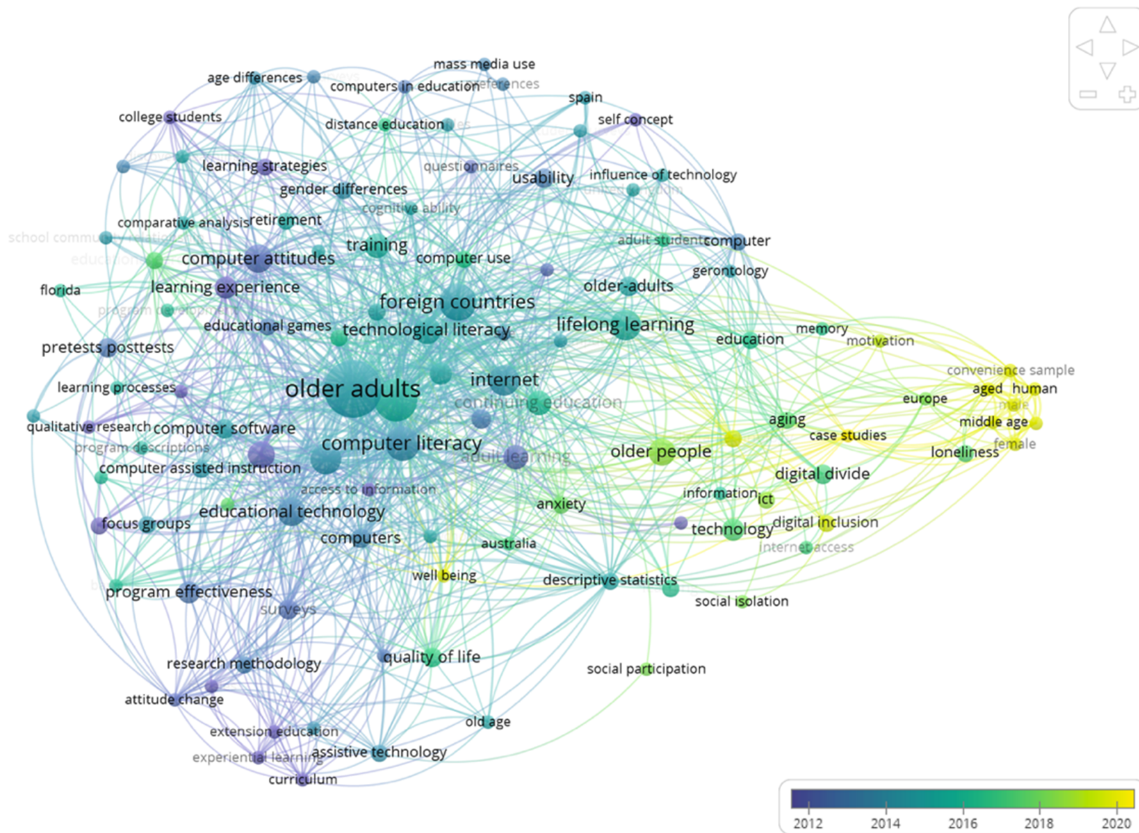
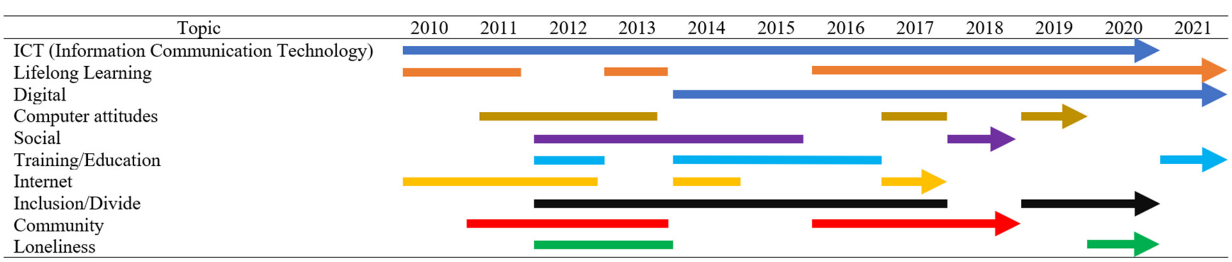


Figure 3 reveals the top ten most persistent research topics over time, including "ICT," "lifelong learning," "digital," "inclusion/divide," "training/education," and "community." The increasing interest in “distance learning” (2021) in publications reflects a global learner transition to remote and distance learning during the COVID-19 pandemic.

Figure 3. *Topic Trends by Year (2010 -2021)*



(RQ5) What research methodologies are used in the research on the learning of older adults with technology? According to the authors, this systematic review includes 28 quantitative research studies, 21 qualitative studies, and 17 mixed-methods studies. A total of 17 research studies (25.8%) did not specify their research design. The most frequently employed designs were quantitative with descriptive statistical analysis (9 studies, or 14% of total) and

experimental ones (7 studies, or 11% of total) with both descriptive and inferential statistical data analysis methods.

(RQ6) What types of technology are used in research on the learning of older adults with technology? In many studies, older adults were enrolled in technology learning courses and were surveyed and observed as they learned new applications. Those applications, when specified, most frequently addressed the use of the Internet and navigation of various websites (10 of 66 studies, or 15.2%). Other researchers studied older adults' use of computer software such as word processing or spreadsheets, followed by tablets, e-learning, and assistive technology. In many cases, the term "ICT" was used broadly without reference to the exact applications with which the participants were engaged. Findings from these studies focused on methods to engage older learners, types of training materials they prefer, and how ICT can impact their well-being.

(RQ7) What is the demographic information of participants in research on the learning of older adults with technology? Many studies (54 out of 66, or 82%) reported the age group of their study participants. It is generally accepted that "older adults" in the selected studies refer to individuals aged 55 or older. There are gaps in research for the upper age range participants, such as 65 and older. Additionally, there were more female participants than male ones. Participants were most frequently recruited from ICT courses in senior centers, lifelong learning centers, universities of the third age, public libraries, and assisted living facilities.

(RQ8) What are the common limitations in research on the learning of older adults with technology? Frequently cited limitations in the selected studies (25 of 66, or 37.8%) were related to homogeneous participants with similar characteristics such as age group or ethnicity, an imbalanced gender ratio, use of one or limited locations, and the self-identified nature of technology users to the exclusion of non-users. In 15 of 66 studies (22.7%), researchers cited a small sample size and the use of convenience sampling as limitations. Other limitations (6 of 66, or 9%) included a study time that was too short; the translated text may not have conveyed the intended meaning of the original questionnaires; or incomplete data sets. We found it unusual that 20 of 66 studies (30.3%) did not include a limitations section or report any possible limitations in their studies. The common limitations reflect the challenges of researching older adults' learning with technology.

Thematic Analysis Results

Promoting Digital Inclusion of Older Adults. The selected publications also reveal the passion certain researchers had to promote the digital inclusion of older adults as they engaged in their studies. For example, Pinzon-Pulido et al. (2019) studied how the “En buena edad” (e.g., at a good age) web platform in Spain focuses on the World Health Organization’s four pillars on active and healthy aging. They incorporated feedback from multiple stakeholders to improve the functionality of their platform and noted in their findings that older people are essential advocates of their health interests and concerns; they need to be recognized with respect and given a voice when developing policies and plans (Pinzon-Pulido et al., 2019). Another example was Reneland-Forsman (2018), who discussed digital exclusion as an obstacle to seniors in Sweden as they struggled to interact independently in social, cultural, political, and commercial contexts using digital interfaces. Reneland-Forsman (2018) equated their lack of digital use to a loss of independence and civic participation, and Munoz et al. (2020) suggested a sustainable adult education program for effective digital inclusion. These studies advocate for and promote the digital inclusion of older adults in their social contexts.

Formal and Informal Learning. The review revealed that most of the selected studies were implemented in formal learning situations, which are very different from those of informal learning occurring at home or even during travel. Organizations that cater specifically to lifelong learning, such as the Road Scholar Lifelong Learning Institute Network and the UNESCO Institute for Lifelong Learning (UIL), take a holistic and integrated approach to lifelong learning as the guiding paradigm for 21st-century education. They support lifelong learning and educational equity, focusing on literacy and non-formal basic education. Nygren et al. (2019) found that non-formal learning skills were positively associated with problem-solving skills in technology-rich environments, indicating that adults' learning ecologies combine formal, non-formal, and informal learning. Walcutt and Malone (2019) contend that while we have primarily documented and valued only formal learning experiences, "informal and experiential learning can have as much, or even more, impact on individuals' abilities to acquire, assimilate, and apply knowledge" (p. 77).

Barriers to ICT Usage Among Older Adults and Recommendations. Our review has identified several critical barriers to older adults' ICT usage and recommendations from selected studies. For instance, due to age-related functional and cognitive declines, many older adults expressed fear, anxiety, discomfort, lack of confidence, or lack of general interest in learning, especially when ICT education programs or the use of new devices required a large amount of memorization and complicated steps (Heaggans, 2012; Hill et al., 2015; Morin et al., 2021). Perhaps more importantly, the causes of older adults' digital divide stem from contextual factors, particularly the lack of appropriate educational resources, information, and opportunities to develop and practice ICT skills (Anikeeva et al., 2019). These contextual constraints further decrease older adults' confidence in and motivation to learn with technologies.

In response to the COVID-19 pandemic, many researchers have made practical recommendations for effective learning for older adults, including considering seniors' characteristics, needs, and constraints. Researchers have suggested prolonged learning periods, sufficient practice time, scaffolded tasks, attention to ergonomic issues, and clearly written printed training materials and visual aids when assisting older adults in learning with technology (Calvo et al., 2017; Huber et al., 2014; Wood et al., 2010; Zheng et al., 2016). Many have also advocated for more learner-centered approaches and increased time to collaborate with peers (Lin et al., 2012; Prodromou et al., 2019; Sayago et al., 2013). In addition, peer mentoring with an intergenerational approach was recommended (Sanders et al., 2013; Stanley et al., 2019).

Discussion

In the review, we found that a limited variety of technologies were studied. Only two studies (Hermann et al., 2012; Parker et al., 2011) addressed the use of assistive technology to empower older adults, in both cases to independently grocery shop and prepare food. We believe the learning needs of older adults are diverse, and research to help them with their learning needs should include the functionality of more technologies such as wearable technology, learning with home robots, and other assistive technology tools. As Pihlainen et al. (2021) pointed out, digital literacy is a relatively narrow definition that covers a range of technology skills; however, socio-emotional aspects of technology use are even more critical for older adults. The technical, socio-emotional, and cognitive aspects of older adults learning with technology should be considered if active aging is the ultimate driving force behind these learning efforts.

Most selected studies were conducted in formal learning environments with established learning objectives and outcomes. In reality, learning of older adults with technology occurs in formal and informal situations. LIFE Center (2005) indicated that more than 80% of learning during our life span occurs in informal learning environments. Our review indicates a clear need for more research to explore the informal learning of older adults with technology. We hope to see more research investigations in this area in the future.

With the rapid development of smartphones, learning how to use them best should not be limited to communication and social connectivity. As more services in society transition to a digital format, older adults must be digitally included. Research is very much needed to explore practical ways to assist older adults in using smartphones for daily activities and routine services, such as managing social benefits, e-health platforms, food-ordering services, and transportation. More research on the learning of older adults with smartphones and other digital devices is needed to align research with current social efforts to promote active aging through lifelong and life-wide learning (LIFE Center, 2005). We also want to draw readers' attention to the demographic information of study participants, which is quite skewed in terms of gender and age representation among the selected studies. There were 703 million persons aged 65 years or over in the world in 2019, projected to double to 1.5 billion in 2050 (United Nations, 2019). As such, more research is needed on participants in this upper age group with a balance in genders if researchers want to theorize the learning with this particular group of people and provide evidence-informed guidance to improve active aging through lifelong and life-wide learning.

Our review paints a picture of the research on the learning of older adults with technology for future research and practice. Accordingly, we offer the following suggestions:

- Agreeing with numerous researchers (Demirbilek, 2010; Ihm & Hsieh, 2015; Kuo et al., 2013; Munoz-Rodriguez et al., 2020; Seifert et al., 2017; Winstead et al., 2013), we recommend longitudinal studies for future research of active aging through learning to measure changes in confidence, competence, and participation accurately.
- Future research should pay more attention to clarity in methodology to increase the study's validity and assist other researchers in replicating these studies at their own sites. Researchers must address the imbalanced gender ratio among participants, with significantly fewer male subjects, to fully explore gender as a variable. The same issue with age groups of participants should also be addressed.
- Future research should expand digital access with devices that individuals already own and could use for greater functionality, such as smartphones or smartwatches, home robots, and other assistive technology. We sincerely hope to see future studies explore the learning of older adults with various technologies in informal situations. The results of such research can help promote lifelong and life-wide learning with evidence-based principles.
- We suggest researchers and practitioners in social service, gerontology, and educational technology engage in more collaborations to conduct field-needed and field-based research. This collaboration can tap into modern technologies that support education about health, independence, safety, and social engagement, which are critical aspects of active aging through learning.
- Educators, who provide learning opportunities for older adults, should consider not only the principles of adult learning but also the unique needs and special characteristics of this age group, being sensitive to ergonomic issues, leveraging the benefits of peer

learning, and drawing on their immense life experience, knowledge, and skills for learning.

Conclusion

After applying our selection criteria discussed in the research methods section above, we significantly narrowed the available studies to capture the research on the learning of older adults with technology. Despite our use of a thorough search strategy, some empirical studies may not have been identified (e.g., gray literature such as unpublished documents and reports) since we only included papers published in peer-reviewed journals. As we coded our articles and charted them based on categories for quality assessment, we realized that the lack of thorough study reporting in many instances and the heterogeneity of technology applications and research questions prevented us from conducting a meta-analysis. Another limitation is that only articles written in English were included in our review. This decision stemmed from the practical inability to survey all studies in all languages; however, we could still incorporate the results of studies from many different national contexts rather than focus solely on studies dealing with English-speaking countries.

The findings presented here provide helpful guidance and direction to other scholars similarly interested in the intersection of learning for older adults and technology. It is our hope and aspiration to promote field-needed and field-based research and, at the same time, research-informed and evidence-based practice when it comes to the learning of older adults with technology. With continual advancements and innovations in technology, much more needs to be done in research and practice to provide older adults with effective lifelong learning opportunities and, thus, enhanced well-being in all aspects of their life.

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Evaluating Students' Art History Learning Performance and Game Flow Experiences in an Educational Game

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Abstract

Educational games can be interactive learning tools to enrich art history education. ARTé: Mecenas is an educational video game that supports students' learning of art history topics. To explore players' enjoyment in ARTé: Mecenas, the gameplay studies were conducted at two southern public universities in the United States. The studies adopted a scale measuring players' enjoyment based on the EGameflow scale (Fu et al., 2009), which comprised six factors (i.e., Concentration, Goal Clarity, Challenge, Autonomy, Immersion, and Knowledge Improvement). The findings have shown students' game flow experiences in ARTé: Mecenas and their learning improvement through the gameplay. The results confirmed students' game flow experiences and learning performance. Additionally, students' gameplay patterns in ARTé: Mecenas were revealed via the clustering analysis, which addressed students' persistence issues and possible reasons for the different learning achievements via the gameplay.

Keywords: art history game, educational game, game flow, game mechanics, clustering.

Introduction

Educational games have been developed to support learning for over two decades. Numerous research articles have been published in the last decades and demonstrated the learning efficacy of educational games (e.g., Tüzün et al., 2009; Hwang et al., 2013; Muntean et al., 2018). Research studies have revealed student motivation in educational games (e.g., Burguillo, 2010), emotional identification (e.g., Christinaki et al., 2014), narrative design in games (e.g., Dickey, 2006), effects of gender differences (e.g., Yang & Chen, 2010), and promotion of self-efficacy in game-based learning (e.g., Hung et al., 2014). Previous game research has involved different subjects at different educational levels, such as mathematics learning in an elementary school (e.g., Kebritcki et al., 2010), computer science education in a high school (e.g., Papastergiou, 2009), English vocabulary learning for college students (e.g., Yip & Kwan, 2006), and civil engineering in higher education (Ebner & Holzinger, 2007). Many of these research studies have acknowledged the significant impacts of educational games on learning from different perspectives.

To better understand the impacts of educational games and the underlying reasons causing the effects, some studies have adopted the flow theory to evaluate players' enjoyment during gameplay to understand their experiences. These studies have reported that games can generate and model players' enjoyment via setting performance expectations and completing a certain difficult level of game tasks (Klimmt et al., 2009). Game enjoyment is also related to a player's self-esteem. A delightful game can improve a player's competence in the game and further promotes the player's self-esteem (Klimmt et al., 2009). Therefore, it is worthy and beneficial to probe players' game flow experiences to evaluate their enjoyment during the gameplay.

In this study, we aim to investigate (1) students' game flow experiences when playing the game *ARTé: Mecenas*, (2) the association between students' game flow experiences and learning performance, and (3) students' gameplay patterns in *ARTé: Mecenas.*

Theoretical Background

Csikszentmihalyi (1990) was the first scholar to evaluate flow experimentally. According to Csikszentmihalyi (1990), flow is an experience "so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous." The flow state is a state of complete engagement in an activity that involves an optimal experience (Csikszentmihalyi, 1990). The optimal experience integrates cognition, motivation, and emotion. Csikszentmihalyi (1990) mentioned eight elements of the flow state and proposed a three-channel flow model composed of boredom, flow, and anxiety. The flow state is linear from the beginning of the task and starts to change with the progressed tasks and challenges (Kiili, 2005). A flow experience aligns a person's skills with a certain level of task challenges in that the skills can be adapted to the challenges (Sweetser & Wyeth, 2005). Therefore, a task that generates a flow experience needs to be goal-oriented and rule-based with proper skills and mental involvement (Sweetser & Wyeth, 2005).

Sweetser and Wyeth (2005) proposed a game flow model to evaluate a player's gameplay experience called GameFlow. The model merges the flow state elements into computer games, which includes eight factors: (1) concentration, (2) challenge, (3) skills, (4) control, (5) clear goals, (6) feedback, (7) immersion, and (8) social interaction (Sweetser & Wyeth, 2005). Fu et al. (2009) presented a scale in the context of e-learning games, known as EGameFlow, based on Sweetser and Wyeth's GameFlow model (2005). Their study was conducted using four different e-learning games to test the validity and reliability of the EGameFlow scale. The scale consists of eight factors: (1) Concentration, (2) Goal Clarity, (3) Feedback, (4) Challenge, (5) Autonomy, (6) Immersion, (7) Social Interaction, and (8) Knowledge Improvement. According to Fu et al. (2009), Concentration relates to a player's focus on the game task and can be achieved when the task has clear goals and timely feedback is provided. Goal Clarity requires game tasks to be clearly explained at the beginning of the gameplay. Feedback helps players acquire the knowledge to complete game tasks. Challenges in a serious game address the player's competence and promote increasing the competence level. Autonomy is a player's perceived sense of control over the gameplay action. Immersion is a player's deep involvement during the gameplay. Social Interaction relates to the collaboration with peers in the game. Knowledge Improvement replaces the player's skills factor in the original GameFlow model to address the goals of educational game development. Overall, the EGameFlow scale not only detects a player's enjoyment through the game flow experience in a learning game but also reflects learning states during the gameplay.

Previous studies have used GameFlow, EGameFlow, or other methods to detect a player's game flow experience (e.g., Sweetser et al., 2020). Some studies have reported the impacts of game mechanics on the game flow experiences (e.g., Kiili et al., 2014). However, few research studies have addressed students' in-game actions and their impacts on the game flow experiences. The in-game actions can be indicatives of gaming strategies that can provide helpful information about specific game mechanics and their importance to the flow experience.

Moreover, there are some contradictive findings regarding the relationship between flow experience and learning. For example, Liu (2014) reported a positive but insignificant correlation between student game flow experience and learning outcomes, while Barzilai and Blau (2014) noted a significant prediction of flow on learning. Hence, it is necessary to investigate the relationship between students' game flow experience and learning performance.

Method

Study Design

In Fall 2017, gameplay studies were conducted at two southern public universities in the United States to evaluate the learning effectiveness of the educational game - *ARTé: Mecenas* (v2). Participants were mainly recruited from two undergraduate art history survey II courses. Participants were required to play the game within two weeks. Initially, 109 students consented to the gameplay studies. Before attending the studies, these participants had completed a unit on Renaissance art as part of the course instruction. Participants who did not play the game or finish the post-test were excluded from the analyses. In the end, 80 participants (61%) played the game and took both pre-tests and post-tests. Additionally, students were requested to complete a questionnaire after the post-test.

Instrument

ARTé: Mecenas (Thomas et al., 2016) is an educational video game that transports students into the 15th and 16th century Italian Renaissance (see Figure 1). During gameplay, players command history as the head of the Medici family, one of the most influential families of the time. True to the life of the Medici, players must balance relationships with powerful city-states, merchant factions, and the Catholic Church or risk excommunication, exile, and bankruptcy. As patrons of such luminaries as Michelangelo and Da Vinci, they learn to use their wits to build a banking empire, establish their reputation, and commission artworks. While playing the game, students are immersed in an experience that helps them grasp the role of art given societal norms. *ARTé: Mecenas* creates a relevant art history experience, deviating from traditional memorization to engage students with the curriculum at a deeper level.

The game's objective components were established based on the learning objective components of the expected achievements. Each game level has its unique game objectives. In the first game level of *ARTé: Mecenas*, the main task is to establish the wealth and reputation of Banco Medici in Florence. The related content topics mainly focus on the Medici's impacts on society and the support for artworks in Florence. In the second game level, the players need to expand the wealth and influence of Medici's family to foreign markets. The content topics involve increasing the Medici's impacts on other foreign cities and the artworks of religious figures such as the Magi in works by Francesco di Pesello and Fra Angelico. Other artists such as Nanni di Banco and Andrea del Castagno are introduced at this level. In the third game level, the main task for the players is to preserve the Medici's wealth and status in Florence and abroad. This level covers the topics such as the early career of Leonardo da Vinci, the rise of Humanist ideals, the links to the Greco-Roman past, and the introduction of oil paintings from Northern Europe through commissions to Joos van Ghent and Hugo van der Goes. In the fourth game level, which is the last level for the players to increase the Medici's influence and art patronage of the Medici. Michelangelo's art was raised at this level, the Academy of Art and Design was established, and the Medici's impacts arose.

Figure 1. ARTé: Mecenas

Measurement

Knowledge of Art History. Subject matter experts in art history designed and validated the test content. The pre-test and post-test had the same content items, including 28 multiple choice questions to assess the art history topic covered in ARTé: Mecenas. Each question was scored one point.

General Questionnaire. The general questionnaire included 16 items (see Appendix AI). Two five-point Likert-scale items measured the game's overall entertainment (i.e., with 1 being the least entertaining game to 5 being the most entertaining game) and game difficulty (i.e., with 1 being the easiest game to 5 being the most challenging game), respectively. The other 14 items were seven-point Likert scale, from 1 being strongly disagree to 7 being strongly agree. These items were students' self-evaluations about this game.

Game Flow. In the game flow questionnaire, six factors (i.e., Concentration, Goal Clarity, Challenge, Autonomy, Immersion, and Knowledge Improvement) were adapted from the scale of EGameFlow (Fu et al., 2009) were applied to measure players' game flow experiences. Two factors (i.e., Feedback, Social Interaction) from EGameFlow were excluded. The exclusion reason is that the game does not have direct feedback and social interaction mechanics. The game was built in a reality-simulated environment where each action could result in possible consequences as being a well-known celebrity (Medici) in history. There is no absolute right or wrong answer for each choice made in the game, but the consequences can still indirectly provide the player clues to being successful in the game. Therefore, the *ARTé: Mecenas* in-game feedback system is hardly being measured using the EGameFlow scale. In addition, *ARTé: Mecenas* is a single-player game. The version used in the studies does not have in-game communities that support social interaction. Therefore, the factor of Social Interaction does not apply to this game setting. The details of game flow items are presented in Appendix Table AII. All the items are on a seven-point Likert scale, with 1 being strongly disagree to 7 being strongly agree. Missing values on an item were replaced by the sample mean of that item. Two items in the survey were removed since the items' content was reversed. One item was "I am burdened with tasks in the game that seem unrelated," evaluating the factor of Concentration. The other item was "When I make errors, I cannot progress in the game," evaluating the factor of

Autonomy. The composite scores for each factor were computed as the sum of the corresponding item scores. A confirmatory factor analysis was run using the lavaan package (Rosseel, 2012) in R version 3.5.2. The results have shown that $\chi 2(237) = 464.0.34$ ($p < .0001$), CFI = 0.84, RMSEA = 0.109, SRMR = 0.076, which indicates a fair fit for evaluating these factors of enjoyment using the current dataset. The standardized factor loadings (SFL) are shown in Appendix Table AII.

Analyses. Several statistical methods and a clustering approach were deployed. First, a pair-sample t-test was used to test the change in students' learning from the pre-test to the post-test. Normalized learning gains were calculated using the formula below (Ruipérez-Valiente et al., 2016).

$$\text{Normalized Learning Gain} = \begin{cases} \frac{Post_{test} - Pre_{test}}{Max_{score} - Pre_{test}} \; if \; Post_{test} \geq Pre_{test} \\ \frac{Post_{test} - Pre_{test}}{Pre_{test}} \; if \; Post_{test} < Pre_{test} \end{cases} \quad (1)$$

where Max_{score} is 28 for both pre-test and post-test.

Multiple linear regression analyses were applied to examine (a) the relationship between student learning performance and game flow factors and (b) the most significant game flow factors for overall game entertainment. A linear model can be written as

$$y_j = \beta_0 + x_{j1}\beta_1 + \cdots + x_{ji}\beta_i \quad (2)$$

where the outcome of object j is modeled as a linear function of predictor value x_{j1}, …, x_{ji} with coefficients β_1,…,β_i, and e_j represents the unexplained component.

Relative importance is considered, which indicates each predictor's contribution to a multiple regression model (Grömping, 2006). In this study, the relative importance of predictors was measured using the Lindeman, Merenda, and Gold (LMG) method (Lindeman, 1980).

A clustering approach was implemented to seek student gameplay patterns, which can be indicatives of student gameplay strategies applied in the game. Clustering is a popular unsupervised data analysis approach grouping a set of objects into a homogenous group (Bradley et al., 2000). In this study, the K-Means clustering algorithm was deployed. In previous research, the K-Means algorithm has been successfully used to probe student performance (e.g., Oyelade et al., 2010).

In a given dataset including m data points x_1, x_2, x_3, …, x_m in R^d, the K-Means algorithm categorizes data into *k* clusters having *k* points $\{T_i\}$ (i = 1, 2, …, k) in R^d (see Equation (1)).

$$\frac{1}{m}\sum_{q=1}^{m}[min_i d^2(x_q, T_i)] \quad (3)$$

Each data point is assigned to its closest cluster using the Euclidean distance denoted by d (x_q, T_i). The *k* points $\{T_i\}$ (i = 1, 2, …, k) are known as cluster centroids. The Euclidean distance of its averaged squared value between a new data point and its closet cluster centroid is minimized, as shown in Equation (3). The K-Means algorithm is an iterative approach that executes *z* times of iterations to find clusters and update the cluster centroids until it reaches the local minimum (Bradley et al., 2000). We used 10-fold cross-validation to evaluate the performance.

In this study, each player's in-game actions were logged. Therefore, we retrieved nine features based on the game mechanics from the log data and applied the K-Means clustering approach. These features included:

1. Average elapsedtime: the average time in seconds spent on each action in the game
2. Average wealth: the average wealth achieved in the game
3. Average rep: the average reputation scores achieved in the game
4. Average soul: the average soul scores achieved in the game
5. Average alum: the average amount of stocked alum in the game
6. Average wool: the average amount of stocked wool in the game
7. Average linen: the average amount of stocked linen in the game
8. Reached HighestLevel: the highest game level that the player reached in the game
9. Duration seconds: the time duration in seconds between the first login date/time and the last login date/time

Results

According to the analysis results of students' performance, the increase in student learning from pre-test to post-test was significant ($mean_{increase}$ = 1.38, pre-test = 4.89 ± 1.94, post-test = 6.26 ± 2.14, $t(79) = 5.53$, $p < .001$, $d = 0.62$). The average normalized learning gains reached 2.5%. The regression result indicated that the overall model, including the pre-test performance score and six game flow factors, significantly explained 24% of the variance ($R^2 = 0.24$, $F(7, 72) = 3.3$, $p < .01$). The pre-test performance score significantly increases by 0.44 on the post-test score when controlling the rest of the predictors. Among these six game flow factors, Knowledge Improvement significantly predicted students' post-test scores ($\beta = 0.11$, $p = .04$), and it explained 4.88% variances after decomposing R^2.

According to the students' self-evaluation results, they thought that the game was entertaining to some extent (n = 80, M = 3.56, SD = 1.03). The game difficulty was also acceptable for them (n = 80, M = 3.13, SD = 0.85). They agreed that their knowledge was increased in all four game levels (see Table I). Among all the participants, 60% reached the highest game level (i.e., level 4) based on the game log data. Each game flow factor was positively associated with students' achieved game level. Among all the factors, students' achieved game level had the moderate positive linear relationship with the factors Knowledge Improvement ($r = .4$, $p < .001$) and Concentration ($r = .38$, $p < .001$).

Table I

Descriptive statistics of average rating on knowledge increase in each game level

Game Level	Number of Participants	Average Rating
Level 1	80 (100%)	5.54 ± 1.44
Level 2	70 (87.5%)	5.62 ± 1.25
Level 3	60 (75%)	5.75 ± 1.27
Level 4	48 (60%)	5.64 ± 1.41

In evaluating students' enjoyment during the gameplay, the game flow analyses showed that students agreed on all six factors. According to the result of the Concentration factor, students could concentrate on the game activities related to the learning tasks (M = 5.65, SD = 1.16). Among all the game flow factors, Goal Clarity scored the highest (5.98 ± 1.08). The Challenge factor showed that the game improved players' in-game skills, such as decision-making (5.68 ± 1.15), which could help the player succeed. The result of the Autonomy factor indicated that students hesitated to decide if they could agree upon the survey items listed in Appendix Table AII (4.63 ± 1.16). In addition, students were undecided if they could immerse themselves in the game, especially on emotional involvement (4.31 ± 1.51). Regarding Knowledge Improvement, the game encouraged students to apply their prior knowledge to the game events and integrate new knowledge with their prior knowledge (5.68 ± 1.18).

All six factors overall explained 50% of the variance when exploring the game entertainment ($R^2 = 0.5$, $F(6, 73) = 12.19$, $p < .001$). The Immersion factor significantly predicted game entertainment ($\beta = 0.12$, $p < .001$) and explained 32% of the variance across the whole model. However, other game flow factors were not significant predictors for game entertainment.

Regarding students' gameplay patterns, the K-Means clustering approach successfully identified four clusters. Players in cluster 3 and cluster 4 reached higher game levels than cluster 1 and cluster 2. Cluster 3 built the most wealth (Average wealth: 3892.88) and obtained the best reputation and soul scores (Average rep: 67.38; Average soul: 59.09) in the game. Cluster 3 also stocked most inventories, including alum, wool, and linen (Average alum: 18.63; Average wool: 22.09; Average linen: 18.02). These results indicated that the players in cluster 3 more actively traded goods in the game than in other clusters. Overall, cluster 3 understood the game mechanics better than other clusters. Compared to cluster 3, cluster 4 was possibly less cautious in making their in-game decisions based on their faster actions made in the game (Average elapsedtime: 73.08). Less wealth, lower reputation and soul scores, and fewer stocked amounts of goods also showed the differences between cluster 4 and cluster 3. One possible reason causing these differences was that cluster 4 spent less time on the gameplay than cluster 3 (Duration seconds for cluster 4: 41825.66; Duration seconds for cluster 3: 46545). Hence, it is highly likely that cluster 4 could have reached the last game level (i.e., level 4) as cluster 3 if they had spent more time on the game.

On the other hand, cluster 1 gave up playing the game before accomplishing game level 2, which yielded the least wealth, the lowest scores on reputation and soul, and the shortest time spent on the game (Average wealth: 89.88; Average rep: 23.49; Average soul: 19.63; Duration seconds: 24748.24). The possible reasons they were not persistent in the gameplay can be the lack of interest in this game or other unseen covariates irrelevant to the game itself (e.g., fatigue). Cluster 2 completed the game level 2 but stopped playing the game after that. It seems that players in cluster 2 were struggling during the gameplay according to their slow actions made in the game (Average elapsedtime: 278.78). These players in cluster 2 might need more straight guidance on understanding how the game mechanics worked to be successful in the game.

Discussion

This paper explored students' game flow experiences of *ARTé: Mecenas* and examined whether there was an association between the game flow factors and students' learning performance. The paper also probed students' gameplay patterns in the game that indicated students' gameplay strategies and potential issues encountered during the gameplay. Improving knowledge and skills is a core objective for developing an educational game and implementing the game in learning, which can further increase students' perceived enjoyment of gameplay (Tiger, 2000). According to the findings, *ARTé: Mecenas* can be a useful supplementary learning tool that allows students to apply the knowledge acquired from classes to the game tasks and helps students expand their knowledge and skills.

Overall, the results confirmed the importance of students' game flow experiences, which can significantly impact their dedication and persistence towards the game. The findings have shown that students could concentrate on the learning tasks in ARTé: Mecenas and had clear goals for these tasks. The challenges in ARTé: Mecenas matched students' perceived skills within the game. However, the students probably had difficulty fully achieving autonomy within the game. Autonomy reflects a player's freedom to make decisions during the gameplay (Kim et al., 2015) and is a player's intrinsic motivation that ultimately increases the overall enjoyment of the gameplay (Przybylski et al., 2010). To improve players' autonomy in the game, the teacher's facilitation of how to play the game at the beginning of the studies can be helpful. This facilitation can reduce students' confusion and improve their understanding of the game. Although the game has a short tutorial section at the very beginning before starting the game level, it has complicated mechanics that can still be challenging for some players, especially those who do not play games often in daily life. Without fully understanding the game mechanics, players can be frustrated and lose a sense of immersion in the game world. This issue perhaps has caused some students to quit playing the game in an early phase. Therefore, additional assistance from the teacher is necessary for successfully deploying the game into students' learning.

In addition, lacking a sense of immersion can result in the early quit of the gameplay. The sense of immersion in the game typically involves the attachment to the game character (Teng, 2010). This indicates that increasing the attachment to the game can improve a player's sense of immersion (Kim et al., 2015). Allowing customization in the game, such as the customization of a game avatar, can strengthen a player's identification with the game and increase the attachment (Fischer et al., 2010). In ARTé: Mecenas, the player's role of Medici is fixed but still has the possibility of customizing the avatar through other aspects, such as allowing the selection of appearance and dress style at the beginning of the game. Moreover, previous findings from our studies have shown that the sense of immersion in the game is the most crucial factor for game entertainment. Applying strategies to increase players' immersion in an educational game can also improve game entertainment.

In previous studies, game analytics have been successfully used to evaluate the game design and gameplay performance (e.g., Hicks et al., 2016). This study exhibited the potential of using game analytics to understand students' gameplay patterns. The findings have noted that game analytics can give a new perspective on evaluating students' engagement in the game and reflect the potential issues of the game mechanism. The information retrieved from game analytics is more unbiased and valuable for understanding the game design and the impacts of game mechanics on students' gameplay persistence and performance. It solves the limitation of adopting the external measurement of the game and supports more research topics related to educational games.

ARTé: Mecenas successfully balances the game's entertainment and difficulty and provides players with enjoyable gaming experiences. However, some improvements can still be achieved in the future updated game version. The findings can also provide researchers and game designers in the educational game field with some insights regarding the importance of players' game flow experiences and gameplay strategies and their impacts on student learning performance. The measurement of game flow also indicates a game's quality to some extent, which can help researchers and designers determine which aspects could be improved during the game design (Perttula et al., 2017).

Conclusion

Investigating perceived game flow experiences is crucial to evaluating an educational game. The game flow model measures players' gameplay experiences and their perceived enjoyment of the game. In this study, the factors for measuring game flow include Concentration, Goal Clarity, Challenge, Autonomy, Immersion, and Knowledge Improvement. This measurement provides comprehensive information about students' game flow experiences in *ARTé: Mecenas*. The findings confirm students' learning performance and game flow experiences in *ARTé: Mecenas*. The results are also meaningful for researchers and game designers when considering designing or refining an educational game. Future studies are expected to comprehensively investigate the different treatment effects on learning between adopting the game and other learning technologies such as virtual realities or intelligent tutoring systems.

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Appendix

Table AI

Questionnaire

	Item Question
Game entertainment	How much did you enjoy the game as a whole? (with 1 being the least entertaining game you have ever played and 5 being the most entertaining)
Game difficulty level	How difficult would you rate this game as a whole? (with 1 being the easiest game you have ever played to 5 being the most difficult)
The following statements pertain to ARTé: Mecenas as a whole.	The environment in the game motivated me to play more.
	The game as a whole increased my knowledge.
	The visuals in the game help me understand the concepts.
The following statements pertain to the ARTé: Mecenas perceived knowledge for each Level.	Level 1 increased my knowledge.
	Level 2 increased my knowledge.
	Level 3 increased my knowledge.
	Level 4 increased my knowledge.
The following statements pertain to	The game is fun.

the ARTé: Mecenas gameplay.		
		The game is engaging.
		The game makes learning fun.
		Playing the game helps me understand content in course lectures.
		Playing the game helps me understand material in my textbook.
		I would recommend this game to other students.
		I would recommend that my teacher use this game as part of the course.

Table AII
Game Flow Items

Factor	Item	Content	SFL	Correlation
CT	C1	Most of the gaming activities are related to the learning task.	0.76	0.65
	C2	Generally speaking, I can remain concentrated in the game.	0.76	0.65
	C3	I am not distracted from tasks that the player should concentrate on within the game.		
GC	G1	Overall, game goals were presented in the beginning of the game.	0.71	0.71
	G2	Overall, game goals were presented clearly.	0.77	0.64
	G3	Intermediate goals were presented in the beginning of each level.	0.85	0.53
	G4	Intermediate goals were presented clearly.	0.85	0.53
CH	L1	The game provides ‘‘hints” in text that help me make decisions.	0.63	0.78
	L2	My skill gradually improves through the course of making decisions and seeing the consequences.	0.79	0.62
	L3	The difficulty of the decisions increases as my skills improve.	0.7	0.71
	L4	The game provides new decisions with an appropriate pacing.	0.74	0.67
AT	A1	I feel a sense of control over objects in the game.	0.84	0.55
	A2	The game supports my recovery from errors.	0.67	0.74
	A3	I know the next step in the game.	0.69	0.73
	A4	I feel a sense of control over the game.	0.89	0.46
IM	I1	I forget about time passing while playing the game.	0.77	0.64
	I2	I become unaware of my surroundings while playing the game.	0.81	0.58
	I3	I feel emotionally involved in the game.	0.77	0.63
	I4	I feel viscerally involved in the game.	0.81	0.59
KI	K1	The game increases my knowledge.	0.93	0.37

K2	I catch the basic ideas of the knowledge taught in the game.	0.85	0.53
K3	I try to apply the knowledge in the game.	0.87	0.49
K4	The game motivates the player to integrate the knowledge taught.	0.81	0.58
K5	I want to know more about the knowledge taught.	0.78	0.62

*CT represents Concentration. GC represents Goal Clarity. CH represents Challenge. AT represents Autonomy. IM represents Immersion. KI represents Knowledge Improvement.

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The Interplay of Different English Proficiency Levels and Gamification in Online English Learning Environment

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Abstract: As educational technology becomes increasingly prevalent in a variety of learning environments, gamification has emerged as a frequently discussed method of increasing student interest, engagement, and learning outcomes. This research will examine the relationship between learners' English language competence levels and their gamification involvement using data from one of the most prominent online English learning platforms, controlling for demographic characteristics. The results revealed that students who are at an entrance level of English proficiency were more motivated to participate in the competition of earning more badges and points and participating on leaderboards as their proficiency increases. However, if the students reach a level greater than 6 out of 8, their interest in the activities reflecting gamification decreases. This might be due to the increasing complexity of assignments, which may become too distracting from acquiring the language skill itself. In addition, gamification as it is currently used in research studies is quite an effective method for learning, despite that factors that contribute to high success in gamification are still somewhat unresolved, in particular, for the cognitive learning results.

Introduction

As educational technology becomes increasingly prevalent in a variety of learning environments, gamification has emerged as a frequently discussed method of increasing student interest, engagement, and learning outcomes (Landers, 2014). Gamification has been shown to have a significant influence on students' motivation and engagement, which in turn enhances their overall learning outcomes. While some study has examined the effect of gender, age, and language on gamification participation, the effect of learners' skill level has received less attention. The study by Sun-Lin et al. (2019) showed that the gamification test group performed significantly better than the control group and comparison group. This research will examine the relationship between learners' English language competence levels and their gamification involvement using data from one of the most prominent online English learning platforms having the majority of students from Latin America, while controlling for demographic characteristics. The website includes tens of thousands active members of varying ages and ethnicities, providing us with a significant sample size for analysis. We see that users at a higher level are more engaged in gamification activities. Nonetheless, after a user attains a particular degree of expertise, their gamification activities decrease. Gamification is quite an effective tool for beginner learners to move up to speed to a certain level of mastery of a subject. Despite the fact that many studies have demonstrated the effects of gamification without the specific theoretical foundation (Hamari et al. 2014; Seaborn and Fels, 2015), many researchers have tried to explain the significant relationship between the variables gamification and learning via provisions of frameworks such as the theory of gamified learning (Landers, 2014). The theory explicitly puts forth the components: game characteristics, behaviors, and attitudes, and learning outcomes. The theory proposes that the instructional content directly impacts the learning results as well as the behavior of learners. As gamification is usually not used to eradicate instruction, but rather it sets to improve on instruction and thus produce higher quality. Instructional content is a stepping stone to have successful gamification (Landers, 2014). The main motive of gamification is to directly impact the results and attitudes of individuals towards learning (Landers, 2014). These impacts affect the relationship between the instructional content and learning outcomes by both moderation or mediation, regarding the nature of the behaviors and attitudes that targeted by gamification (Landers, 2014).

Research context

Online English Learning. Due to the COVID-19 outbreak, online classes have started in earnest in English subjects as well. The characteristics of the English subject, which are relatively high in private tutoring and mainly taught by dedicated teachers, clearly reveal the advantages and disadvantages of online classes compared to other subjects (Famularsih, 2020). First, the advantage of online English classes is that students can take classes at their own pace from anywhere. In addition, since there are many contents available to learners in the EFL environment in online classes, students can use more diverse materials to conduct classes (Fitria, 2020). On the other hand, the disadvantages of online English classes were also varied. Disadvantages of online English classes include lack of teacher feedback, polarization of academic achievement, difficulties in reflecting individual learner characteristics, difficulties in understanding students' academic achievement, and difficulties in interaction between students and students and between students and teachers (Hsu, 2008). In addition, as English classes, which were conducted through various interactive activities in the classroom, are conducted online, students' interest, satisfaction, and participation in classes decrease, which can have a significant impact on students' English acquisition. Gamification can be regarded as one of the solutions to address the above-mentioned issue in online English learning.

Gamification.

It is scientifically described as the use of gaming aspects to non-game circumstances. Levels, points, badges, leaderboards, and avatars are among the most often used game features. Combat, content unlocking, gifting, boss battles, quests, social graphs, certifications, and memes are just a few of the additional methods accessible in gamified platforms. There are a few gamification advantages to consider (design elements, known from video games). The most reported gamification components were points, which were often used as a foundation for other features. Often, points and leaderboards were used to encourage competitiveness among players. For time restrictions, for example, they were utilized as a foundation for determining the level of crowdsources in a level with the ability for comparisons between team members and peers, as well as with badges or missions to visualize particular goals in different implementations of the system. Nebel (2017) concluded that leaderboard could promote competition, while it had limited positive impact on motivation and effort. In this research, we will look at the gamification features of badges, leaderboard, students' weeks on leaderboard and their points. In the recent times due to the overall growth in all areas we as a people we have become more technology reliant. Thus, the need to introduce new learning methodologies using the available tools. At first it was not as indulging so research has been in the forefront to bring out new ideas that could increase the rate at which students grasp content and in a fun way in the process. There was the idea about gamification born. Gamification of learning ways has been one of the game changing improvements over the years that has been seen to enhance the learning capabilities of students. However, as there is not yet sufficient evidence on how this enhancement is made, it might be important to see what kind of drastic changes occur in the given data of our interest with the level attained by individuals in the gamified learning platform. This is an upcoming technology whose value is increasing in popularity given what it promises to offer to individuals who are interested in learning something. Whether it's pursuing a whole new subject or growing upon what they already know. We can say that gamification is quite an innovative a creative solution to many challenges that present themselves when one is dealing with other forms of delivery of content. Students like to compete; they compete in everything that can warrant approval from others given any circumstance.

Platform introduction

This Open English learning platform offered 24/7 learning activities and classes, with trained North American instructors available at all times. Courses and seminars in real time; practice activities. These eight levels are intended for new students who have successfully completed a placement test. Additionally, the course's gamification provides students with "miles", "badges", and "leaderboards". Each week, fifty students are assigned to fifty groups. Each week, the top 50 learners of the classes are listed. Leagues are formed by the top 10 students. Each week, the leaderboards are updated, and new groups are formed. Leaderboard badges are not a badge type. There are badges for weekly events, performances, and special occasions. If a student completes ten tasks this week, they earn a badge. To earn a performance badge, a student must complete prescribed requirements. The Halloween badge is comparable to the holiday badge.

Literature review

Theoretical framework

As a single topic of interest usually has many implications the theoretical framework acts as the 'blueprint' or rather pattern for research (Grant & Osanloo, 2014). Our framework is based on the existing theory in the field of learning that gamification is a likely method to enhance productivity and learning. Gamification has been identified as one of the many technologies that will revolutionize the way schools offer learning materials to students (Johnson et al.,2014) and considering the new approach that has the ability to minimize the gap between students and their teachers (Kapp, 2017; Oblinger, 2004)/ The studies on gamification usually stress on the appropriate and strategic use of games so as to have the most positive learning experience and engagement with the learners.

Striking a balance between the game and the quality of learning material is of the utmost importance as games alone are not sufficient to enhance performance neither is crude content. Therefore, one must balance these two components to have optimal outcome of the desired goal. (Apostol et al., op. cit.). Some experts have raised some concerns regarding the limitations of the method. But many have considered the arguments as trivial impediments that can be solved diligently by performing more research in the problem statement.

In this paper we will focus on the learning of the English language at different proficiency levels. We research how students behave at different levels of the learning stages in the gamified structure of study. And generate some insights if at all the level of an individual is significant in their motivation to move to the next level as they earn points and badges in the process.

Methodology

Data

Participants and Online English Learning Platform.

A total of 26,191 learners from 103 countries participated in a commercial online English program (Open English: www.openenglish.com), which includes several features that qualify as CSCL. The age range of the participants was very diverse, from 18 to late 60s. The features and functions in Open English (OE) are described below:

1. OE Provides individualized and structured course arrangements based on learners' language levels. Before learners start their courses, they are required to take an adaptive placement test, then they are allocated to a level (from level 1 to level 8) according to their English skills. Learners at each level are required to participate in a minimum number of each of the different activities, but are not limited in the number of any activities they prefer.

2. OE provides a host of interactive multimedia content (i.e., interactive videos), which is designed to make the lessons fun and more attractive for learners.

3. Multi-platform modules (unit lesson, and practices), various English tools (dictionary, pronunciation, writing tool, grammar guide, translator), functions and techniques (gamification, standardized test prep, practice lessons, interactive videos) are designed to meet learners varying at baseline language knowledge and proficiency levels and their diverse learning needs. Within each module, a wide range of authentic topics related to business, news, arts, sport, everyday life, etc. in various contexts, are incorporated.

We selected 63,221 learners with gamification activity records as our sample from data provided by Open English. To compare the group differences in gamification performance, a multivariate analysis of covariance was used.

Independent variable (N= 1): Proficiency Level

Dependent variables (N= 4): Practice Points, Leaderboard Points, Badge Earned, Weeks on Leaderboard

Covariates (N=4): age, gender, score, mother language

1. Gender: 0 – female, 1 – male
2. Mother Language: 0 – Spanish, 1 – Portuguese

Variable definitions
Practice: The points the student has accumulated (for the students who currently not on the leaderboard)
Badge Earned: How many times the badge has been won by the student
Leaderboard Points: How many points they've earned from activities. It is the sum of points student has obtained from different leaderboards. Points here only applies to students on the leaderboard (not all students are on leaderboard, there is no overlap with Leaderboard Points)
Weeks on Leaderboard: It reflects how many weeks that student was on a leaderboard
Proficiency Level: It shows the highest English proficiency level this user has reached measured by the test score of the platform.
Research Question:
What was the main effect of users' current learning level on this learning platform on the gamification activity, controlling the effects of their demographic information such as age, gender, score, and language?

Results

The independent variables mean the user level was divided into 8 levels, level 1 had the biggest user number of 23410, and level 8 had the smallest user number of 6. Practice Points, Badge Earned, Leaderboard Points, and Weeks on Leaderboard was set as dependent variables mean the points the student has accumulated, how many times the badge has been won by the student, how many points they've earned from activities, and how many weeks that student was on a leaderboard, respectively. From the data we have levels 1 to 8 each having a certain value of number of students at each. It is represented in a pie chart in figure 1 below:

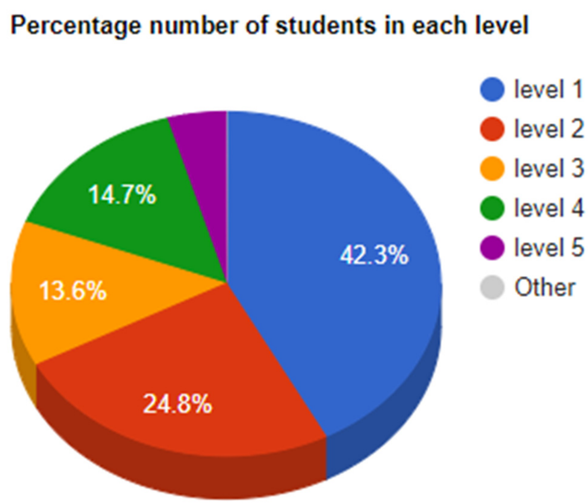

Figure 1. Pie chart of students' levels

The mean and standard deviation for Practice Points, Badge Earned, Leaderboard Points, Weeks on Leaderboard under 8 levels. The maximum value of Practice Points from 21 users was 5153.00 in level 6, and the minimum value from 23410 users was 1260.22 in level 1. The maximum value of Badge Earned from 21 users was 1096.14 in level 6, and the minimum value from 23410 users was 219.34 in level 1. The maximum value of Leaderboard Points from 21 users was 153305.52 in level 6, and the minimum value from 23410 users was 26470.43 in level 1. The maximum value of Weeks on Leaderboard from 6 users was 3628.83 in level 8, and the minimum value from 23410 users was 329.56 in level 1. It's understandable that he users in level showed lowest Practice Points, Badge Earned, Leaderboard Points, Weeks on Leaderboard, but the surprising aspect of the data was the level 6 users seems more active than high level users.

We compared the difference in Practice Points, Badge Earned, Leaderboard Points, and Weeks on Leaderboard under different Proficiency Level using pairwise comparison. The Practice Points in Proficiency Level 1 was significantly higher than Proficiency Level 3, 4, and 5 (p <0.001), and significantly lower than Proficiency Level 6 (p <0.001). The Practice Points in Proficiency Level 2 was significantly higher than Proficiency Level 3, 4, and 5 (p <0.001), and significantly lower than Proficiency Level 6 (p <0.001). The Practice Points in Proficiency Level 3 was significantly lower than Proficiency Level 1, 2, 6, and 8 (p <0.001). The Practice Points in Proficiency Level 4 was significantly lower than Proficiency Level 1, 2, 6, and 8 (p <0.001). The Practice Points in Proficiency Level 5 was significantly lower than Proficiency Level 1, 2, and 6 (p <0.001). The Practice Points in Proficiency Level 6 was significantly higher than Proficiency Level 1, 2, 3, 4, and 5 (p <0.001). There was no significant difference in Practice Points under different Proficiency Level. The Practice Points in Proficiency Level 1 was significantly higher than Proficiency Level 2, 3, 4, and 5 (p <0.001). When the significant value was lower than 0.001, and the mean difference (I-J) was positive, which can be considered that the value (I) was significantly higher than value (J). For the detailed and full results of this pairwise comparison, please refer to Appendix A.

To test which is combination of variables performs the best out of all the possible combinations, a multivariate analysis of covariance (MANCOVA) was conducted with Proficiency Level as an independent variable, Practice Points, Badge Earned, Leaderboard Points, Weeks on Leaderboard as dependent variables. After controlling the influence of covariates, significant main effects (Proficiency Level) were found (Wilk's Λ= 0.99), F =11.91, p <0.001, η_p^2 =0.002. These results illustrate that Practice Points, Badge Earned, Leaderboard Points, and Weeks on Leaderboard have significant difference under different Proficiency Level. The p values were significant (<0.001) in all covariates, illustrate that use age, gender, score, and language as covariates were correct.

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.002	31.174[b]	4.000	55273.000	<.001	.002
	Wilks' Lambda	.998	31.174[b]	4.000	55273.000	<.001	.002

	Hotelling's Trace	.002	31.174[b]	4.000	55273.000	<.001	.002
	Roy's Largest Root	.002	31.174[b]	4.000	55273.000	<.001	.002
Age	Pillai's Trace	.004	59.615[b]	4.000	55273.000	<.001	.004
	Wilks' Lambda	.996	59.615[b]	4.000	55273.000	<.001	.004
	Hotelling's Trace	.004	59.615[b]	4.000	55273.000	<.001	.004
	Roy's Largest Root	.004	59.615[b]	4.000	55273.000	<.001	.004
Gender	Pillai's Trace	.001	10.220[b]	4.000	55273.000	<.001	.001
	Wilks' Lambda	.999	10.220[b]	4.000	55273.000	<.001	.001
	Hotelling's Trace	.001	10.220[b]	4.000	55273.000	<.001	.001
	Roy's Largest Root	.001	10.220[b]	4.000	55273.000	<.001	.001
Score	Pillai's Trace	.007	98.205[b]	4.000	55273.000	<.001	.007
	Wilks' Lambda	.993	98.205[b]	4.000	55273.000	<.001	.007
	Hotelling's Trace	.007	98.205[b]	4.000	55273.000	<.001	.007
	Roy's Largest Root	.007	98.205[b]	4.000	55273.000	<.001	.007
Language	Pillai's Trace	.002	22.431[b]	4.000	55273.000	<.001	.002
	Wilks' Lambda	.998	22.431[b]	4.000	55273.000	<.001	.002
	Hotelling's Trace	.002	22.431[b]	4.000	55273.000	<.001	.002
	Roy's Largest Root	.002	22.431[b]	4.000	55273.000	<.001	.002
test_level	Pillai's Trace	.006	11.891	28.000	221104.000	<.001	.002
	Wilks' Lambda	.994	11.902	28.000	199291.058	<.001	.002
	Hotelling's Trace	.006	11.911	28.000	221086.000	<.001	.002
	Roy's Largest Root	.004	33.237[c]	7.000	55276.000	<.001	.004

We performed tests of between-subjects effects to check whether the Proficiency Level would have any effect on Practice Points, Badge Earned, Leaderboard Points, and Weeks on Leaderboard, the results showed that they were significantly different on Practice Points (p <0.001, η_p^2 =0.004), Badge Earned, (p <0.001, η_p^2 =0.003), Leaderboard Points (p <0.001, η_p^2 =0.003), and Weeks on Leaderboard (p <0.001, η_p^2 =0.001) under different Proficiency Levels. The partial eta squared (η_p^2) statistic reports effect size, the individual variables in our results had a significant difference but may be do not have great effect on the value of all dependent variables.

Data interpretation

Gamification applications can be applied in many different fields, and available research has consistently failed to bring to light that there are many different game design factors that can influence results in different manners for the learners, methods of social interactions, and learning arrangements (Sailer et al. 2017a). Therefore, including different factors to cater for conceptual heterogeneity in gamification. Further, because contextual and the situational influencers may impact the effects of gamification on the learning outcomes (Hamari et al. 2014), and gamification research does lack methodological rigor (Dicheva and Dichev 2015; Dichev and Dicheva 2017), we did include situational, contextual, and methodological factors. The procedure of choosing potential moderating factors for the effects of gamification on learning results was iterative in design. We included moderating factors that were both theoretically interesting and also those that our research could manage to support their inclusion.

The data that we have has 11 columns of which 10 of them are key variables of interest. All the 10 variables are significant in the regression analysis of the data, as the p-values for each is less than 0.05 alpha level of significance thus they are significant. There is almost a total drop of users in the levels 6,7, 8 which may be attributed to several factors. We have the additive linear model as: Design: Intercept + age + gender + score + language + test level.

Performing a pairwise analysis on the data to test if there are defects using the combination method. Most defects are usually caused by interaction of at most two variables. The data is clean there is no necessity of doing any data cleaning. The dataset is large enough to aid us in our research despite there are lesser values that represent the levels which are higher than the optimum. The data suggests that there is quite a large drop of individuals as soon as the fifth level is reached. We have close to zero individuals that push through the 6^{th} to the 8^{th} level. This can be caused by several factors maybe in the complexity of the tasks in the level or there is a big jump with the difficulty measure.

Discussion

Students portray a very fascinating behavior as we have come to observe in our analysis problem. Humans have a very highly competitive nature; this may be the reason why many students at the beginning of the learning process are highly motivated so that they can win points and awards to prove to others that they are better. This is a quite a fun and engaging way to enhance the intake of knowledge as at the end of the day it is highly encouraged to ingest a high amount of knowledge. That is the optimum as taking in too much is usually pointless as it corrupts the learned information. As the individual skill up or level up to a certain point we can call it optimum as per our analysis it's almost as if they do not want to take in much and their competitive nature starts to lag. Learning professionals have come to find the use of game-based learning methodologies highly effective over the years.

From what we have observed one can say that if students think that something is a challenge, they tend to shy away from it as they do not find it interesting, boring things are not usually one of their strongholds. The points that the individuals get after some hard work works as a clear goal that they would be inclined to sweat for. By the time they reach an optimum level where most of them are bored and participate less they usually have accrued most of the valuable material as the building blocks of the relevant subject that they indulge in. Given that the complexity of the learning material is set to increase exponentially this can highly challenge students as they have quite a low threshold for challenges, such that they would rather ran as far as they could away from them rather than face the challenges head on. With the continued rise in the use of technological tools, which are most likely to take over traditional styles of content delivery, the gamification learning process is likely to be the best methodology to implement in order to have the best results.

The question we need to pose later on is how we make the individuals that have lost some key interest in gaining it back so as to have a consistent flow and have the productivity set as high as possible. Simplification of challenges in the latter levels may be one way to have a consistent competitiveness of individuals. Also maybe increasing the reward system in the challenging levels so that students can have some motivation not to lag or decrease morale in the learning process. Gamification is yet to be tapped fully to its full capacity of potential. Given that it has only been there for a while and it has proven to work quite effectively it can be researched upon broadly why indeed these characters drop consistency or rather their competitive potential. Knowing these exact reasons can open up a whole new level of productivity not only in learning the English language but also extended to other fields as the notion can be applied across. Social interactions are also implied while undertaking this gamification exercises. When individuals meet other individual on a setting whether physically or virtually, they usually form key bonds. The result for behavioral learning outcomes is evident from the indulging of games, showing that combinations of competition and earning rewards through collaboration in games are promising for learning (Clark et al. 2016).

Limitations

As a result, one drawback of our study is that the sample size for higher level students was quite small, particularly for the behavioral learning outcomes and all subsplit analyses. This limits the generalizability of the results and is also problematic for statistical power because, for random effects models, power is dependent on the total number of participants across all studies as well as the number of primary studies. This limits the generalizability of the results and is also problematic for statistical power (Borenstein et al. 2009). When there is a significant between-study variation, as there was in this meta-analysis, power is likely to be insufficient. This means that statistically insignificant results do not always indicate the absence of an impact; instead, they might be explained by a lack of statistical power, which is especially true when effects are tiny.

Conclusion

We observed that students in the beginning level of English proficiency may be more motivated to compete for badges, points, and leaderboard participation as their proficiency grows. But after level 6, students may lose interest. The rising difficulty of assignments may be distracting from learning the language itself. The study's sample size of higher-level learners is limited. Also, students that participate in instructional activities may not be competing just for badges or points. Maybe people reach a particular degree of skill and assume that their knowledge is sufficient to use in the field. It's an intriguing outcome that many of the study's participants shared. In general, additional high-quality research is required to investigate other aspects that may influence individual productivity.

The findings indicate that gamification may be an extremely effective strategy for increasing student involvement in learning processes. Individuals are clearly motivated to perform when a reward system is in place. When other variables stay constant, the motivation to compete declines with level. Enhancing the incentive system at more difficult or later levels can assist in retaining a group of people's engagement. This gamification-based learning approach is applicable to a wide variety of context.

Individuals feel more competitive when they are in a group, and learners may share knowledge. Individuals seek to understand things in a variety of ways in order to trade their perspectives on a subject and obtain the most experience and results. This style has been proven to be the most effective, and with future study, it may become the preferred form of instruction. Dropping out after a given level could undoubtedly be improved. These might become the new standard, upending previously accepted procedures.

Implications

Our findings mean that we can apply more of this method to the enhancement of the way students learn. More research in the field would generate a lot more information and results that could be highly relied upon. We have found that this method of learning could be of great benefit to both teachers and students. It is quite a practical way of achieving goals. The study could be replicated easily in a setting. The methodology that is used has been explicitly stated and hence the ease. One can also use conceptual replication method to produce the results.

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Volume 2

Selected Papers On the Practice of Educational Communications and Technology

The Pedagogical Impact of Integrating Open Educational Resources in A College Course

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Abstract

The need for empirical evidence of the impact of open educational resources (OER) on teaching and learning is eminent as it highlights the necessity of shifting the focus from considering OER as merely open content to considering it as open educational practices (OEP). The current study represents the Local Impact Evaluation Phase of a larger Design-Based Research (DBR) study that sought to design an integrative OER intervention in a college course to promote open educational practices (OEP). This study aimed to evaluate the implementation of the OER intervention prototype in a college course. Pre- and post-course surveys, a focus group, interviews, and an artifact analysis were used to gather the data of this formative evaluation. The insights gained from this study offer educators and instructional designers guidance and best practices for integrating OER in a college curriculum, and a theoretical understanding of how learning environment-enabled OER use and creation can be designed to manifest in OEP.

Keywords: Design principles, Open educational resources, open pedagogy, open educational practices; student-created OER; threading across assignments.

Theoretical Rationale

In the literature regarding OER adoption in education, there is a consensus that we lack explicit evidence for the effectiveness of OER in teaching and learning contexts (Al Abri & Dabbagh, 2019; DeRosa & Robinson, 2017; Ehlers, 2011; Hegarty, 2015). This evidence scarcity lowers the perception of OER in higher education and limits awareness of the goals of OER and Creative Commons licensing among faculty and students in these institutions. These limitations of the OER movement have discouraged the widespread adoption of this novel pedagogical approach across higher education institutions (Allen & Seaman, 2016; Hilton, 2016; Pitt, 2015). Nowadays, the primary concern about OER use in teaching and learning is that these open and free resources are used to merely promote open access to knowledge (Ehlers, 2011). The need for evidence of the impact of OER on teaching and learning is eminent as it highlights the necessity of the emerging shift in ways of using OER in education contexts. Researchers (Ehlers, 2011; Geser, 2012) suggest that shifting the focus from considering OER as merely open content to considering it as open educational practices will lead to enhancing the quality of education. Masterman (2015) underlined that the openness attributes associated with OER can promote innovation in institutional pedagogy when OER is used in courses. Geser (2012) stated that applying OER as part of innovative ways of teaching and learning could change pedagogy and reinforce a user-centered approach to learning. Wiley (2017) asserted that the concept behind adopting open pedagogy with OER integration is not the usage of OER materials per se, but engaging in the 5Rs activities.

A likely explanation for the lack of evidence of OER's impact is that faculty have used OER in a way similar to teaching with traditional textbooks. Hilton (2016) stated that "it is not clear how OER might have been used in each of the [OER initiatives]" (p. 587). DeRosa and Robinson (2017) suggest that open pedagogy uses OER as a bridge from seeing courses as a repository of content to creating an open environment with more collaboration and engagement in the world of knowledge beyond the classroom. Taken together, these findings suggest that OER's transformative possibilities in teaching and learning must be scrutinized utilizing empirical methods. There also seems to be a definite need for formal guidelines for faculty to support the shift from OER to OEP. As a result, it is imperative to explore the design principles that can support these open educational practices in courses at the higher education level, and, in turn, to sustain continuous improvement in the OER movement.

Local Impact Evaluation

This Design-based research (DBR) was carried out using the four phases of the Integrative Learning Design Framework or ILDF (Bannan-Ritland, 2003). The Local Impact Evaluation Phase of the ILDF promotes formative evaluation, further testing of the implementation of the prototype intervention of OER, and refining the generated design principles. Thus, this Evaluation Phase sought to: (a) examine to what extent the OER intervention enhanced students' awareness of OER and associated concepts; (b) explore the perceptions of students regarding the benefits and drawbacks of the OER intervention in supporting their learning ; (c) explore the instructor's perception regarding the effectiveness of the OER intervention in the course and the pedagogical models that might contribute to advance the usage and creation of OER; and (d) determine if there is evidence of a shift in the pedagogy of the course. This is the overarching research question guiding this phase of the DBR study:

. How are the OER design principles operationalized and implemented in a college course?

Three sub-questions were investigated:

A. What are the perceptions of students regarding the benefits and drawbacks of OER design principles in supporting their learning?
B. What are the perceptions of the instructor regarding the effectiveness of the OER intervention in the course?
C. Is there evidence of a shift in the pedagogy of the course?

Intervention Setting

The research setting was the Advanced Instructional Design course offered in the Instructional Design and Technology master's program at a mid-Atlantic research university. It is a 16-week course delivered in the Fall semester between August 27 and December 10, 2019. The main assignments of the course are designed to empower students to practice what they learn either individually or in groups. The first assignment is a group project where students select an example of a constructivist learning environment (CLE) and describe to what extent this example best represents the characteristics of constructivism. The second assignment is for individuals. Each student selects a constructivist-based pedagogical model (e.g., cognitive apprenticeship, community of practice), or an instructional strategy (e.g., collaboration, articulation, scaffolding), or a problem type (e.g., strategy problem, decision-making problem, design problem, dilemma) and writes a brief research paper about their selection. The third assignment is an individual or group project: students develop a proposal for designing a Technology Supported Constructivist Learning Environment (TSCLE) prototype. In regard to

OER integration, an OER intervention was created in the course LMS Blackboard, as shown in Figure 1. Students in this section of the course were provided knowledge, information, and instructions in relation to reusing and producing OER, alongside the instructions related to the 5R practices. In addition, links to specific information were embedded in the instructions of each assignment to ensure that students had access to the required information to complete the intended tasks.

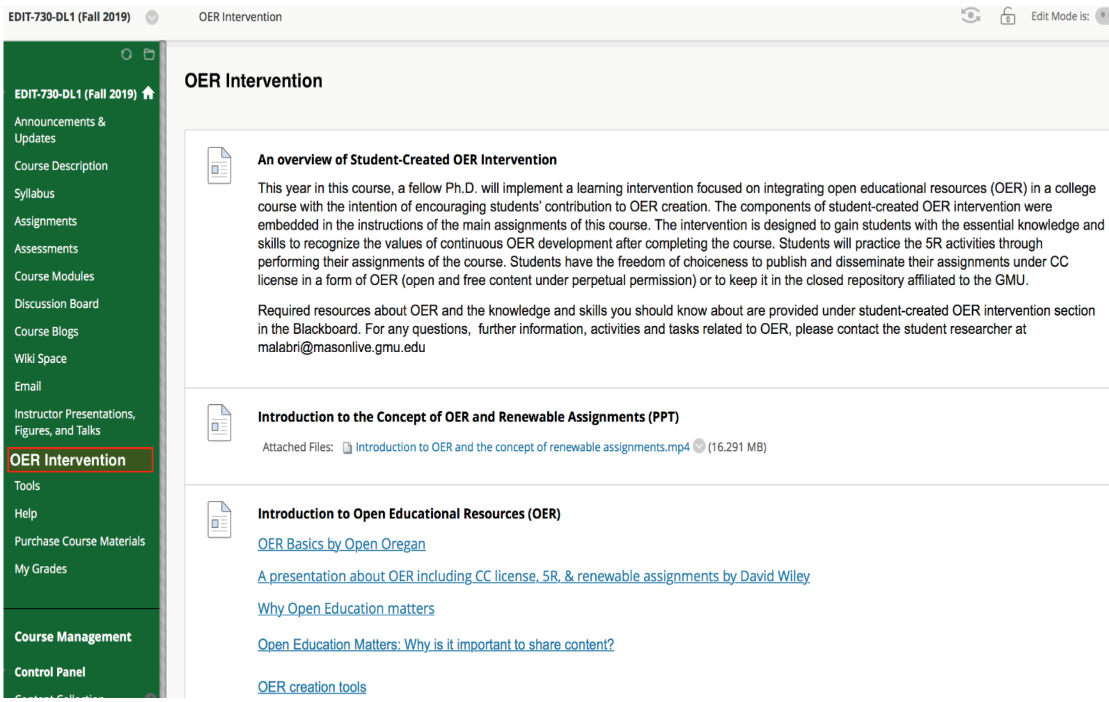

Figure 1. Creating a section for OER intervention prototype in the Blackboard LMS

Recruitment of Participants

The target population of this phase of the DBR study was the Instructional Design and Technology master's students enrolled in the Advanced Instructional Design as well as the course instructor. The sample for this phase is purposively a convenience sample because easy access to the participants was available through the instructor of the course. The only criteria for participants' selection was their enrollment in and completion of the course. The participant students were the eight graduate students who enrolled in the course in the Fall semester of 2019. Of these eight participants, three (37%) were male and five (62%) were female. The majority of participants (62%) had professional work experience of more than 10 years, and 87% were part-time students. The participants had a variety of work experience: instructional designer, consultant, training instructor, instructional coach for world languages, specialist in human resource development, and administrative assistant. The involvement of the course instructor in this phase was limited to directing students toward the activities that were infused in the instructions of the main assignments and prompting them to respond and cooperate with the researcher of the study. The communications with students in relation to their fulfillment to publish and share their assignments under a CC license was limited to communication between students and the researcher, to avoid the instructor's potential influence on students and to overcome the validity threats of bias and reactivity (Maxwell, 2013).

Study Design

The research method used in this Evaluation Phase was an exploratory case study, relying on a mixed-method (MM) design. This MM design occurred in sequences in which at least two strands were conducted chronologically. The sequential mixed-method design used in this phase encompasses: (1) a quantitative method (QUAN) involving a pre-course survey and a post-course survey to gather students' awareness of OER and their perceptions about the effectiveness of the intervention integrating OER into the curriculum of the course; and (2) a qualitative method (QUAL) involving a focus group discussion, an intensive interview, and artifact analysis to explore and understand students' and the instructor's experiences of embedding OER in OEP in the course, and to capture if a shift has been made to pedagogy of the course. In this study, the results of the focus group informed the formulation of the post-course survey questionnaire, and the results of both the post-course survey and the focus group informed the formulation of the interview questions. The final conclusion and inferences were reported based on integration of the results from both strands.

Data Sources and Research Instruments

The data sources used in the Local Impact Evaluation Phase of this DBR study were the OER renewable assignments of previous students that had completed this class. These assignments were uploaded to Multimedia Education Resource for Learning and Online Teaching (MERLOT). MERLOT is an online repository that provides access to OER. It is essential to have a collection of CC assignments prior to implementing the usage and creation of OER in a course. These CC assignments acted as a base for current students to practice the 5Rs instead of using them as merely models of best practices.

Two strands of MM design were used to gather data in this phase. Strand (1) included instruments of the pre-course survey, focus group discussion, and post-course survey that were used to collect data from the students. Strand (2) included two data sources: a semi-structured interview that was used to collect data from the course instructor, and an artifact analysis that was used to analyze structure of the course after integrating OER and the 5Rs into the course's syllabus to look for evidence of a change in the pedagogy of the course. Table 1 shows the alignment of the research questions with the data sources and gathering intended data.

Specifically, the pre-course survey sought to measure students' awareness of the concept of OER and its components before exposure to the intervention. Then, The focus group discussion was chosen to gather qualitative data in this phase concerning students' perspectives on the effectiveness of the generated design principles and OER intervention in supporting students' learning. After that, the post-course survey was developed to obtain further information on the perceptions of students regarding the benefits and drawbacks of the generated design principles in supporting their learning. Then, A semi-structured interview was chosen to gather qualitative data from the instructor as a result of integrating the OER intervention in the course she taught. The face-to-face interview took place after completion of the course; Finally, the artifact analysis took place after designing and embedding the OER intervention in the course Blackboard

Table 1
Research Questions and Data Sources Guiding the Local Impact Evaluation Phas

Research Question	Data Sources and Instruments	Purpose

Q. How are the OER design principles operationalized and implemented in a college course?	• Pre- and post-course surveys • Focus group • Interview • Artifact Analysis	
a. What are the perceptions of students regarding the benefits and drawbacks of these principles in supporting their learning?	• Pre-course survey	• Determine students' awareness of the concept of OER and associated attributes.
	• Focus group	• Examine the effectiveness of the generated OER design principles and OER intervention in supporting students' learning and opening the practices of teaching and learning in the course.
	• Post-course survey	• Examine to what extent the OER intervention contributed to increase the awareness of OER and related concepts among students. • Explore to what extent the intervention manifested in opening the practices of teaching and learning in the main assignments of this course, from the students' perspectives. • Explore students' perceptions to what extent the design of the OER intervention made it easy to follow the planned instructions and activities related to the integration of OER and 5R practices in the main assignments of the course.
B. What are the perceptions of the instructor regarding the effectiveness of the OER intervention in the course?	• Interview	• Examine the effectiveness of the OER intervention in the course design based on the instructor's perceptions. • Explore pedagogical models that might contribute to advance the usage and creation of OER in college courses.
C. Is there evidence of a shift in the pedagogy of the course?	• Artifact analysis	• Capture if a shift existed to the pedagogy of the course, and to the instructions of the main assignments that were used to engage students in OER usage and creation.

Procedure

At the beginning of the semester (August 28, 2019), the researchers introduced the OER intervention to students along with the course syllabus and encouraged them to explore the resources under the intervention section in Blackboard. Since the selected course was mostly delivered online, a narrated presentation was uploaded under the intervention section in

Blackboard to introduce students to the term OER and interrelated concepts including the concept of renewable assignments and students' engagement in OER usage and creation. In addition, examples of CC assignments in MERLOT for students in previous classes were shown in order to practice the 5Rs such as reusing the previous renewable assignments in MERLOT as exemplary examples of the three main assignments, selecting one example of a constructivist learning environment (CLE) presentation for previous students that was published in MERLOT under CC license, and critique the selected example based on the criteria of the assignment, and cite and build on one of the previous research-brief assignments in MERLOT.

Because the OER intervention was embedded in the course curriculum, the instructions in relation to OER usage and creation as well as the 5R practices were infused in the instructions of the main assignments. To begin this process of evaluation, the researcher invited the participants via email early in the semester (week 3) to respond to the pre-course survey online via Survey Monkey. Results from this pre-course survey helped determine students' awareness of OER and associated components, and the results also indicated areas in which the students were interested in further information.

Throughout the implementation of the OER intervention, the researcher observed students' engagement in and execution of instructions related to the intervention via LMS Blackboard. Consequently, according to the communication between the instructor and the researcher, the researcher followed up students' completion of related activities. In terms of encouraging students to share their assignments under a CC license, the researcher approached students via email after each assignment was completed and graded by the instructor, asking if they wanted to make their assignments OER and upload them to OER databases. To direct students for publishing OER renewable assignments, the researcher provided students detailed instructions that guided them to the process of attributing their work under a CC license and sharing them online in MERLOT and/or in OER Commons. An example of these detailed instructions is presented in Figure 2.

Later, in week 12, to explore students' perceptions based on their experiences in executing the activities related to the OER intervention, the researcher invited students via email to a focus group discussion and sent them the consent form for confirming their participation. The data was transcribed and analyzed immediately; the results of the data analysis informed the next data collection method, the post-course survey.

The post-course survey, developed based on the results obtained from the focus group data, was administered in week 16, near the end of the course. Open-ended questions were used to avoid missing data that might remain undiscovered through closed-ended questions. To understand and link the results of this post-course survey to the results obtained from the focus group on students' perspectives, the data from the post-course survey was analyzed immediately after all students' responses. Both of these results informed the formulation of the interview questions for the instructor. As a result, after the course completion, the researcher approached the instructor of the course via email and conducted a semi-structured interview. Finally, an artifact analysis was conducted to see if a change had been made to the original structure of the course after embedding the OER intervention in the curriculum. Sequential mixed data analysis was adopted to analyze the data of this evaluation phase (Teddlie & Tashakkori, 2009).

Hello Tom,

First of all, thank you for completing the online survey.

If you decided to share you final project under CC license, you can upload it in MERLOT or OER Commons or other OER database. The instructions are as follows.

- Access Blackboard and download the components of the final project. You can combine it in any way do you prefer.
- Select the type of CC license in which you want others/ future students in this class to use your work. To learn more about different types of CC license, explore resources under student-created OER intervention (An Overview of Copyright and Creative Commons Licenses)
- To create CC license for your final project, you can access (https://creativecommons.org/choose/), follow the instruction to select the type of CC license for your work. Your selected CC license will be created automatically in the website. Copy the license and past it in your documents. The second option to create your CC license is to add CC add-in to the Microsoft office so, you can create your CC in the Word & PowerPoint presentation itself.
- After you created the CC license for your document, access MERLOT OR OER Commons) to upload your assignments.
    - To upload your assignment in MERLOT, you need to upload it in OneDrive or any other places where users can access to view and reuse it. Log in to MERLOT, select (add a material to MERLOT), and follow the instructions to submit it in MERLOT database. Also, you can explore resources under student-created OER intervention (How to use MERLOT: "How to add materials to MERLOT").
    - To upload it in OER Commons, join the Advanced Instructional Design group in OER Commons and upload your assignment in this group. When you uploaded, it will appear pending for approval from the OER Commons administrator. It will take couples of days to be published in the database (no further actions are required).
- After you completed publishing your assignments in any CC database, please, send me the URL of your publication to add them to the webpage of all CC assignments.

If you have any questions, clarification or need further information, please let me know.

Thank you for your cooperation.

Figure 2. An example of the instructions the researcher emailed when inviting participant students to share their assignments under CC licenses.

Results

The results obtained from the Local Impact Evaluation Phase revealed the following insights:

- Integrating OER into the Advanced Instructional Design course did not contribute to change in the current pedagogy of the course, but it did contribute to change in the main assignments' instructions and guidelines in terms of the way the students conducted their assignments.
- OER intervention enhanced the students' awareness of OER and associated attributes; however, no significant evidence was found regarding students' understanding of the different types of CC licenses and the usefulness of InfoGuide in supporting students in executing their assignments.
- All students were unaware of the university's ownership of the copyright.

- Students favored aligning everything and linking it together by making connections between knowledge across the assignments within a course and across the classes for the entire academic program through a platform or a database.
- There is a continuum of knowledge across the main assignments and learning activities within the selected course.
- Threading across assignments encouraged the instructor to generate new instructional strategies to encourage students to use the components of earlier assignments within the course in future assignments of the course in order to connect knowledge and understanding of the course topics and learning outcomes.
- Students endorsed students' contribution to OER creation (renewable assignments), but they showed uncertainty about the quality and trustworthiness of the existing open content.
- Critiquing previous students' renewable assignments in MERLOT helped students to look at examples of assignments from previous students in different disciplines at different levels, to think what the assignment is about, to execute their own assignments, and to provide comments to the original authors to improve their assignments.
- The perceived intention behind the 5Rs is to build on existing data and to explain what is new about it, beyond only remixing and revising. However, significant questions remain about the meaning and intention of some of the Rs, and differences between some of the Rs in the 5Rs framework are still unclear at this point, due to several challenges.
    - It is believed that the MERLOT database is not an ideal platform to encourage active participation in repurposing and creating OER, so there is a technology issue – a need for further development of the platform with more features.
    - The benefits that faculty and students will get from engaging in the 5Rs are unclear.
    - There is an endpoint for these renewable assignments, where their content has been repeatedly improved to the point that no further improvements can be made.
- Sharing teaching resources under a CC license is more practical for exchanging best practices of teaching strategies and building resources upon one another, along with sharing students' assignments.
- Students and instructors favored mainstreaming the concept of threading assignments across classes for the entire Instructional Design and Technology program in the research university. However, that is difficult to accomplish, for several reasons:
    - There is an infrastructure issue with the academic institution, when the institution is based on a credit system and a course system.
    - It is difficult to thread assignments across pedagogical models.
    - Each assignment needs to adhere to the assignment's criteria for each class.
- Threading across assignments could influence the pedagogy of courses by supporting students in connecting their knowledge across the courses and within the courses. This could help students gain a better understanding of the course content and apply their understanding to the various assignments and projects in the program. In addition, building assignments upon one another could encourage students to share their assignments online under CC-BY instead of keeping them in the LMS. This in turn could encourage students to reuse and remix these published open resources.
- The use of OER in the course will only remain through showing students some exemplary assignments in MERLOT that are under CC-BY.

- Students did not fully understand the concept of integrating OER and threading across assignments in the course until near the end of the course.
- These are the main considerations for integrating OER into courses in higher education:
    - The top management in an institution must embrace the philosophy and paradigm of OER and develop a policy of OER use and creation.
    - The benefits of OER for instructors and students alike should be clearly explained.
    - The course pedagogy should move toward a constructivist approach of teaching.
    - Faculty need more specific guidelines, examples of best practices, and training on how to use OER and the 5Rs in the curriculum.
- The instructions related to OER intervention were easy to follow, clear, and straightforward.

Finalized refined OER design principles and their implementation in the Advanced Instructional Design Course.

- To support the use and creation of OER, OER should be integrated into a course that is designed based on a learner-centered pedagogical model using the principles of a constructivist approach to teaching.
- OER should be embedded as a main component of the pedagogy of a course.
- OER integration into a course should support the use and creation of open content under an open license using effective and efficient OER databases
- An in-person session should be used early in the course to introduce the OER term, related attributes, its operationalization, threading across assignments, and the benefits from engaging in OER use and creation
- The goals of integrating OER into a college course should focus on making students knowledgeable about the term "open educational resources" and related concepts
- Students should have the option to share their assignments under an open license and to select the appropriate license
- The instructor should provide a collection of OER content as a starting point for embedding the 5Rs
- OER content that is shared openly online should be reusable and end in a meaningful purpose for learning.
- Creating OER content is more effective through collaborative work between both faculty and students.

Conclusion

The evidence of this study shows that integrating OER into the Advanced Instructional Design did not change the current pedagogy of the course, but it did contribute to a change in the main assignments' instructions and guidelines in terms of the way the students conducted their assignments. In addition, the findings show that integrating OER use and creation provides opportunities to make connections between successive modules and assignments, and to build upon previous work. This suggests that engaging students in OER use and creation increases opportunities for sharing peer-reviewed open content and allows students to value their assignments and to build on their assignments within the course and across courses and semesters. Regarding the benefits of engaging instructors in OER use and creation, sharing resources under an open license provides benefits for sharing teaching resources to be remixed and built upon by others.

Despite these findings, faculty in higher education contexts need more specific guidelines than those generated from this study. Best practice examples and training on how to repurpose OER by using the 5Rs in a course curriculum are recommended. Furthermore, students need examples of case studies of the iteration of revising and remixing activities with the existing assignments under open license, to encourage students to think of the process and understand how they can build on existing knowledge using OER.

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Learning Artificial Intelligence in Summer Camps: A Brief Systematic Literature Review

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Abstract

Artificial intelligence (AI) spearheads current technological advancements and has become one of the fastest-growing subfields of computer science. Therefore, it is important for youth to learn about AI both in school and in informal settings because knowledge in this area increases youths' problem-solving abilities. However, since AI is often taught at the college level, there is still a dearth of understanding regarding how to teach middle and high school-age children about AI. Hence, this paper discusses the findings from literature on the learning about AI that takes place in informal settings, such as summer camps. The findings showed that students were able to understand AI concepts and reported gaining knowledge about AI by participating in summer camps.

Introduction

Digital life is changing traditional human activities because AI systems offer previously unimagined opportunities to make our daily activities easier (Martins & Gresse Von Wangenheim, 2022). One such system, algorithm-driven AI, shows behavior indistinguishable from humans, such as cognitive intelligence (Haenlein & Kaplan, 2019). The rapid technological and societal advancements enabled by AI make it important for students to learn more about it because it will only become more integrated into societal systems as time progresses (Webb, 2022). Informal learning environments are most suitable for learning about AI because these environments have more potential to support students' learning and engagement (Meyers et al., 2013). Presently, there are many summer camps across the U.S. that offer short-term, informal learning about AI. The U.S. AI Workforce reported that as of 2021, there were about 450 AI and AI-related summer camps across 48 U.S. states, 53% of which were offered in certain states, such as California and New York. Only 10% of the AI camps were offered by universities and non-profit organizations, having primarily high school students as their target audience (Gehlhaus et al., 2021).

Relevant literature (e.g., Anand & Dogan, 2021; Meyers et al., 2013; Nugent et al., 2015) demonstrates that informal learning environments are vital to stimulating interest in science, technology, engineering, and math (STEM). Several studies (e.g., Kahn et al., 2018; Wan et al., 2020) report that students from low and medium socio-economic backgrounds who have limited programming knowledge struggle to enhance their AI understanding because the existing K-12 AI learning environments require knowledge of block-based visual programming, such as Scratch, that not all schools in the U.S. have access to because of the variations in K-12 computer science education across the U.S. Therefore, an opportunity to learn about basic machine learning concepts and methods outside school settings, such as at university-sponsored summer camps, helps them be more sensible with respect to decision-making and learn about ethical aspects of AI such as trust and fairness (Wan et al., 2020). AI knowledge is vital for K-12 students in modern times because it allows them to participate in the creation and critique of AI artifacts (Williams et al., 2022).Thus, summer camps or out-of-school learning experiences contribute significantly to students' interest in STEM, thereby enhancing their knowledge and skills in this field (Anand & Dogan, 2021; Mohr-Schroeder et al., 2014; Roberts et al., 2018) and encouraging their choice of STEM related careers. Specifically, university-sponsored computer science-related summer camps introduce students to a variety of computing-related areas and applications, such as games, artificial intelligence, mobile app development, robotics, cyber security, and 3D printing (Miller et al., 2018).

On Artificial Intelligence

The word "artificial intelligence" was officially coined in 1956 during the eight-week-long Dartmouth summer research project on AI (DSRPAI) at Dartmouth College in New Hampshire (Haenlein & Kaplan, 2019). Since the 1950s, AI has improved tremendously, growing in three main areas: (a) Neural Networks (NNs), which were present from 1950s to 1970s and were known as "thinking machines"; (b) Machine Learning (ML), which was a popular type of AI from the 1980s to the 2010s; and (c) Deep Learning (DL), which is popular at the present time and has spearheaded recent the technological advancements (Khayyam et al., 2020).

There are many definitions of AI that have been offered by different scholars. For instance, Nilsson (2010) defined AI as "making machines intelligent, [where] intelligence is that quality that enables an entity to function appropriately and with foresight in its environment" (p. 7). Although there are many definitions of AI proposed by various scholars in the field, Rapaport's (2020) is the most adequate for the purposes of your study because the author defined AI as a branch of computer science (CS) that helps us understand the tasks computationally (i.e., using the language of Turing Machines), providing algorithms for solving them efficiently and ethically. Such a definition of AI provides an important baseline for analysis in understanding the societal consequences of AI's application (Maas, 2020).

Theoretical Framework

To explore how participation in an informal learning environment influences students' perceptions of STEM learning, situated learning theory (SLT) was chosen as a theoretical framework guiding this literature review. This theory has widely been utilized by scholars (e.g., Anand & Dogan, 2021; Johri & Olds, 2011; Kelly & Knowles 2016; Roberts et al., 2018) to examine the positive influence of informal STEM education on students and to guide research on the changes in attitudes toward STEM-related careers after participating in informal learning programs or activities. SLT posits that in informal learning environments, learners engage in dialogues and collaborate with each other in knowledge-building processes that are not subject to the same restrictions to curricular objectives drive learning in school environments (Mohr-Schroeder et al., 2014). As Anand and Dogan (2021) contend, SLT focuses on how learning occurs as a regular social practice rather than through formal institutions as the venues of learning. In informal learning environments students can connect their knowledge to their everyday lives (Johri & Olds, 2011; Mohr-Schroeder et al., 2014). Through opportunities to acquire and apply knowledge and practice skills, learners develop deeper understandings of such knowledge (Johri & Olds, 2011).

SLT as a theoretical lens will allow us to examine the process of knowledge-building on

AI due to student participation in an authentic STEM learning environment. As an informal learning environment, STEM summer camps can encourage ongoing student interaction and engagement by providing action-based learning (Mohr-Schroeder et al., 2014). As Kelly and Knowles (2016) stated, any situated STEM learning is authentic in that the students' knowledge acquisition is contingent upon the physical and social elements of learning, such as informal learning space and collaboration with peers. Students participating in a STEM camp, therefore, can learn more about STEM education and practices as they interact with their peers than they would in a regular classroom setting (Mohr-Schroeder et al., 2014

Methodology

A systematic literature review was chosen as a methodology to conduct content review of the studies included in this review. The systematic literature review followed the protocol suggested by Petticrew and Roberts (2006), which consists of seven steps, such as: (a) defining the research question that will guide the study; (b) creating keywords or phrases (search string); (c) conducting literature search in different databases; (d) screening literature to identify which studies will be included in the review; (e) setting inclusion and exclusion criteria for the studies; (f) critically appraising the studies; and (g) reporting primary studies' presentation of the summary of the documentation.

In accordance with the protocol, the following research question was formulated: How do the studies report the student learning experiences during AI summer camps? As for creating search phrases, the articles were searched, using generic words, such as "artificial intelligence" and "machine learning". The phrase "data science" was used because machine learning is related to the fields of statistics and data science (Martins and Gresse Von Wangenheim, 2022). Wildcard characters, such as an asterisk (*), were used to include different variations of keywords; keywords were adjusted as well in accordance with the specific syntax of each database, as presented in Table 1.

The following databases were used to search for literature: ACM Digital Library, ERIC (EBSCO) IEEE Xplore, Science Direct (Elsevier), and Scopus. Where possible, we limited the search to focusing on abstracts and/or keywords. In addition, the search results were filtered from 2016 until 2022.

Table 1.
Search phrases

Databases	Search phrases
ACM Digital Library	[[Abstract: "artificial intelligence"] OR [Abstract: ""machine learn*"] OR [Abstract: "deep learn*] OR [Abstract: "data science"] OR [Abstract: cod*] OR [Abstract: robot*] AND [[Abstract: "summer camp"] OR [Abstract: " summer program "] OR [Abstract: "summer science camp"]] AND [Publication Date: (01/01/2016-10/31/2022]
ERIC	[Metadata] "summer camp" OR "summer program" OR "summer science Programs" AND cod* OR robot* OR "artificial intelligence" OR "machine learn" OR "deep learn* OR "data science" OR computation* OR "computer science" OR "natural language processing"
IEEE Xplore	(("Abstract": "artificial intelligence" OR ("Abstract": deep learn*) OR ("Abstract": "data science")) AND ("Abstract": "summer camp") OR ("Abstract": "summer program") OR ("Abstract": "summer science camp")) Filters Applied: 2016- 2022

ScienceDirect (Elsevier)	("artificial intelligence" OR deep learn* OR cod* OR robot*) AND ("summer camp" OR "summer program" OR "summer science camp) Filter: Year: 2016-2022
Scopus	TITLE-ABS-KEY ((machine learn* OR "artificial intelligence" OR deep learn* OR "data science") AND ("summer camp" OR "summer program" OR "summer science camp)) AND (LIMIT-TO (PUBYEAR 2016-2022)

The search results were scanned to identify the studies to be included in the review. The inclusion and exclusion criteria followed the format suggested by Martins and Gresse Von Wangenheim (2022), adjusting as needed (see Table 1). The search was done in August 2022. The search resulted in many results even after a calibration of the search string. Thus, titles, abstracts and keywords were reviewed to identify articles that adhere to the exclusion criteria in 411 results, resulting in 69 potentially relevant artifacts (Table 2).

Table 2
Search results

Database	Number of search results	Number of potentially relevant results	Number of reviewed articles
ACM Digital Library	44	18	3
IEEE Xplore	51	10	5
Scopus	215	13	3
ERIC(EBSCO)	33	13	3
ScienceDirect	68	15	2
Total	411	69	16

When screening the literature to identify the potential articles to be included in the review, the focus was to review findings section to see whether they provided substantial information regarding findings related to student learning. Other criteria in regard to inclusion and exclusion are presented in Table 3.

Table 3
Inclusion and Exclusion Criteria

	Inclusion	Exclusion
Topic	Learning about AI, robotics, coding, robotics during summer camps or programs	Using AI to analyze different forms of data; not related to teaching or learning about AI in summer camps; learning AI in formal school settings
Content	Findings related to student learning about AI and coding	Major findings are not reported
Methodology	Qualitative, quantitative, mixed methods	No specific methodology
Type of publication	Articles in journals and papers in conference proceedings	Reports, blogs

The Table 4 (See Appendix) provides detailed information regarding the selected studies that were included in this review. The findings from the literature were summarized and categorized under themes.

Summary of Findings

All studies reported how students gained knowledge and skills in different software and developed confidence in applying these skills during the program. Two major themes emerged from findings: (a) Acquisition of AI knowledge; and (b) Learning content for positive change.

Acquisition of AI knowledge

Some studies (e.g., He, J., & Xin, C., 2021; Miller et al., 2018; Oskotsky et al. 2022; Stapleton et al., 2019; Vachovsky et al., 2016; Williams et al., 2022) highlighted how students gained AI knowledge by attending summer camps. The findings of those studies reported that utilizing high-technology and low-technology avenues during summer camps helped students develop knowledge on artificial intelligence. Studies also reported that the knowledge gained during the summer learning experience can be transferred or applied to the formal school setting as students would learn making relevant connections. For instance, Oskotsky et al. (2022) discussed how students received an in-depth research experience through hands-on projects and learned to implement machine learning models that can classify COVID-19 cases in chest x-ray images. Williams et al. (2022) shared the ethical aspects of using AI, such as AI systems work and how they impact society.

Learning content for positive change

When addressing the topic of AI in relation to robotics, some studies discussed different applications and programming as languages for coding to control robots. Studies (e.g., Álvarez, 2017; Ilyas et al., 2021; Lédeczi et al., 2019) reported that students perceived that they not only learned the content through robotics camps but also recognized connections between what they were learning and the real, serving as a catalyst for a positive change in how the students perceived future STEM content. These studies highlighted that robotics is becoming a more effective way to engage students with coding and programming, while helping reinforce soft skills such as teamwork, critical and creative thinking, problem-solving, and algorithmic patterned thinking. Studies also underscored that robotic-based programs are more effective at retaining a students' computing knowledge for those who have limited programming or coding experiences.

Conclusion

The findings of the study underscore how participation in summer camps impact student learning. Moreover, this learning experience encourages students to choose STEM related careers. Therefore, educational practitioners and school administrators should recommend that their students participate in informal learning experiences that would encourage students to choose careers in STEM.

APPENDIX

Table 4

Summary of the studies

Authors	Sample	Research method	Reported Findings
Álvarez, I. J. B. (2017)	N=14 Location: USA University of Puerto Rico at Aguadilla	Pre-post-camp survey and a questionnaire with the opinion questions nine months after the camp	The general average of the post-test (77.79%) is significantly higher than the pre-test (69.93%). The camp had a positive impact on the participants' learning. The objectives to integrate the programming of robots with technology were successfully demonstrated through the application of what was learned during the camp.
Anand & Dogan (2021)	N= 65 Location: USA University located in Southeast Texas.	Mixed methods: Participants took a post-camp survey and responded to interview questions. Responses coded into major themes organized hierarchically with higher codes representing more complete and complex definition. Analysis: descriptive	The coding curriculum taught students to code and build their games. The interview data analysis showed the camp experience increased their interest in coding and in future activities, such as programming robots that can cook. The knowledge gained during the summer learning experience can be transferred and applied to the formal school setting by making relevant connections.
He & Xin (2021)	N=29 Location: USA Old Dominion University	Quantitative: a short questionnaire	75.9% of the students enjoyed using the chatbot; overall, 82.8% were satisfied with the AI-powered chatbot. Chatbot can be used to serve thousands of students simultaneously, which will be very useful to numerous students who are learning cybersecurity worldwide.
Ilyas et al. (2021)	N=23 Location: Saudi Arabia University of Jeddah	Mixed-methods; pre-and-post-camp survey; focus group	Survey responses demonstrated that students developed their good knowledge of Arduino and programming of CODI Bot. They also improved their critical thinking and problem-solving skills. Focus group discussions showed that girls developed interest in technology and careers in computer science.
Khan & Aji (2018)	N=20; Location: USA, Tuskegee University	Pre- and post-camp survey	The camp activities were very useful in exposing the participants to exciting hands-on activities and developing their computational thinking skills.
Lédeczi et al. (2019)	N=24 students Location: USA Vanderbilt University	Mixed methods: pre- and post- camp surveys and post-camp interview	The results showed students' self-efficacy in programming, attitudes towards technology, and task values placed upon robotics and cybersecurity improved significantly (p-score < 0.05). Findings from interviews showed the camp increased interest in

			coding, and robotics helped to apply what they had learned in the camps.
Mac Iver & Mac Iver (2019)	N=193. Location: USA, John Hopkins University	Quantitative: The primary outcome variable for this study was yearly attendance rate, calculated for all students in the year following the summer program. The treatment variable indicates whether a student was in the robotics program (coded 1) or the matched comparison group with no summer school (coded 0).	The study found a statistically and educationally significant program effect on school attendance the following year, suggesting that high-interest hands-on educational activities can help maintain student engagement in school.
Miller et al. (2018)	N=200. Viterbi School of Engineering at USC	Quantitative (pre-and post-camp survey)	The pre-camp survey showed that 69% of the students expressed a strong interest and 83% of the students expressed a strong interest after the camp, with an increase of 15% of the students stating "extremely interested" in learning Scratch program.
Nite et al. (2020)	N=46 Two universities in Western U.S.	Quantitative (survey)	The paired samples t-test yielded a test statistic of 2.508 ($p = .02$), showing a statistically significant difference in scores before and after the findings revealed that students developed their knowledge after participating in microcontroller and coding activities in a STEM summer camp.
Oskotsky et al. (2022)	N=29; (all female) Location: USA, UCSF	Pre-and post-program survey	Students reported that they know how to clean data before using it in machine learning algorithms (MWUtest, adjusted p-value<0.001) and know how to evaluate and apply machine learning algorithms (MWUtest, adjusted p-values<0.0). They also gained hand-on experiences and knowledge by attending this camp.
Qu & Fok, (2022)	N=40. Location: China The Education University of Hong Kon	Mixed methods design: survey and interview	Results demonstrated that computer and technology skills of students improved during the summer camp.
Simley et al. (2020)	N=23. Location: USA Morehouse College, Georgia	Mixed methods: naturalistic observation and a pre-post-camp survey.	The pre-assessment had an average of about 39% with the post-assessment having an average of about 63%. On average, students did 28% better on the post-assessment. Findings from observations showed that students began using the correct terminology and could compare codes in Python to block coding.

Stapleton et al. (2019)	N = 66 (total number of campers over the three-year period). Location: USA University of Florida	Quantitative: Participants rated from 1 (strongly disagree) to 5 (strongly agree) how they learned coding and technology.	Campers gained computer programming skills through a series of increasingly difficult coding challenges using MIT Scratch. 80% of the participants reported interest and confidence in technology.
Vachovsky et al. (2016)	N=24. The Stanford Artificial Intelligence Laboratory's Out-reach Summer (SAILORS) program	Quantitative Two sets of surveys. The second set of surveys focused on the admitted students pre and post participation in the 2-week summer program.	Statistically significant evidence that SAILORS relates to 1) increase in confidence in CS; 2) increase in confidence in AI; 3) increase in likelihood of pursuing CS; 4) increase in likelihood of pursuing AI-related careers.
Wan et al. (2020)	N=8. Location USA University of Rochester	Mixed methods: Post questionnaires for learning gains; interviews, screen recordings, and video recordings of the system interactions from 8 participants	Findings from an initial case study with high school students in a pre-college summer program show that SmileyCluster leads to positive change in learning machine learning (ML) concepts, methods, and sense-making of patterns.
Williams et al. (2022)	N=78, Location: USA MIT	Mixed methods: pre-test and post-test questionnaires and student engagement and performance in the lessons and activities.	As students explored technical concepts in tandem with ethical ones, they developed a critical lens to better grasp how AI systems work and how they impact society.

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Design and Adoption Recommendations for K12 e-Textbooks

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Introduction

At the dawn of the 21st century, e-Textbooks (and Digital Educational Resources) are perceived as an integral part of the educational process regardless of their form and functionality or the type of instructional process which they support and facilitate (Gomez et al., 2019). With the proliferation of e-Textbooks in the K12 and their ever-evolving nature due to related technological advancements, this study proposes specific research-based recommendations for the design, selection and adoption of K12 e-Textbooks: an extremely important, though rather under-researched topic especially for its impact on student learning.

Defining e-Textbooks

Digital textbooks are mainly viewed as an electronic/digital version of the traditional printed book made accessible with the help of appropriate hardware and e-textbook reading software. The different definitions put forward in the literature seem to be related to the different features of the digital textbooks as these may be related to hardware, software or content. In addition, the terms *electronic* and *digital* are used interchangeably when referring to the format, form and text of e-textbooks.

Although "a plausible definition does not seem to exist" (Mahatma Ghandi Institute, 2019, p. 32), the following definitions are advanced as the most comprehensive ones to date:

- An electronic textbook (e-Textbook, or Digital Textbook) is a "digital learning tool that contains a systematic and complete presentation of the subject or part of it, ensuring the completeness of the didactic cycle of the learning process, creating an individualized active educational environment (Makarova, 2019; Abuzjarova, 2018; Ashmarov, 2018; Aminova & Tsakhaeva, 2018; Badakhova, 2017; Bolotin et al., 2017; Borisov, 2018 in Sergeeva et al., 2020, p. 3)
- "The main feature of the electronic textbook is that it includes not only the content of education, but also the selected learning technology. An electronic textbook is an automated training system that includes didactic, methodological, and informational reference materials for an academic discipline, as well as software that allows using them in a comprehensive way to obtain and control knowledge independently" (Sergeeva et al., 2020, p. 5).

Research Context and Methodology

This research project was conducted as part of the Education Modernization Project (Ministry of Education and Science of the Republic of Kazakhstan), and implemented through the technical and financial support of the World Bank. The author's role within the consulting team, focused on the development of e-textbook evaluation for the K12, and the capacity-building of K12 e-textbook experts. In this chapter, we will present phase 1 of the project, namely, the literature review and ensuing research-based recommendations.

The literature review presented here spans the period 2001-2021, and has examined books, research articles, policy reports, and other relevant, scholarly material. Of the aforementioned body of extant literature, 91 sources have been utilized to describe and explain the current status of digital textbooks in K12 education globally.

The underlying goal was to identify research-based answers to the following questions:

1. What are the learning outcomes of the digital textbooks as those as utilized at (a) different subject areas; (b) university, secondary, elementary, and PreK-12 education levels?
2. What criteria are utilized internationally in the design process of digital textbooks?
3. What criteria are utilized internationally in the selection and adoption processes of digital textbooks?

Learning Outcomes- What the research suggests

Digital textbooks' learning outcomes, as well as related student and teacher perceptions, preferences and attitudes have been popular, Higher Education research topics for over a decade. This is owed to the fact that such research has quite a significant impact on the processes of design, selection, adoption, transition to, and evaluation of digital textbooks which in turn impacts student learning. A review of research on the PreK-12 learning outcomes follows below.

- No significant difference in learning has been identified between print textbook and e-book (Blazer, 2013; Murray & Pérez, 2011; Weisberg, 2011; Woody, Daniel, & Baker, 2010). In other words, student performance is not significantly impacted by format or way of delivery. These results suggest that reading can happen effectively in a variety of presentation formats (Margolin et al., 2013). Regarding the elementary school however, it was found that when controlling the experimenters' behavioral protocol in the two media, the print format fared better than the digital textbook on literacy measures that benefited from child-adult interaction (Kozminsky & Asher-Shadon, 2013).
- Digital textbooks represent a technological advance from a two-dimensional to a three-dimensional information tool, replacing the page with the screen and enlivening text with rich imagery, sound, and animation (Kress, 2003). As such, digital textbooks have the potential to provide a non-linear experience with multiple pathways for students to navigate and explore, due to their connection to a plurality of multimedia (concept maps, videos, etc.) which in turn can improve learning outcomes (Huang, Chen & Ho, 2014). According to these researchers, concept maps in particular, if utilized as advanced organizers of the layout of a digital textbook, can "not only reduce learners' cognitive load, but increase their learning outcomes in three different domains, that is, cognition, affection, and psychomotor performance" (p. 614).
- Potential benefits of using digital textbooks have been reported (Bikowski & Kasal, 2018) as: multimodality (Vaarala & Jalkanen, 2010), a more enjoyable learning process (Blazer, 2013; Gu, Wu, & Xu, 2015), increased motivation (Huang, 2013; Jang, Yi & Shin 2016), and, if implemented correctly, hypertextuality (DeStefano & LeFevre, 2007).
- The potential of digital e-textbooks to serve as interactive learning environments thereby facilitating more effective teaching and learning processes, can have a positive impact on student cognition and motivation (Ghaem et al., 2018) and may lead to higher-level learning (Dennis et al., 2016).

- Digital textbooks appear to have a positive impact on reading comprehension and particularly on elementary school students' emergent literacy skills (Blazer, 2013; Korat, 2010; Korat & Shamir, 2008; Segal-Drori et al., 2010) which is also owed to the multimedia affordances of digital textbooks (Grimsaw et al., 2007). The impact of digital content of student algebra performance was found to vary depending on the learning conditions. Yet, research (Huang et al., 2012) also suggests that a customized digital textbook learning system could achieve a better personalized learning experience for elementary school students.
- While the impact of digital content of student algebra performance was found to vary depending on the learning conditions (Blazer, 2013), learning outcomes on the subject of chemistry outperform those based on print textbooks (Chiu, Cheung & Lau, 2017). Nonetheless, these researchers report that no significant difference was found in the psychomotor domain.
- According to Jang, Yi and Shin's meta-analysis (2016) on the effects of digital textbook use on students' learning outcomes in South Korea, the effects on student motivation are higher than the effects on achievement. These findings indicate that digital textbooks can be utilized to increase student motivation. To fully realize the educational potential of digital textbooks, the researchers suggest deregulation of the rigid digital textbook review and approval policy.
- In the context of K-12 education system, Luik and Mikk (2008) sought to identify those characteristics of electronic textbooks that correlated with knowledge acquisition by learners of different achievement levels. Their research findings suggest that not only the content of digital textbooks, but also the design of the associated software should be adapted according to the different achievement levels of students.
- According to Blazer's (2013) review, several studies have reported that students using digital textbooks read slower than those reading print textbooks. In addition, student retention of learned material is poorer than that of students' reading the print version of the same text.
- It has been argued that the interactive features of digital textbooks when operating as distractors, may be responsible for the slower reading speed, and for the reduced content retention (Blazer, 2013; Chiu, Cheung & Lau, 2017). Similarly, De Jong and Bus (2003) point out that the so-called "edutainment" features in children's story books, may hinder instead of promoting learning. Roskos et al. (2011) argue that an important research task is to understand not only how these educational affordances impact particularly early literacy development and learning processes, but also how to use them well.
- It is equally important to address the effect of design on learning outcomes which is implicitly related to selection and usability. Due to the increasingly heightened familiarity and involvement of students -- so called *digital natives* (Prensky, 2001) -- with digital material, Huang, Chen, and Ho (2014) suggest that availability of a variety of digital alternatives is essential. The researchers also emphasize the importance of collaboration between subject matter experts and teachers toward the improvement of the quality of the digital textbook. In order to increase learning outcomes, the digital textbook should not be utilized as a supplement, but as an extension and enhancement of the printed textbook (Huang, Chen, & Ho, 2014; Lau, 2008).

Despite the fact that student performance is not significantly impacted by format or way of delivery, studies have shown that students prefer print textbooks over their digital counterparts (Chou, 2016; Woody, Daniel, & Baker, 2010). Yet, according to deNoyelles and Raible (2015; 2017), students have become more receptive and accepting of using digital textbooks over the recent years while at the same time the use of the latter has increased and become broader demographically. On the other hand, despite the rapid and continuous advances of technology, and the digital textbook trend in education, the teacher's role does not seem to have changed significantly (Wang, 2015). This is why further professional development including increased awareness, instruction, and active modeling is called for (deNoyelles & Raible, 2015).

Design Recommendations

If e-textbooks are to play a leading part in reforming technology-based education (Yu & Kim, 2019), they need to clearly "differ from printed textbooks in terms of design, usability, content, didactic concepts, and features that support learning. Only digital learning applications auguring clear added value beyond printed textbooks, fulfilling the needs and learning objectives of today's users, and designed with regard to users' capabilities and motivational factors, will be widely utilized (Schulmeister, 2013). This view is supported by the expectancy-value theory (Wigfield & Eccles, 2000)" (Behnke, p. 12, 2021).

In light of the above, the following research-based recommendations on e-textbook design are proposed with specific reference to the K12:

- The content of an e-textbook should present methodological, declarative, procedural knowledge in the associated subject area, and knowledge of information retrieval, techniques and methods of search, processing and use of information when making decisions (including information literacy) (Ivanova & Osmolovskaya, 2016). It should also facilitate the development of declarative and procedural memory, consolidate understanding, attract and sustain attention (Flores, Ramos, & Escola, 2015).
- Interactivity must be both embedded and fully functional (Behnke, 2021; Flores, Ramos, & Escola, 2015; Grönlund, Wiklund, & Böö, 2018; Zhang, et al., 2006; Preradovic, Lauc, & Panev, 2020).
- A consistent implementation of all learning process components in the e-textbook information educational environment (i.e. motivational-targeting, content, operational-activity, evaluative- resulting) should take place, and be reflected in all steps of the learning process and requisite components of the online educational environment. The entire sequence of the learning process from setting goals to achieving results shall be implemented as well: a module – a hypertext – interactive tasks – evaluation of educational achievements. This way, an e-book can operate at an advanced level as an information and educational environment that facilitates interaction between teacher and students (Nurgaliyeva et al., 2019).
- There must be an alignment between the contents of the e-textbook and teachers' lesson plans and overall teaching value of the lesson (Behnke, 2021; Flores, Ramos, & Escola, 2015; Grönlund, Wiklund, & Böö, 2018).
- The e-textbook must be of high-quality regarding on-screen text readability and comfort to the human eye (Abuloum et al., 2019; Harjono et al., 2020); interoperability of content across platforms, and lifespan of technical support must be ensured (Chapman et al., 2016; Lokar et al., 2011); subject information with pedagogical content knowledge guiding the design of the e-textbook (Ivanova & Osmolovskaya, 2016) should be provided; and, the design must be carefully

considered to be both visually attractive and behaviorally interactive (Shangguan et al., 2020).

- Considerations regarding technical and functional satisfaction of the end user (i.e. the student) should be taken into account in the design stage. These involve easy and consistent orientation and navigation; clear interfaces; easy access to important information; user-friendly note-taking and bookmarking; multimodality through text, video and animations; adaptation in support of student needs and disabilities; inclusion of learning support tools (dictionaries), teacher tools, communication and collaboration tools (Chapman et al., 2016; Dutkiewicz et al., 2018; Flores, Ramos, & Escola, 2015; Grönlund, Wiklund, & Böö, 2018; Xie et al., 2018).
- Good e-textbook quality (as described above) may help the reader avoid superficial (vs. deep) information processing which typically occurs as a result of on-screen reading during the limited class time (Delgado & Salmerón, 2020).
- Programmers or ICT specialists need to be involved in the design and development of the e-textbook, especially as technology advances rapidly and AI, machine learning, and voice/natural language technologies start making their way into the e-textbook in order to improve student learning further (Leddo et al., 2020).

Selection and Adoption Recommendations

In closing, a few adoption recommendations can be advanced with implications for both educators students, and publishers.

It is important to include student and teacher input in the design of digital textbooks for they are end users, as such they know better how to improve weaknesses of this educational resource. Student and teacher input should be surveyed without linking it to any specific software or hardware (Sheen & Luximon, 2015). This way the pedagogical (vs. the technological) experience will become the crux of the matter.

Digital literacy skills and their development need to come into the discussion (Gillen, 2014) particularly since many students are not sufficiently trained on learning in such media-rich environments (Avgerinou, 2021; Avgerinou & Moros, 2020; Bikowski & Casal, 2018).

As Alsadoon (2020) aptly suggests, with the movement toward digital books, we need to expend more effort to help students enjoy reading from e-books and to value their advantages. More research is needed to explore ways in which e-books can meet students expectations and make the learning experience with them more enjoyable. In line with the aforementioned, Schreurs (2013) recommends more research that focuses on children reading e-books for pleasure, and takes into account the opinions and preferences of children.

Students (and teachers) need sufficient time in learning to take advantage of digital textbooks and their educational affordances (Chou, 2016). Educators and publishers need to communicate to students the benefits of using e-textbooks (e.g., low prices, accessibility, weight, etc.), what features e-textbooks offer (e.g., highlighting capabilities, portability), and how e-textbooks can be better for the environment (e.g., use less paper) (Millar & Schrier, 2015). In particular, teachers need to be trained properly to utilize all features/tools of the e-textbook, and also be able to model the tools for the students (Chapman et al., 2016; Clinton-Lisell, Kelly, & Clark, 2020; van Horne et al., 2016).

Last but least, the adoption of digital textbooks should be driven by educational value instead of other criteria such as a potential textbook price reduction (Murray & Pérez, 2011).

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Design and Adoption Recommendations for K12 e-Textbooks

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Introduction

At the dawn of the 21st century, e-Textbooks (and Digital Educational Resources) are perceived as an integral part of the educational process regardless of their form and functionality or the type of instructional process which they support and facilitate (Gomez et al., 2019). With the proliferation of e-Textbooks in the K12 and their ever-evolving nature due to related technological advancements, this study proposes specific research-based recommendations for the design, selection and adoption of K12 e-Textbooks: an extremely important, though rather under-researched topic especially for its impact on student learning.

Defining e-Textbooks

Digital textbooks are mainly viewed as an electronic/digital version of the traditional printed book made accessible with the help of appropriate hardware and e-textbook reading software. The different definitions put forward in the literature seem to be related to the different features of the digital textbooks as these may be related to hardware, software or content. In addition, the terms *electronic* and *digital* are used interchangeably when referring to the format, form and text of e-textbooks.

Although "a plausible definition does not seem to exist" (Mahatma Ghandi Institute, 2019, p. 32), the following definitions are advanced as the most comprehensive ones to date:

- An electronic textbook (e-Textbook, or Digital Textbook) is a "digital learning tool that contains a systematic and complete presentation of the subject or part of it, ensuring the completeness of the didactic cycle of the learning process, creating an individualized active educational environment (Makarova, 2019; Abuzjarova, 2018; Ashmarov, 2018; Aminova & Tsakhaeva, 2018; Badakhova, 2017; Bolotin et al., 2017; Borisov, 2018 in Sergeeva et al., 2020, p. 3)
- "The main feature of the electronic textbook is that it includes not only the content of education, but also the selected learning technology. An electronic textbook is an automated training system that includes didactic, methodological, and informational reference materials for an academic discipline, as well as software that allows using them in a comprehensive way to obtain and control knowledge independently" (Sergeeva et al., 2020, p. 5).

Research Context and Methodology

This research project was conducted as part of the Education Modernization Project (Ministry of Education and Science of the Republic of Kazakhstan), and implemented through the technical and financial support of the World Bank. The author's role within the consulting team, focused on the development of e-textbook evaluation for the K12, and the capacity-building of K12 e-textbook experts. In this chapter, we will present phase 1 of the project, namely, the literature review and ensuing research-based recommendations.

The literature review presented here spans the period 2001-2021, and has examined books, research articles, policy reports, and other relevant, scholarly material. Of the aforementioned body of extant literature, 91 sources have been utilized to describe and explain the current status of digital textbooks in K12 education globally.

The underlying goal was to identify research-based answers to the following questions:

1. What are the learning outcomes of the digital textbooks as those as utilized at (a) different subject areas; (b) university, secondary, elementary, and PreK-12 education levels?
2. What criteria are utilized internationally in the design process of digital textbooks?
3. What criteria are utilized internationally in the selection and adoption processes of digital textbooks?

Learning Outcomes- What the research suggests

Digital textbooks' learning outcomes, as well as related student and teacher perceptions, preferences and attitudes have been popular, Higher Education research topics for over a decade. This is owed to the fact that such research has quite a significant impact on the processes of design, selection, adoption, transition to, and evaluation of digital textbooks which in turn impacts student learning. A review of research on the PreK-12 learning outcomes follows below.

- No significant difference in learning has been identified between print textbook and e-book (Blazer, 2013; Murray & Pérez, 2011; Weisberg, 2011; Woody, Daniel, & Baker, 2010). In other words, student performance is not significantly impacted by format or way of delivery. These results suggest that reading can happen effectively in a variety of presentation formats (Margolin et al., 2013). Regarding the elementary school however, it was found that when controlling the experimenters' behavioral protocol in the two media, the print format fared better than the digital textbook on literacy measures that benefited from child-adult interaction (Kozminsky & Asher-Shadon, 2013).
- Digital textbooks represent a technological advance from a two-dimensional to a three-dimensional information tool, replacing the page with the screen and enlivening text with rich imagery, sound, and animation (Kress, 2003). As such, digital textbooks have the potential to provide a non-linear experience with multiple pathways for students to navigate and explore, due to their connection to a plurality of multimedia (concept maps, videos, etc.) which in turn can improve learning outcomes (Huang, Chen & Ho, 2014). According to these researchers, concept maps in particular, if utilized as advanced organizers of the layout of a digital textbook, can "not only reduce learners' cognitive load, but increase their learning outcomes in three different domains, that is, cognition, affection, and psychomotor performance" (p. 614).
- Potential benefits of using digital textbooks have been reported (Bikowski & Kasal, 2018) as: multimodality (Vaarala & Jalkanen, 2010), a more enjoyable learning process (Blazer, 2013; Gu, Wu, & Xu, 2015), increased motivation (Huang, 2013; Jang, Yi & Shin 2016), and, if implemented correctly, hypertextuality (DeStefano & LeFevre, 2007).
- The potential of digital e-textbooks to serve as interactive learning environments thereby facilitating more effective teaching and learning processes, can have a positive impact on student cognition and motivation (Ghaem et al., 2018) and may lead to higher-level learning (Dennis et al., 2016).

- Digital textbooks appear to have a positive impact on reading comprehension and particularly on elementary school students' emergent literacy skills (Blazer, 2013; Korat, 2010; Korat & Shamir, 2008; Segal-Drori et al., 2010) which is also owed to the multimedia affordances of digital textbooks (Grimsaw et al., 2007). The impact of digital content of student algebra performance was found to vary depending on the learning conditions. Yet, research (Huang et al., 2012) also suggests that a customized digital textbook learning system could achieve a better personalized learning experience for elementary school students.
- While the impact of digital content of student algebra performance was found to vary depending on the learning conditions (Blazer, 2013), learning outcomes on the subject of chemistry outperform those based on print textbooks (Chiu, Cheung & Lau, 2017). Nonetheless, these researchers report that no significant difference was found in the psychomotor domain.
- According to Jang, Yi and Shin's meta-analysis (2016) on the effects of digital textbook use on students' learning outcomes in South Korea, the effects on student motivation are higher than the effects on achievement. These findings indicate that digital textbooks can be utilized to increase student motivation. To fully realize the educational potential of digital textbooks, the researchers suggest deregulation of the rigid digital textbook review and approval policy.
- In the context of K-12 education system, Luik and Mikk (2008) sought to identify those characteristics of electronic textbooks that correlated with knowledge acquisition by learners of different achievement levels. Their research findings suggest that not only the content of digital textbooks, but also the design of the associated software should be adapted according to the different achievement levels of students.
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- It is equally important to address the effect of design on learning outcomes which is implicitly related to selection and usability. Due to the increasingly heightened familiarity and involvement of students -- so called *digital natives* (Prensky, 2001) -- with digital material, Huang, Chen, and Ho (2014) suggest that availability of a variety of digital alternatives is essential. The researchers also emphasize the importance of collaboration between subject matter experts and teachers toward the improvement of the quality of the digital textbook. In order to increase learning outcomes, the digital textbook should not be utilized as a supplement, but as an extension and enhancement of the printed textbook (Huang, Chen, & Ho, 2014; Lau, 2008).

Despite the fact that student performance is not significantly impacted by format or way of delivery, studies have shown that students prefer print textbooks over their digital counterparts (Chou, 2016; Woody, Daniel, & Baker, 2010). Yet, according to deNoyelles and Raible (2015; 2017), students have become more receptive and accepting of using digital textbooks over the recent years while at the same time the use of the latter has increased and become broader demographically. On the other hand, despite the rapid and continuous advances of technology, and the digital textbook trend in education, the teacher's role does not seem to have changed significantly (Wang, 2015). This is why further professional development including increased awareness, instruction, and active modeling is called for (deNoyelles & Raible, 2015).

Design Recommendations

If e-textbooks are to play a leading part in reforming technology-based education (Yu & Kim, 2019), they need to clearly "differ from printed textbooks in terms of design, usability, content, didactic concepts, and features that support learning. Only digital learning applications auguring clear added value beyond printed textbooks, fulfilling the needs and learning objectives of today's users, and designed with regard to users' capabilities and motivational factors, will be widely utilized (Schulmeister, 2013). This view is supported by the expectancy-value theory (Wigfield & Eccles, 2000)" (Behnke, p. 12, 2021).

In light of the above, the following research-based recommendations on e-textbook design are proposed with specific reference to the K12:

- The content of an e-textbook should present methodological, declarative, procedural knowledge in the associated subject area, and knowledge of information retrieval, techniques and methods of search, processing and use of information when making decisions (including information literacy) (Ivanova & Osmolovskaya, 2016). It should also facilitate the development of declarative and procedural memory, consolidate understanding, attract and sustain attention (Flores, Ramos, & Escola, 2015).
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- A consistent implementation of all learning process components in the e-textbook information educational environment (i.e. motivational-targeting, content, operational-activity, evaluative- resulting) should take place, and be reflected in all steps of the learning process and requisite components of the online educational environment. The entire sequence of the learning process from setting goals to achieving results shall be implemented as well: a module – a hypertext – interactive tasks – evaluation of educational achievements. This way, an e-book can operate at an advanced level as an information and educational environment that facilitates interaction between teacher and students (Nurgaliyeva et al., 2019).
- There must be an alignment between the contents of the e-textbook and teachers' lesson plans and overall teaching value of the lesson (Behnke, 2021; Flores, Ramos, & Escola, 2015; Grönlund, Wiklund, & Böö, 2018).
- The e-textbook must be of high-quality regarding on-screen text readability and comfort to the human eye (Abuloum et al., 2019; Harjono et al., 2020); interoperability of content across platforms, and lifespan of technical support must be ensured (Chapman et al., 2016; Lokar et al., 2011); subject information with pedagogical content knowledge guiding the design of the e-textbook (Ivanova & Osmolovskaya, 2016) should be provided; and, the design must be carefully

considered to be both visually attractive and behaviorally interactive (Shangguan et al., 2020).

- Considerations regarding technical and functional satisfaction of the end user (i.e. the student) should be taken into account in the design stage. These involve easy and consistent orientation and navigation; clear interfaces; easy access to important information; user-friendly note-taking and bookmarking; multimodality through text, video and animations; adaptation in support of student needs and disabilities; inclusion of learning support tools (dictionaries), teacher tools, communication and collaboration tools (Chapman et al., 2016; Dutkiewicz et al., 2018; Flores, Ramos, & Escola, 2015; Grönlund, Wiklund, & Böö, 2018; Xie et al., 2018).
- Good e-textbook quality (as described above) may help the reader avoid superficial (vs. deep) information processing which typically occurs as a result of on-screen reading during the limited class time (Delgado & Salmerón, 2020).
- Programmers or ICT specialists need to be involved in the design and development of the e-textbook, especially as technology advances rapidly and AI, machine learning, and voice/natural language technologies start making their way into the e-textbook in order to improve student learning further (Leddo et al., 2020).

Selection and Adoption Recommendations

In closing, a few adoption recommendations can be advanced with implications for both educators students, and publishers.

It is important to include student and teacher input in the design of digital textbooks for they are end users, as such they know better how to improve weaknesses of this educational resource. Student and teacher input should be surveyed without linking it to any specific software or hardware (Sheen & Luximon, 2015). This way the pedagogical (vs. the technological) experience will become the crux of the matter.

Digital literacy skills and their development need to come into the discussion (Gillen, 2014) particularly since many students are not sufficiently trained on learning in such media-rich environments (Avgerinou, 2021; Avgerinou & Moros, 2020; Bikowski & Casal, 2018).

As Alsadoon (2020) aptly suggests, with the movement toward digital books, we need to expend more effort to help students enjoy reading from e-books and to value their advantages. More research is needed to explore ways in which e-books can meet students expectations and make the learning experience with them more enjoyable. In line with the aforementioned, Schreurs (2013) recommends more research that focuses on children reading e-books for pleasure, and takes into account the opinions and preferences of children.

Students (and teachers) need sufficient time in learning to take advantage of digital textbooks and their educational affordances (Chou, 2016). Educators and publishers need to communicate to students the benefits of using e-textbooks (e.g., low prices, accessibility, weight, etc.), what features e-textbooks offer (e.g., highlighting capabilities, portability), and how e-textbooks can be better for the environment (e.g., use less paper) (Millar & Schrier, 2015). In particular, teachers need to be trained properly to utilize all features/tools of the e-textbook, and also be able to model the tools for the students (Chapman et al., 2016; Clinton-Lisell, Kelly, & Clark, 2020; van Horne et al., 2016).

Last but least, the adoption of digital textbooks should be driven by educational value instead of other criteria such as a potential textbook price reduction (Murray & Pérez, 2011).

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Impacting Human Rights Education through Interdisciplinary Collaboration and First Principles of Instruction Methodology

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Abstract

Interdisciplinarity seeks to integrate knowledge and solve problems that individual disciplines cannot solve alone. (Jacobs and Frickel 2009). As a field, instructional technology has a history of interdisciplinary collaboration with neighboring fields such as psychology, communication, and information technology (Cho, 2017). However, it is not as common for instructional technologists and designers to collaborate with unrelated academic disciplines. This paper seeks to show how collaboration between unrelated fields can impact student learning and increase the understanding and respect for the field of instructional design by highlighting a design project related to faith and human rights. In this project, a single instructional designer directed a team of law students as they worked to learn and utilize instructional design techniques and First Principles of Instruction methodology (Merrill, 2002, 2020) in order to improve student learning in the area of freedom of religion or belief and human rights. This project has implications on how instructional designers work on interdisciplinary teams, how the field of instructional design is viewed by outsiders, and for the impact of First Principles of Instruction on student outcomes.

Introduction

This paper will highlight the processes and methods used in the development of the Faith for Rights Toolkit Online Conversion project, as well as the project itself. Instructional design (ID) methodologies such as First Principles of Instruction (FPI) (Merril, 2002, 2020) can significantly impact student learning outcomes (Frick et al. 2010), (Lee & Koszalka 2016), (Tiruneh et al. 2016). In addition, the demand for online learning provides increased opportunities for instructional designers (IDers) to collaborate across disciplines. While collaboration with related fields such as psychology and human performance is common, collaboration between ID and unrelated fields during the design process itself is less common (Cho, 2017). Concentric collaboration, a style used in business to develop individual and collective leadership (Roberts & Coghlan, 2011), can be used to aid IDers and individuals of unrelated disciplines in working together to provide the best learning outcomes. Additionally, successful interdisciplinary collaboration with diverse stakeholders requires characteristics of Communication, Humility, Adaptability, Mentorship, Engagement, Looping, Empathy, Oscillating, and Networking (CHAMELEON) (Bawa & Watson, 2017). The actions of IDers during collaboration with stakeholders and colleagues can contribute to the way organizations view learning design. Thus, IDers can be agents of change by sharing and in effect, *teaching*, the use of learning methodologies and ID practices (Campbell, Schwier, & Kenny 2007) to those who are unfamiliar with such practices. This, in turn, can enhance the outcome of learning products by improving communication and understanding across disciplines.

Background

The purpose of the Faith for Rights Toolkit Conversion project is to convert an existing learning framework, the Faith for Rights Toolkit (FFRT), originally only available in pdf format, into an online learning resource useable by faith leaders and human rights proponents of varying educational and cultural contexts, thus enabling them to advocate for and teach about human rights in their respective communities. This project was sponsored by the Brigham Young University J. Reuben Clark Law School under the direction of Professor David H. Moore, Associate Director of the International Center for Law and Religion Studies (ICLRS). The project was completed in conjunction with the Human Rights Law Clinic course offered to BYU law students in an effort to provide these students with an opportunity to participate in a real-world project applicable to human rights law. Stakeholders included representatives from the United Nations Office of the High Commissioner for Human Rights (UN OHCHR), some of whom were the original authors of the FFRT. These stakeholders were consulted regularly throughout the project. Their goals were to provide a readily available resource for facilitators and inter-faith groups seeking to further the cause of freedom of religion or belief and human rights in their locales, educate faith leaders about how to incorporate human rights education into their ministries, and provide a web-based avenue for sharing the Faith for Rights program.

A unique aspect of this project was that the product (the FFRT) was already developed. The content, the learning activities, and some learning objectives were compiled previously. In spite of this, there were no measurable outcomes as far as learner abilities or the ability of learners to achieve learning goals. The stakeholders' purpose in engaging in this project was to adapt the product to reach a wider audience of participants and facilitators. As such, our intent in analyzing the gaps was not to identify gaps in learner ability or knowledge, but to identify the gaps in the current product itself. This analysis included questions such as:

- Why is the FFRT not being utilized?
- How can the product be accessible to a broader (non-UN) audience?
- What adjustments could be made to the product to make it more user-friendly?
- What was needed to provide training on how to facilitate the Faith for Rights program?

In completing a user and product analysis, it was determined that the original FFRT was being utilized only by a narrow section of individuals with connections to the UN OHCHR. In order to broaden the reach of the program, the product would need to be modified to suit the needs of a wider variety of users. In addition, the original FFRT content did not provide the user a clear path to successfully facilitating a Faith for Rights session. Nor did the original content provide clear objectives or a strategy to achieve competencies. These gaps were not knowledge or ability gaps based on the user's capabilities, but were gaps in the design of the original content. The FFRT contained broad objectives, detailed contextual information, many insightful and useful learning activities, resources, and suggestions. However, it did not follow an instructional strategy that would allow facilitators and participants of the Faith for Rights program to effectively achieve the goal of the program to "shift from abstract inter-religious dialogues into individual and joint positive actions by faith actors in defense of human dignity for all."

As a result of user and product analysis, this project sought to narrow that goal into the following outcomes:

1) Develop a web-based resource based on proven instructional methodology for five of the eighteen modules included in the original FFRT. This included content on facilitation, religious or belief pluralism, gender equality, minority rights, and issues surrounding incitement to hatred.
2) Develop a web-based training course for FFRT facilitators that would familiarize learners with the background and purpose of the FFRT program, train in the use of peer-to-peer learning techniques, aid facilitators in engaging with participants in a manner that would allow them to avoid and resolve conflict and tension, and plan and present Faith for Rights events.

The resulting product is the Faith for Rights Online Conversion, a website hosted on the ICLRS server. The website contains five of the eighteen modules in the original FFRT, as well as an online facilitator guide course. Each of the modules on the website contains the following:

- instructional information on how to use the modules, learning paths, and peer-to-peer activities
- learning paths comprised of peer-to-peer activities, each focusing on a specific learning objective and competencies, following FPI methodology
- a complete list of all the peer-to-peer activities provided for the module in an a-la-carte list
- a Learning Library of resources related to the module

In addition, each peer-to-peer activity has been fully developed for ease of use including:

- a list of competencies that will be achieved by participants as they complete the activity
- step-by-step instructions
- discussion questions
- resources specific to the activity
- facilitator tips

Each peer-to-peer activity has been fully developed with the intent to provide a user friendly experience for both facilitators and Faith for Rights participants.

Collaborative Process

A central component of this project was the interdisciplinary collaboration between the fields of ID and international law. Law students worked not as subject matter experts, but actively engaged in ID tasks alongside a lead IDer who worked to facilitate ID processes, as well as gain understanding on the intersectionality of freedom of religion or belief and human rights. Stakeholders from the UN OHCHR were consulted throughout the process. The intent of this interdisciplinary collaboration was to impact student learning by combining ID methodology and broad experience in the subject matter, thereby providing learners a robust and adaptable platform of resources and learning paths. This was accomplished utilizing a concentric collaboration (CC) method in which interdisciplinary team members extended the reach of their skills, making connections across disciplines. This style of collaboration (Roberts & Coghlan, 2011) in which team members' roles were not traditionally compartmentalized provided an opportunity to broaden the reach of ID methods and thereby strengthen the impact on student learning by bringing a range of experience and viewpoints to the design table.

The team consisted of seven law students and one instructional design student. As such, it was necessary that the law students participate in ID activities, rather than participate solely as subject matter experts (SMEs). The utilization of CC allowed the law students to learn and gain confidence in ID principles. As described by Roberts and Coghlan, the process of CC is similar to a pebble being dropped in a pond:

> As each 'pebble' or concept is dropped into the 'pond', the ripples of knowledge, learning, connection, and influence move from the individual leader (center) outward to his or her immediate team. The ripples expand to reach other departments, finally extending and connecting throughout the organization.

This was done by following a series of processes:

Process 1: Work sessions. Weekly work sessions were dedicated to learning ID processes, solving specific instructional design problems, and collaborating regarding ideas. Topics included the ADDIE model, learner/user analysis, learning objectives and competencies, instructional methodologies, development strategies and procedures, and evaluation.

Process 2: Working with templates. Several instructional design templates were created to aid law students in properly applying the ID principles discussed in the work sessions.

Process 3: Law students worked in pairs on ID tasks and were given feedback on their work. This allowed the law students to practice what they had learned both independently and collaboratively with a partner, building their confidence in engaging in design work.

Process 4: The team reviewed the product in stages and collaborated on next steps, relying on each other to develop a working product.

Process 5: Work was presented to the stakeholders for feedback and approval.

As a result of this ongoing process, law students reported that they had a higher understanding of the ID field and its methodologies. They also gained confidence in their ability to contribute to work for which they had not initially been trained. Most importantly, the understanding of the purpose and importance for intentional instructional design was elevated. For example, when asked how their personal understanding of ID changed as a result of their participation in this project, the students provided the following feedback:

> I understand much more about what goes into creating a course. There is so much more behind the scenes than I realized, and I have much more appreciation for how much thought goes into each small detail.

SO much more knowledge and respect for this field.

The project has increased my understanding of the instructional design process and given me an appreciation for the principles we have employed and the structure they provide to enable learning.

I had no idea what it entailed previously, and now I have a stronger understanding of certain principles.

As more fields seek to make learning content available online, the need for collaboration between IDers and professionals in unrelated fields will continue to increase. As IDers, we can impact student learning by sharing our knowledge of ID principles and processes on a variety of projects in a variety of disciplines. Working with an ID can increase the understanding of learning processes, online learning facilitation, and ID methodologies across disciplines. This can impact student learning across fields (Bawa & Watson, 2017).

In addition to collaboration with non-ID team members, the nature of this project required collaboration with a group of stakeholders who were diverse in areas of education, culture, and thought and who were highly vested in the project. In their 2017 study, Bawa and Watson asserted that the increased need to collaborate with diverse stakeholders requires IDers to utilize characteristics that relate to both a metaphorical chameleon and the suggested acronym, CHAMELEON. The metaphor of a chameleon refers to the requirement that IDers be adaptable to change, willing to listen to the ideas and needs of others, and have an ability to apply what they learn from others to the development of a product. In this case, these principles were utilized in the following manner in order to build and maintain rapport and trust with the stakeholders, as well as to continue momentum on the project. See Figure 1.

Figure 1
CHAMELEON collaboration principles

Communication	Frequent and open communication via zoom with stakeholders regarding content modification, methodology, and technology occurred.
Humility	Humility was displayed as law students worked to understand and utilize ID principles, and as all team members worked to understand the needs of users from a variety of belief systems and international settings.
Adaptability	The ID, law students, and UN OHCHR stakeholders worked to be adaptable to change throughout the process. This was seen in the ID being able recognize the ideas and contributions of non-ID team members as new ways of doing things, the law students being able to put aside their own views of how a course should be developed, and the stakeholders being able to see their original content modified.
Mentorship	The area of mentorship was another area in which all participants contributed equally based on their own expertise. The ID mentored law students in ID techniques and processes. The law students mentored the ID in the nuances of conflict resolution and international human rights

	law. The UN OHCHR stakeholders mentored both groups in international
Engagement	All team members were determined to engage with the content in an effort to understand the complexities surrounding religion and human rights in order to develop a product that would be impactful to users around the world.
Looping	The team followed an iterative design process, in which ideas, designs, and content was presented for collaboration with the team and stakeholders. The process was repeated (or looped) throughout the development process.
Empathy	Empathy included forming relationships of trust, focusing on needs of other team members, being transparent about the process, defining roles and expectations, and having understanding for the viewpoint of others.
Oscillating	The team utilized a process of collaboration in which content and materials were developed and then reviewed in a back and forth fashion. Multiple versions were considered. In this way all contributed equally to the development of the product.
Networking	An extended network of individuals not directly involved in the project were consulted. These included ID professionals from the BYU Department of Instructional Psychology & Technology, the Board of Directors for the BYU Center for Law and Religion, individuals with prior connections to the UN OHCHR and the Faith for Rights program, and an ID team working on a separate Faith for Rights product at the US Institute for Peace.

The increased demand for online learning in a variety of contexts has created a greater necessity for interdisciplinary collaboration. By utilizing CC and CHAMELEON techniques, IDers can increase awareness of and respect for the field of ID. Interdisciplinary collaboration also allows for a greater variety of contribution when designing learning products, thus increasing the impact on student learning.

First Principles of Instruction Methodology

The original FFRT consisted of a 124-page document made up of 18 learning modules, each containing lists of peer-to-peer learning activities. The document was the product of workshops attended by a group of legal, religious, and human rights scholars affiliated with the UN OHCHR. As such, its development did not consider ID strategies. Problems with the toolkit included densely written academic language, a text-based format that provided little structure for learning sessions, a high number of learning activities without logical sequencing, broad learning objectives, and the absence of an effective instructional methodology.

It has been shown that instructional methodologies such as First Principles of Instruction (FPI) (Merril, 2002, 2020) can significantly impact student learning outcomes (Frick et al. 2010), (Lee & Koszalka 2016), (Tiruneh et al. 2016). Therefore, it was determined that the most effective instructional methodology for this project would be FPI. However, a significant challenge encountered in this project was implementing FPI methodology within a pre-established framework of peer-to-peer learning modules, rather than within an instructor-led framework. To assist in this effort, three key instruments based on FPI (Merril, 2021) were developed. The instruments were intended to aid in the development of sequenced learning paths, identifying competencies and learning objectives, and identifying a progression of problems. These design instruments were as follows:

First, Applying Merrill's Principles of Instruction (Figure 2). This instrument helped law students determine the problem and the subsequent principles of instruction that would help learners solve the problem using the FPI sequence: Activate, Demonstrate, Apply, Integrate. Instructions given with this instrument:

1) Identify the main problem that participants will work toward solving in the module.
2) Determine the activities you would like to use. The activities will be problem-based, peer-to-peer activities.
3) Identify the principles of instruction that will be used in the activity: Activate, Demonstrate, Apply, Integrate
4) Explain how each principle will be implemented in the activity.

Figure 2
Applying Merrill's Principles of Instruction

Problem: Participants come from varied backgrounds and need to work in cooperation with each other to advance the cause of rights of women and girls in their communities

Module/Activity	**Activate**	**Demonstrate**	**Apply**	**Integrate**
Unpacking	Participants activate their understanding of Commitment V (CV) by breaking down the C. into different components.	When coming together as a group, participants demonstrate their understanding of CV and the various actors with responsibilities within CV.	After breaking down CV into different components, participants apply those components and CV to their own lives and contexts.	NA
Translating	Participants activate their understanding of CV by simplifying it and bringing out the core principles of CV in an understandable way.	Participants demonstrate their interpretation of what the core principles and how to convey the principles of CV without losing the substance of CV.	Participants apply this exercise by translating it into a local dialect or language and by practicing how to convey the core principles of CV without losing substance within their	NA

			culture and context.	
Storytelling	Participants activate past stories and experiences pertaining to CV and share how they handled them.	The facilitator demonstrates the power of storytelling by sharing the story of Jamila Mahdi.	Participants apply storytelling to their specific demographic and context. Participants discuss how these stories can encourage equality in their respective communities.	Participants choose a story from their personal life, or one which was shared in the group and write it down. Participants commit to sharing this story with members of their community or congregation.
Exploring	Participants activate their previous experiences in how religion postiviely or negatively impacts gender discrimination.	NA	Participants apply their personal experiences to the questions asked by discussing the questions posed by the facilitator.	Participants create a sermon/talk/discussion plan wherein they express how their religion can encourage and promote gender equality.
Inspiring	Participants activate their previous experiences by discussing the ways women are viewed and treated within their society and faith communities.	The facilitator demonstrates how others have expressed the principles of CV and gender equality through artistic expression by sharing examples and videos	Participants apply CV to an artistic expression through calligraphy, art, dance, music, etc.	NA

Second, Progression of Problems document (Figure 3). This instrument helped law students align a progression of problems with learning objectives and competencies. Instructions given with this instrument:

1) Identify the learning objectives in the module you are working on. (These are found in the F4R pdf).
2) Develop competencies based on the learning objectives. Competencies are what the participants should be able to do by the end of the module.

3) Determine the Problems that will be used to help participants master the learning objectives and complete the competencies. (These are the learning activities that will be used in the module)
4) Arrange the activities in the chart in a progression from beginner to advanced.
5) Create a separate table for each module. Modules may have multiple learning objectives and competencies.

Figure 3
Progression of Problems

*This is a sample problem to illustrate how to use this chart. Delete it and fill in the activities for your module.				
Module 4: Religious or Belief Pluralism		**Problem-based Activities (Peer-to-Peer Learning Activities)**		
Learning Objectives	**Competency**	**Problem #1**	**Problem #2**	**Problem #3**
Participants realize the risk that both notions of "state religion" and "doctrinal secularism" could lead to discrimination and the required vigilance by both State and non-State religious actors in this respect.	Participants identify positive ways to counter discrimination within their own sphere of influence.	Participants discuss the example found on page 28 (2004, Macedonian Orthodox Church). Participants identify the ways in which "state religion" contributed to this event	Participants will work in groups to draft a constitutional provision defining an ideal relationship between religion and state.	Participants engage in a simulation of a court exercise in which a fictitious case related to state religions or doctrinal secularism is presented.

Third, the Faith for Rights Module Checklist. This checklist was used to ensure that FPI methodology was included in each module, that competencies were aligned with learning objectives, and that activities included in each learning path followed a progression. See Figure 4.

Figure 4
Faith for Rights Module Checklist

Faith for Rights Module Checklist			
Element	**Yes?**	**No?**	**Comments**
Learning Objectives & Competencies			
Did you use a maximum of 4 learning objectives from the module?			
Do the competencies define and clearly state what the participants will be able to do after completing the module?			

Do the competencies align with the learning objectives?			
Peer to Peer Learning Activities			
Are the activities problem-based?			
Do you identify the principles utilized in the activity? Example: Activate, Demonstrate, Apply, Integrate			
Are the activities presented in a progression of difficulty format? Or is a suggested order of activities given?			
Are the activities identified by their strategy, i.e. Unpacking, Critical Thinking, Tweeting, etc?			

In addition, several presentations were designed to help law students understand ID principles and techniques, as well as FPI. For example, a presentation on developing competencies helped law students to convert broadly written learning objectives already present in the FFRT into action-oriented competencies upon which to build a progression of problems. The following examples were part of this presentation (Figure 5, 6):

Figure 5

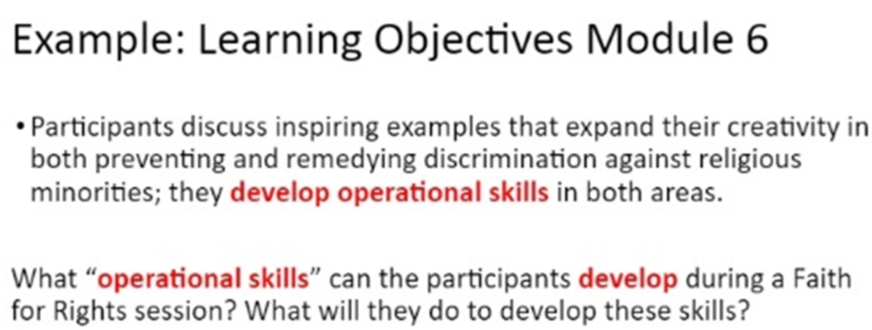

Figure 6

As a result of the analysis completed on each module, it was determined that Learning Paths would be developed in order to better follow FPI methodology. The placement of activities in the original FFRT was random. Each module contained a list of peer-to-peer activities from which a facilitator could choose. The Faith for Rights Toolkit online conversion contains three designated Learning Paths that allow facilitators to identify specific competencies that they feel best meet the needs of their learners. The Learning Paths are built upon a progression of problems that will meet the objectives of the module. Each Learning Path allows the learners to activate prior knowledge, demonstrate their understanding, apply new knowledge, and integrate what they have learned into their own context. The Learning Paths simplify preparation and follow a proven FPI methodology. As requested by the UN OHCHR stakeholders, complete lists of peer-to-peer activities were included within each module to allow facilitators to modify Learning Paths as they deem appropriate.

Conclusion

Instructional Designers can improve the impact on student learning by changing the way interdisciplinary design teams work together. The result of this project is a robust online learning platform which provides clear FPI methodology that can be used to impact student learning around the world. By utilizing principles of concentric collaboration and CHAMELEON, IDs can become agents of change in how interdisciplinary ID teams collaborate, and thereby improve the impact on student learning, as well as the understanding of the field of ID in a variety of disciplines. In addition, this project highlighted the use of FPI in a peer-to-peer learning program used to advance the joint causes of freedom of religion or belief and human rights. The relevance of this project can be observed in two key areas:

1) As a result of the growing demand for online learning in diverse fields, opportunities for interdisciplinary collaboration have increased, highlighting the need for IDers to adjust the way in which they work and collaborate with interdisciplinary team members and diverse stakeholders.
2) Evidence-based ID techniques and methodology can be used to impact student learning in diverse international environments by providing action-oriented and logically sequenced learning paths and activities.

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Perspectives from Instructional Design Professionals Experienced in Corporate, Higher Education, and K-12 Industries

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Descriptors: Instructional Design and Career Path

The field of instructional design dates to the 1940s and World World II, with the pressing need to educate military personnel at high quality (Reiser, 2001). The industry is rooted in models, methodologies, and frameworks that have been designed to help facilitate positive learning experiences. When building a learning experience, instructional designers are typically involved in tasks like conducting a needs assessment, writing learning objectives, identifying relevant content, designing/developing instructional materials, coordinating with the team, and much more (Aschaiek, 2021). With the abrupt shift online resulting from the COVID-19 Pandemic, instructors had to figure out how to teach students digitally (Pilbeam, 2020), and instructional design became even more relevant. Instructional design emerged as an essential function requiring innovative thinking and foundational learning principles and became recognized by more people as a critical component of quality (Pilbeam, 2020).

The Bureau of Labor Statistics (2022) states that "employment of training and development specialists is projected to grow 11 percent from 2020 to 2030, faster than the average for all occupations" (p. 1). Given the importance of this position, it is crucial to hire individuals with the proper credentials, like a degree in instructional design, educational design, learning design, or educational technology (Aschaiek, 2021).

There are instructional design functions and positions in different industries, e.g. higher education, corporate, and K-12. Foundational instructional design practices apply across contexts, including considering learner characteristics, background knowledge, and motivation; alignment between learning outcomes, instructional content, and assessments; and understanding how to use technology to enable and support learning. Instructional designers help to bridge the gap between learning and technology; create an engaging educational experience; and are an integral part of the learning process, no matter what sector they serve (Klein, 2014).

At the same time, unique areas specific to each sector will also impact differences in things like roles, titles, salaries, schedules, job prevalence, technologies used, required skill sets, reporting lines, job autonomy, flexibility, and the role of subject-matter experts. Here we explore three key educational sectors--higher education, corporate, and K12--in terms of the unique ways instructional design work gets done in each context.

Instructional Design in Higher Education

In contrast to skills-based training programs, higher education tends to take a more holistic approach to learning, positioning itself as educating the whole student rather than providing (only) discrete skill acquisition. There are challenges to this traditional model, such as competency-based programs, but most instructional design in higher education institutions remains vested in a holistic framework (Andriotis, 2017). The main drive for educational institutions is to build knowledge banks in various disciplines rather than learning specific skills (Lynch, 2020).

In this context, instructional designers work predominantly in support of or collaborating with subject matter experts to develop curricular and cocurricular learning experiences. Here we will focus on the curricular experiences wherein the subject matter experts are the academic faculty members. In some cases, the instructional designers may also be in faculty roles, though typically in professional/non-tenure track lines. There are two broad categorizations for the type of work an instructional designer, also sometimes called a learning designer, works with academic faculty and their courses: the "concierge" or the consultant model (Quinn, 2020; Vieger, 2020).

In the concierge model (Vieger, 2020), an instructional (or learning) designer and faculty member work closely to design and develop a course for an online or blended offering. The process is highly collaborative, and it is common for the instructional designer and faculty members to work together for an entire semester or more. The instructional designer often has project management responsibilities and either build the course themselves in the university-supported learning management system or coordinates with others who do. This is a very hands-on approach and involves a sense of co-ownership, where the designer and the faculty member view the course as "theirs."

In the second model, the consultant model, the designer is positioned in a less hands-on manner and acts as a consultant to the faculty. Rather than being assigned to work very intensively on a few courses or a program and with a few faculty members, the designer might instead support all faculty in an entire department, college, or campus. In this role, the instructional designer is available to offer advice and solutions to faculty members regarding their online and hybrid courses, but ultimately, the course is solely in the domain of the faculty member (Quinn, 2020). There is not the same sense of shared ownership over the course and the amount of time the designer dedicates to individual course design is much less as their work is spread more broadly.

In both the concierge and consultant role, it is not uncommon for the designer to also take on a fair amount of informal faculty development. Given that most academic faculty receive little to no formal education or training into pedagogy, learning theory, or course design, it is common for the designer to inform the faculty member about best practices in online or hybrid course design and teaching as well as what is known about how learning best takes place given constant advances in the learning sciences and our understanding of "how people learn."

The key technology instructional designers in higher education will use is the learning management system. Specific examples include Canvas, BlackBoard, and Moodle. Instructional designers also need to understand how multimedia can support and enable online learning, but will typically work with multimedia consultants rather than producing that media themselves. Salaries will largely depend on standards within the university itself and can vary across institutions.

In addition to staying professionally competent and being abreast of the latest developments in educational technology and innovative pedagogical approaches, much of the work of instructional designers in higher education comes down to relationship management. They will always need to successfully navigate the relationship between themselves and the faculty members with whom they work. Working with an instructional designer is a new experience for many faculty members. They are not always, at least initially, comfortable with having someone not in their field give input on how they should teach or design their course. It is essential that the instructional designer has strong communication and relationship-building skills and be confident in their expertise, an expertise that is typically distinct from the faculty member's discipline-specific expertise. Ultimately, the instructional designer's job in higher education is to create the best learning experiences for the students they ultimately serve.

Instructional Design in Corporate Sectors

Corporate learning aims to ensure that every employee has the knowledge and expertise to handle any specific operation that will allow an organization to carry on its operations. In other words, the focus is on building competencies (Lynch, 2020). Competencies are the capabilities, knowledge, skills, and resources that constitute its defining strength. Furthermore, corporate organizations focus on training, and there may be requirements, but often, learning happens through curiosity and a library of courses. Training prepares the learner for something new and helps them to learn different skills and how they are applied in the workplace (Andriotis, 2017).

An instructional designer in the corporate sector will create engaging learning experiences like higher education. An instructional designer will often interview subject matter experts, write instructional content, design storyboards, and develop an interactive learning experience. The goal is to create training delivered as eLearning, face-to-face workshops, job aids, and other performance support solutions. An instructional designer will use instructional design models to help structure the learning material, but each model may have a unique application. The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) is a popular model. The model provides instructional designers with a streamlined, focused approach that provides feedback for continuous improvement (Quigley, 2019). Another widely used model is Merrill's Principles of Instruction (MPI) which looks at the five learning principles. These are the task-centered principle, activation principle, demonstration principle, application principle, and integration principle (WRC, 2020). No matter which model is being used, this allows the instructional designer to visualize the training need and break down the process of designing training material into steps.

According to the Articulate Community (2021), there is a range of titles, for example, Instructional Designer, eLearning Developer (or Designer), Learning Experience Designer, Learning Strategist, Learning and Development Specialist, and Curriculum Developer. Career path-wise, an instructional designer might move into a senior or manager role, working with or supervising a team of other designers. Typically an instructional designer works in a company's training and development department. The salary range varies depending on factors such as education, certifications, additional skills, and years in the profession (Salary.com, 2021). This role often appears on the 'top jobs' lists due to the high job satisfaction and the good work-life balance (CNN, 2021).

The core skill of an instructional designer is improving an individual's performance. This includes designing learning experiences, a system, or information and being a great communicator with words, visuals, and media. Individuals in this role come from various backgrounds and are passionate about designing high-quality, engaging learning experiences. A corporate instructional designer believes learning is about performance improvement and behavioral change, focusing on interactive learning experiences. While only some instructional design roles require you to know much about technology, most do. Most individuals in an instructional design role write the instruction and develop it into its final online or face-to-face format using various tools. Using technology like authoring tools (e.g., Articulate Storyline, Articulate Rise, Adobe Captivate, etc.) to develop courses is common for corporate instructional designers. Corporate instructional designers don't use the same learning management systems in higher education. In summary, the instructional designer's job, like in higher education, is to create the best learning experiences for the students they serve. The major difference is in the tools, structure (reporting lines), and models.

Instructional Design in K-12 Education

In K-12, like Higher Education, education takes on a more holistic approach to learning – equipping students with knowledge from multiple disciplines (i.e., core subjects) – rather than developing specific skills (Andriotis, 2017). In an academic context, instructors primarily focus on knowledge transfer (Lynch, 2020).

In contrast to higher education and corporate instructional design, within a K-12 setting, instructional design work is almost entirely placed in the teachers' hands (Smith, 2011). Even though professional development or a Master's degree is necessary for teachers, there is not a required focus on instructional design specifically. Most educators are unaware of instructional design principles (Herron & Wolfe, 2021) or their impact on student learning. However, the shift to online pandemic teaching required most educators to quickly transform from face-to-face to virtual teaching environments (Hodges et al., 2020). One model created and deployed at this time was the CAFE model, which made many assumptions (i.e., knowing students and needs, available technology, and instructional content) to allow for a more streamlined approach (Wang, 2021).

Actual stand-alone positions as instructional designers within K12 settings are typically packaged within an instructional technologist, technology coach, or technology director role. In most cases, the teachers are the subject matter experts, technology integrators, and instructional designers, with some support from coaches if available. Although districts often employ technology coaches, their role is mainly to coordinate professional development, administrative work, and other faculty support, not instructional designer support. Therefore, the focus on K12 technology integration is often on tool use and not the overall design of instruction.

However, instructional designer positions can be more easily found within large corporate K12 virtual schools or companies focused primarily on publishing developed content packages. Although this role can sometimes provide a great deal of autonomy in what materials are used, how they are presented, and how technology is integrated, these depend on the school district and administration for the guidelines for implementation.

The leading educational technologies utilized by K12 school districts are Google products, YouTube, and Kahoot (Staff, 2022). Google Classroom, Schoology, Moodle, and Canvas are the most commonly selected for districts utilizing a learning management system. Additional tools often integrated into the learning management system or used as stand-alone technologies are Seesaw, Flipgrid, Formative, Padlet, and Socrative.

The core focus of instructional design in K12 environments is to enhance student's learning experience by providing opportunities for deeper learning through simulations and layered experiences, collaboration, and digital skills development (Kosmas, 2022).

How are the Industries the Same?

Foundational instructional design practices apply across contexts, including consideration of learner characteristics, background knowledge, and motivation; alignment between learning outcomes, instructional content, and assessments; and an understanding of how to use technology to enable and support learning. Instructional designers' work is often a mix of independent and team-based projects and typically includes the following tasks use technology to enhance and support learning, focus on learning alignment, engage learners, and create assessments to evaluate learning.

To be successful in all sectors, instructional designers need the following skills:

- **Creativity:** Instructional designers use creativity to develop engaging learning experiences for their audience to develop engaging learning activities, create engaging learning environments and develop engaging learning experiences.
- **Communication:** Instructional designers must bridge multiple stakeholder groups, requiring verbal and nonverbal communication and interviewing skills. This also includes negotiation and diplomacy (Klein, 2014).
- **Technology:** Learning specific technologies for course development, authoring, and media development, as well as keeping current with emerging technologies (Klein, 2014)
- **Pedagogy:** Undending how to design asynchronous, synchronous, and blended learning environments is important for all sectors, particularly following the pandemic (Klein, 2014). In addition, a growing weight is placed on understanding the integration of technology to enhance social presence (Sugar, 2016).

Lastly, no matter what sector, an instructional designer will design and create the content with the learner in mind for a user-centric experience. Much of what an instructional designer is doing is making sure the learner comes first. This allows the learner ample opportunities to reflect and process information and focus on it by prioritizing information (Khouri, 2022). From a user experience (UX), the instructional designer finds ways to cut down long presentations (in a corporate setting or a classroom), break up unbroken text blocks, and reduce needless bells and whistles that might distract and overload attention (Khouri, 2022).

Conclusion

Instructional design is not a new field; however, due to the pandemic, it is increasingly recognized as necessary. This field is always evolving, especially with technology. All sectors have leveraged the role of the instructional designer in creating meaningful learning environments. In each sector, we are rooted in the same learning theory, educational technology affordances, learning outcomes, assessment outcomes, and a focus on the learning experience. However, how these activities play out can vary depending on your location. It is important for individuals pursuing degrees in instructional design (and related fields) and those interested in instructional design work to be aware of these key industry differences. The practice of instructional design will further establish itself as a critical component of quality learning experiences. The future is promising for instructional designers as essential partners in learner success.

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HOW ARE SECONDARY STUDENTS DOING? A STUDY ON THE IMPACT OF EMERGENCY REMOTE TEACHING ON K-12 STUDENTS AS THEY RETURN TO FACE-TO-FACE CLASSROOMS

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ABSTRACT

The Covid-19 pandemic began in the late months of 2019 and by Spring of 2020, in an effort to limit transmission of the virus, schools across the globe had closed and transitioned to emergency online teaching which may have disrupted their current learning procedures (Jelińska & Paradowski, 2021). In the United States, over 13,000 school districts completely closed down during this time (Peele, 2021). Schools began to offer multiple types and modes of instruction in order to continue providing instruction for their students (Peele, 2021). One of these was *emergency remote teaching* (Hodges et al., 2020). Therefore, during the Covid-19 pandemic, reverting to *emergency remote teaching* left many teachers and faculties at the mercy of self-learning because campus and school support personnel for online learning were not able to provide support to a huge pool of teachers and faculties (Hodges, et. al., 2020). On the other hand students too, were left at the mercy of self-learning as many students did not have at-home parental support. Parents may have to be out to work, or just did not have the expertise to help their students. Students, during this at-home period not only had to continue navigating their academic duties but may have also had to share household duties like taking care of younger siblings. Added to this was the issue of unstable internet connection which made taking online classes a challenge for many students, especially in rural and remote areas. Even if there was internet at home, the available bandwidth may have been shared by multiple devices for multiple children at home. Another issue that teachers noticed was that their students were fast losing engagement. For secondary students, school is a crucial part of their lives where they can interact with their peers and teachers in a more informal manner. Therefore, losing that kind of social connection may have made them less motivated to engage with their academic content that was only exacerbated by the stress of the disease and staying at home.

This study also explores secondary teachers' experiences while teaching online (who taught online during the Covid-19 pandemic), the challenges they faced, what instructional practices they engaged in, and which of these practices they will be incorporating into their teaching practices when schools return to face-to-face teaching.

INTRODUCTION AND PROBLEM STATEMENT

The COVID-19 pandemic began in the late months of 2019 and by the spring of 2020, in an effort to limit transmission of the virus, schools across the globe closed and transitioned to emergency online teaching (Jelińska & Paradowski, 2021). This disrupted schooling for over 80% of students worldwide (International Labor Organization, 2020; UNESCO, 2020). Currentlty K-12 classrooms integrate technology both for curriculum and policy (Chapman et al., 2010; Warschauer et al., 2004) The emphasis on technology integration was critically mandated by The Elementary and Secondary Education Act of 2001 fort K-12 education (Barrett et al., 2014; U.S. Department of Education, 2011). However, in K-12 the use of technology is not homogenous and is affected by multiple factors, such as policy, attitudes and belief of teachers toward technology, and geographic location of schools and students (Dolan, 2016). Further, the COVID-19 pandemic upended the education and technology integration plans for educational institutions all over the world and exacerbated existing inequalities in the implementation of technology in education.

Reverting to *emergency online teaching* left many teachers and faculties at the mercy of self-learning because campus and school support personnel for online learning were not able to assist the huge pool of teachers and faculties (Hodges, et. al., 2020). While the move to online teaching and learning was inevitable, many learners, found that online schooling had certain challenges due to lack of access, lack of resources, lack of infrastructure, unavailability of devices, and a lack of qualified teachers to assist with online learning (Dube, 2020). To transition to online teaching, teachers had to adjust their instructional strategies and pedagogies (Mahmood, 2020). Some of these instructional strategies might have been useful for teachers while some were not. This study explores the experiences of secondary teachers who taught online during the COVID-19 pandemic, including the challenges they faced, the instructional practices they engaged in, and which practices they planned to incorporate into their teaching when schools returned to face-to-face teaching.

Background

The COVID-19 pandemic created one of the largest disruptions in the history of education systems, affecting nearly 1.6 billion learners in more than 200 countries. Closures of schools, institutions, and other learning spaces impacted more than 80% of the world's entire student population from tertiary to secondary and in higher education spaces. This contributed to far-reaching changes in all aspects of our lives, not only education. Social distancing and restrictive movement policies disrupted traditional educational practices significantly. Reopening schools after the relaxation of restrictions was another challenge with many new operating procedures put in place.

Within a short span of the COVID-19 pandemic, many researchers shared their works on teaching and learning. Several schools, colleges, and universities discontinued face-to-face teaching and sought ways to move learning online. There was a fear of losing the 2020 academic year, or even more, so people in the education community were looking for ways to continue instruction. It was therefore crucial to innovate and implement alternative educational systems and assessment strategies. One of the modes was *emergency remote teaching*, not to be confused with traditional online teaching. The COVID-19 pandemic provided an opportunity for educators to introduce digital learning on a mass scale. This study aims to provide a report on the impact of the COVID-19 pandemic on online teaching and learning, while upholding and detecting the voices of teachers about their experiences while teaching during the pandemic.

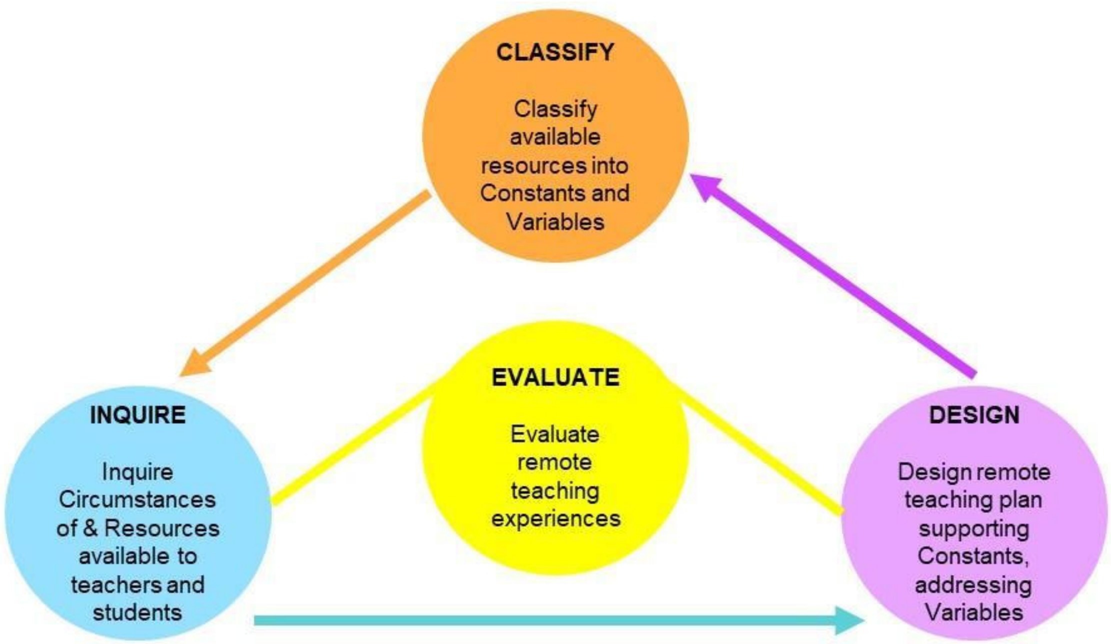
Conceptual Framework

There are several frameworks for technology integration and online learning in K-12 environments during a non-crisis situation. However, the pandemic did not give teachers the opportunity to implement an intentional and well-designed and well though-out online teaching plans (Ewing & Cooper, 2021), so those established frameworks were not a valid basis on which to situate this study. There was an immediate and critical need to apply alternative educational and assessment strategies that could be implemented online (Pokhrel & Chhetri, 2021). Teachers took recourse in using a variety of online platforms to continue instruction and student learning. For this study, the Emergency Remote Teaching Environment (ERTE) framework provided an appropriate conceptual structure (Whittle, et al., 2020).

During the COVID-19 pandemic, teachers faced an unprecedented and shifting landscape for the continued education of their students. Emergency Remote Teaching Environments (ERTE) are a response to a crisis situation and vary, therefore, from the design, meaning, and implementation of frameworks for pre-planned online teaching. ERTEs propose rapid development of instructional support to address periods of crisis (Hodges et al, 2020), during which online teaching environments can be "understood circumstantially and supported provisionally" (Whittle et al., 2020, p. 312). Figure 1 shows a model of the Emergency Remote Teaching Environment framework (Whittle, 2020).

Figure 1

The Emergency Remote Teaching Environment Framework



Note. Based on "The Emergency Remote Teaching Environment Framework: A Conceptual Framework for Responsive Online Teaching in Crises," by W. Whittle, S. Tiwari, S. Yan, and J. Williams, 2020, *Information and Learning Sciences, 121*(5/6), p. 315. (https://doi.org/10.1108/ILS-04-2020-0099). Copyright 2020 by Emerald Publishing Limited.

The ERTE framework positions the teacher as the first responder to an educational crisis, because they are most knowledgeable about the resources they can shift and can establish contact with the students to apprise them of the current expectations (Whittle et al., 2020). The framework has four non-linear and iterative steps: inquiry, classifying available resources into constants and variables, designing relevant educational experiences, and evaluating remote teaching experiences. This iterative approach is critical for both the ERTE framework and unforeseen changes in the educational landscape during a crisis that leads to shifts in resources and goals (Whittle et al., 2020). In this study, I used the ERTE framework to compare the findings of the study to the factors within the framework for a rich and meaningful data set.

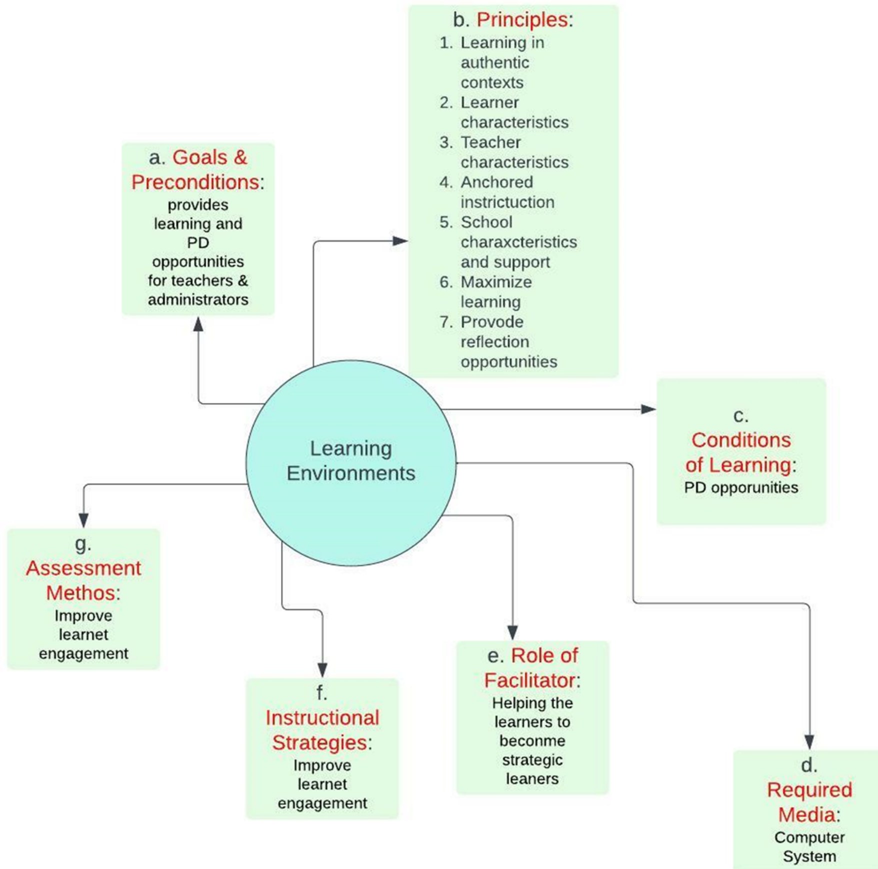
Theoretical Framework

A theoretical framework was used in this study to focus on the online teaching experiences of secondary K-12 teachers during the COVID-19 pandemic and explore the relationships among related components (Ravitch & Riggan, 2017). A theoretical framework provides space for the researcher to define some important concepts related to the study and illustrate how the research fits within those concepts and then builds on existing knowledge of the researchers (West & Heath, 2009. A theoretical framework allows the researcher to make a robust sense of the data with which to work with, (Neuman, 1997) while not limiting the data to the confines of the framework. Therefore, the data in this study will not be bound or limited within the framework but freed up to create new meanings and to assign weight and significance to teachers' voices, feelings, and emotions.

The Strategic Teaching Framework (STF) was used for this study (Jones et al., 1993). This framework includes seven critical dimensions that describe teaching and learning environments.

Principles: STF consists of seven critical dimensions: (1) Goals and metaphors that drive learning and instruction: situate all learning within authentic contexts; (2) Learner characteristics, responsibilities, and values: develop rich mental models of classrooms by presenting examples of exemplary classes for a full class; (3) Teacher characteristics, responsibilities, and values: provide multiple perspectives on classroom activities from various experts; (4) Tasks that define the nature and level of achievement: anchored instruction; (5) School characteristics (context) that support teaching and learning: provide flexibility of time and access, and cost-effective resources; (6) Principles of sequencing: the learner works to identify their own needs and will sequence their experience in a way which will maximize their own learning; and (7) Principles of assessment: provide reflection opportunities

Figure 2
Strategic Teaching Framework (Jones et al., 1993)



Note. Based on "Jones, B. F., Knuth, R. A., & Duffy, T. M. (1993). *Components of constructivist learning environments for professional development.* In T. M. Duffy, J. Lowyck, & D. H. Jonassen (Eds.). Designing environments for constructivist learning (pp. 125-137). (https://doi.org/10.1108/ILS-04-2020-0099).

Importance of the Study

COVID-19 provided an opportunity to leverage digital learning on a much greater scale than before the pandemic (Dhawan, 2020). Despite the catastrophic situation created by the pandemic, online learning students were mostly able to continue learning without major interruptions (Ferri et al., 2020). Teachers strived to provide continual, equitable, and universally inclusive education to all students, but many students without access to devices or a stable internet connection were left out. School closures meant that students were not able to access the infrastructure they had always relied upon that ensured equitable public education, such as schools, textbooks, technology, and resources like teachers, classrooms, and meals. Despite the presence of online instruction and other online learning and teaching resources, many students did not have any access to reliable internet connection or even personal devices. These were structural and socioeconomic barriers to the continuance of online education. (Doucet et al., 2020).

Before the pandemic, the primary purpose of online and distance education in any form was to provide access to education and instruction to those students who otherwise did not have any access to education for many reasons like being in geographically remote location, or attending schools with courses they wanted to pursue. As its purpose expanded to support continuity of instruction, the participation in online learning broadened throughout the educational ecosystem (Lockee, 2021). The unplanned transition to *emergency online learning* revealed a gap in research about what online learning is and the best practices used by educators (Pokhrel & Chhetri, 2021). The flexibility of teaching and learning that resulted from the COVID-19 pandemic situation may likely transform the expectations of teachers and students, with remnants of *emergency online teaching* thus blurring the lines between online and face-to-face education (Lockee, 2021). My prior study focused on rural elementary schools and this study will provide a continuum to understand how COVID-19 affected K-12 schools overall.

I also chose secondary school as it is a time when peers become more important than family and parents, and not being with their peers at this stage in students' lives may take an emotional toll on them (Hates, et al., 2021). This study provides information about the experiences of secondary teachers who work in schools and helps amplify their voices (Pryor et al., 2020). Although more than 4.1 million of America's school-aged students go to secondary schools, not much is known about their educational environment (Bouchrika, 2020). Even less is known about their teacher voices, school administration, and leadership (Lavalley, 2018).

Purpose of the Study

The presence of COVID-19 pandemic upended the schooling and education plans for 2020 for most school districts and for much of the educational community. Almost all face-to-face classes, including labs, were cancelled and it was decreed that faculty may move their move their classes online to help control the spread of COVID-19 virus (Kronke, 2020). So, teachers, in order continue instruction of the students, transitioned to *emergency online teaching* (Jelińska & Paradowski, 2021) as one of the forms of continuing education for their students, especially for the ones who had access to stable internet connection and had their own devices.

Online education has long been viewed as an alternative method of delivering and receiving education, particularly suitable for adult learners who were seeking higher education opportunities to better their circumstances (Lockee, 2021). So, if education has to be moved online, it affords the enablement and flexibility of learning and teaching anywhere and anytime, but in the CIVID-19 situation the speed with which faculties had to move to online instruction was unprecedented (Hodges, et. al., 2020).

Though teachers and school districts had various policies about online education, because of the quick transition to online learning there were gaps in assessing how online learning should or should not be leveraged by education institutions (Jandric, 2020a). Schools and other educational institutions created and supported teachers with professional development through options like drop-in sessions, free webinars, blog posts, emergency policy documents, social platform groups (Doucet et al., 2020), and even lessons learned from earlier university lockdowns (Czerniewicz, 2020). Teachers had to adjust their instructional strategies so that students could adjust to their new mode of online learning (National Academy of Sciences, 2020). For example, researchers found that during the *emergency remote teaching* phase, students faced a lack of social interaction and teachers recognized this important aspect and prioritized student engagement by adjusting their instructional strategies for online teaching (Starkey et al., 2021). The limitations of the pandemic also created an opportunity for teachers to test new instructional strategies to teach curricular concepts (Lockee, 2021). Though many of the instructional approaches may have been forced and hurried, it gave teachers an opportunity to rethink issues like lengthy “seat time,” interaction with students, and learning principles that may be beneficial for student learning (Lockee, 2021).

The sudden shift to online learning affected both students and teachers. In addition to issues with access, some students faced psychological and emotional distress and were not able to engage with learning (Pokhrel & Chhetri, 2021). Teachers began prioritizing students’ emotional well-being over their education, and many schools and school districts adopted a “Maslow before Bloom” approach that prioritized a child’s total well-being (Doucet et al., 2020). Prior research on the impact of significant societal changes on teachers (Malinen et al., 2018) suggests that teachers were also vulnerable to the negative impacts of the COVID-19 crisis on education (Collie, 2021).

As noted, e-learning tools played a critical role during the emergency online teaching phase in facilitating student learning (Subedi et al., 2020). For *emergency remote learning* to be successful, it was necessary to gauge staff and student readiness and offer support, as needed (Subedi et al., 2020). A one-size-fits-all online pedagogy does not work (Pokhrel & Chhetri, 2021) and different approaches to online learning are required for different subject areas and age groups (Doucet et al., 2020). Despite various instructional strategies used by teachers, the best practices for online teaching and learning for a pandemic-like situation are yet to be explored (Petrie, 2020). Online learning relies on the technology expertise of both teachers and students, and pedagogy used for face-to-face learning environments is often not applicable to online learning (Pokhrel & Chhetri, 2021). Teachers need to adapt their teaching to use relevant pedagogy and instructional strategies for online learning depending on their and their students’ technology expertise and access (Pokhrel & Chhetri, 2021).

Research Question

The purpose of this study was focused on how secondary teachers experienced teaching during the COVID-19 pandemic and how it impacted their students. Therefore, this study will examine the following research question (Kim & Bagaka, 2005):

- **RQ 1:** What were secondary teachers’ perspectives on the impact of emergency remote teaching on their students as they returned back to face-to-face classes?

Terminology and Constructs of the Study

Critical Incident Technique: A systematic procedure that ‘encompass factual happenings, qualities or attributes, not just critical incidents … its capacity to explore differences or turning points … its utility as both a foundational/exploratory tool in the early stages of research, and its role in building theories or models” (Butterfield et al., 2005, p. 480). This term is sometimes used alternatively with Critical Events Analysis (Butterfield.

Devices: Any physical unit of equipment that contains a microcontroller or computer can be termed as a device. Some examples are laptops, tablets, and smartphones.

E-learning: Leveraging digital and electronic technologies to access educational curriculum and resources. It is sometimes used interchangeably with online learning.

Emergency remote teching: A temporary shift of instructional delivery mode to an alternate mode due to a crisis situation.

Instructional practice: The means through which teachers help students achieve learning outcomes. Instructional practices are aligned with learning outcomes. For example, if a learning outcome of a course is that at the end of the course students should be able to think critically about world geography, teachers must help students have learning experience that will allow them to practice thinking critically. The difference between instructional strategy and practice is that the former informs the tasks to be done and what is to be achieved (such as brainstorming ideas for an inquiry-based learning unit) and the latter informs how to do it. So, an example would be a classroom activity that the teacher designs that allows students to brainstorm ideas.

Instructional strategy: A technique that teachers apply to ensure that students learn the academic content. The goal is to create independent learners who are able to apply their learning.

Internet: A wide network that allows different computer networks to connect to one another, access, and create information.

K-12 secondary schools: The range of publicly supported primary and secondary education.

One-to-one: A term applied to programs that provide all students in a school, district, or state with their own laptop, tablet computer, or other mobile computing device. The term refers to one computer for every student.

Online Teaching: A mode of education that is conducted in a fully virtual or online environment and is well planned. This term is often used interchangeably with e-learning or internet-based learning and may be used for distance learning purposes.

Pedagogy: The study of teaching, including the theory and practice of teaching, the strategies used to teach, specific teacher-student interactions, content used, the manner in which content is presented to the learners, and the combined goals of the teachers and the learners.

Technology integration: The use of technology to improve student learning experiences aligned with the curriculum.

Technology use: Using technology that is not necessarily aligned with any curriculum or to improve student learning experiences.

LITERATURE REVIEW

The purpose of this basic qualitative study (Merriam, 2002) was to explore secondary teachers' experiences while teaching online during the COVID-19 pandemic: the challenges they faced, the wins they experienced, the instructional practices they engaged in and which of those practices they will incorporate into their face-to-face teaching, and their feelings and emotions about the pandemic and online teaching. This literature review provides an overview of topics that support a broader understanding of themes related to teaching and learning during the COVID-19 Pandemic It is divided into the following subsections:

1. COVID-19 Crisis
2. Educational Challenges During the COVID-19 Pandemic
    a. Teachers' Responses and Experiences During the COVID-19 Pandemic
3. Teaching and Learning During the Pandemic
    a. Teaching Online
    b. *Emergency remote teching*
4. Instructional Strategies Used During the COVID-19 Pandemic
    a. Pedagogy For Continuing Online Instruction
    b. Parental Community

I began the literature review by looking up search words in Google Scholar and ERIC, focusing on the most recent studies about COVID-19. To contextualize this study and the findings, I began my literature review with a history of school closures to understand previous attempts to continue education of children during the closures. Then I looked at literature about worldwide and nationwide school closures due to the COVID-19 pandemic and the challenges faced by the education community as a whole as they transitioned *to emergency remote teaching* (Hodges, 2020). I also looked for teachers' reactions and their voices during the COVID-19 pandemic. Although research is scant on this very recent phenomenon, the studies that have been published begin to indicate how educators experienced this transition, helping to contextualize my research.

COVID-19 Crisis

The COVID-19 pandemic began in the late months of 2019 and by spring of 2020, in an effort to limit transmission of the virus, schools across the globe closed and transitioned to emergency online teaching (Jelińska & Paradowski, 2021). The World Health Organization (WHO) officially identified the COVID-19 as a pandemic (2020) and this announcement disrupted schooling for over 80% of the students worldwide (International Labor Organization, 2020; UNESCO, 2020). Reverting to emergency online teaching left many teachers and faculties at the mercy of self-learning because campus and school support personnel for online learning were not able to provide support to the huge pool of teachers and faculties (Hodges, et. al., 2020). The United Nations Educational, Scientific and Cultural Organization (UNESCO) estimated that nearly 100 countries had already issued orders to close down their educational institutions in order to limit exposure (Ross-Hain, 2020). Approximately 80% of students around the world were affected by school closures, meaning that their education had to be continued online (Education, 2020). In the United States, between February and May 2020, 48 states, four U.S. territories, the District of Columbia, and the Department of Defense Education Activity schools required closure for the remainder of the 2019–2020 school year (The Coronavirus Spring, 2020).

In February 2020, Indiana Governor Eric J. Holcomb, in Executive Order 20-02 recognized the Coronavirus as a pandemic (Executive Order Declaration of Public Health

Emergency, 2020). In May 2020, in Executive Order 20-05, the Governor stated, "All K-12 schools in Indiana, public or private, shall close and cease in-person instruction through May 1, 2020" (Executive Order Declaration of Public Health Emergency, 2020). According to Executive Order 20-05, school buildings were closed and in-person instruction halted temporarily, with the school buildings mandated to be available for community use as deemed necessary in the pandemic situation (State of Indiana Executive Order 20-05, 2020). The transition to emergency learning in Indiana had begun similar to other states in the nation. While the move to online teaching and learning was inevitable, many learners found that online schooling presented challenges due to lack of access, lack of resources, lack of infrastructure, unavailability of devices, and a lack of qualified teachers who could assist with online learning (Dube, 2020). To be able to transition to online teaching, teachers had to adjust their instructional strategies and pedagogies (Mahmood, 2020).

The Indiana Department of Education published *Indiana Continuous Learning Guidance* in March 2020 to aid educators in understanding how to continue the teaching their students online. It included critical aspects of online teaching and learning: a continuous learning framework, recommended activities for students, social-emotional learning, educator and student wellness, family partnerships for online learning, and technology guidance (Indiana Continuous Learning Guidance, 2020).

Educational Challenges During the COVID-19 Pandemic

The unprecedented disruption to education during COVID-19 pandemic instigated multiple challenges for administrators, teachers, students, and families that they were not prepared for. School administrators, district leaders, and principals had almost no training in managing schools during a crisis situation. Teachers were now confined to their homes, their existing lesson plans falling short of the current needs, physically removed from their students, and quickly learning and transitioning to new technology platforms to continue teaching (Baird, 2020). Studies on K-12 settings during the COVID-19 extensively looked at online learning, and student and teacher well-being. Dorn et al. (2020) discussed the learning loss that was happening as a result of online learning during the pandemic that was especially pronounced for students from low socio-economic background (SES), and those with Black and Hispanic heritage. These students not only faced loss of learning, thus exacerbating existing learning gaps, but many were also forced to drop out for different reasons like family poverty, lack of learning space at home, or food insecurities (Dorn et al., 2020, Ferri et al., 2020). The inequalities during school closures were amplified due to a lack of access to resources including devices for online learning and stable internet connection; a lack of physical spaces to continue learning from home among students from underserved, low-SES, or marginalized backgrounds; and a lack of support for home-based learning for students from underserved, low-SES, or marginalized backgrounds (Ferri et al., 2020). To overcome these concerns, some researchers recommended that school districts provide improved access to the internet and other e-learning platforms for their students and provide continuous professional development opportunities for their teachers to learn online teaching strategies and pedagogies (Yusuf, 2020). These recommendations are aligned with the question of equity and inclusion that are central to emergency online teaching.

Students' socio-emotional learning becomes critical at a time of crisis when they are removed from their usual learning environment, friends, and teachers. Venet (2020) outlined how teachers can stay connected to their students to ensure their emotional well-being and learning progress. Evidence suggests that when students do not go to school regularly (for example during breaks or holidays) they become less active physically, engage in longer screen time, and experience food issues and irregular sleeping patterns that could result in weight gain and loss of cardiorespiratory fitness (Wang et al., 2020).

While the physical issues discussed above are worrisome, students' mental health can also be affected when they are at home during a pandemic. Stressors like fear of infection, lengthy home confinement, boredom and frustration, a lack of information about the current situation, lack of in-person contact with classmates and teachers, financial anxiety at home, and lack of personal space may have adverse effects on children and adolescents and may affect their mental health (Wang et al., 2020). Sprang and Silman (2003) stated that children who have been quarantined experience post-traumatic stress four times more than children who have not been quarantined. The authors also mentioned that although there are many common factors between pandemics and other disasters, such as community impact, fatalities, and long-lasting effects, the response to pandemics is unique because being with others is discouraged resulting in isolation (Sprang & Silman, 2003). Quarantine can be associated with insomnia, feelings of grief, frustration, confusion, anxiety, and anger that students and teachers alike may have felt during the pandemic situation and that may have affected their learning and teaching (Brooks et al., 2020).

The pandemic also acutely intensified issues of poverty and financial well-being. For many students, school-supplied meals are the main source of nutritious foods (Van Lancker & Parolin, 2020; Walters, 2020). Additionally, students in especially low-income families were at risk of receiving very little to no support for their learning at home while navigating new technology. This is exacerbated among rural or low-SES families where students may not get either the access or the support, they need to adopt to technology, either because their parents cannot afford technology (in case of low-SES families) or are not familiar with it (Ma, 2017). There is also the issue of bad quality internet or no internet access that may result in a "homework gap" where students are not able to complete assigned homework because of their internet problems (Consortium of School Networking, 2017) because most of the homework assigned is on a device and needs a device and internet connection to be completed. In addition, students may have had to deal with parents less motivated to support them, caring for their siblings at home, and sharing a device during the pandemic (Ross-Hain, 2020).

During the COVID-19 school closures, the quality of students' learning depended on the quality of the remote instruction, home and parental support, and student engagement in learning (Dorn et al., 2020) and school closures intensified an already present achievement gap, with the U.S. ranking 18th out of 37 countries in high school graduation (Organization for Economic Co-operation and Development, 2020). The increased the number of school dropouts among teens may have been the result of not being able to attend school physically, detaching them from the support they receive from empathetic adults such as school social workers, teachers, and counselors. The experiences of teachers were impacted by the perceived experiences of the students as they connected with video conferencing, email, phone calls, information exchange through distributed information and educational packages, and collaborative projects and assignments.

According to the literature on COVID-19 K-12 challenges, the most severe challenges were the psychological influence and economic and social inequities that were more pronounced during the pandemic. Several studies addressed the inequities that students suffered in accessing educational resources digitally or garnering parental and sometimes school support to progress academically (Chabbott & Sinclair, 2020; Dorn et al., 2020; Walters, 2020). The COVID-19 pandemic disrupted the educational system that had been in place for many years and the effects of this disruption are still to be understood and dealt with in all their facets.

Teachers' Responses and Experiences During the COVID-19 Pandemic

In the early months of the pandemic, teachers began reporting their experiences of teaching online during the pandemic, such as physical exhaustion, lack of physical activity, feelings of panic, loss of student engagement in learning, concerns about students' emotional and physical wellbeing, and feelings of vulnerability at not being able to meet the students face-to-face (Fagell, 2020; Gewertz, 2020a). Additionally, they also reported personal health and emotional concerns for self and family, their financial condition, and changes in daily living habits (Vu et al., 2020). Kaden (2020) reported in a case study about a small rural school in Alaska that there were several issues that came to the forefront during COVID-19, such as the teachers' increased workload, the complexity and complications of online teaching due to different pedagogies and skills needed, difficulty adapting to new content to teach, assessing student learning, and struggling to engage students. Other authors reported that teacher workload was expanded by constant communication with students and parents (Cullnane & Montacute, 2020). They also reported a notable decline in students' engagement and learning outcomes, plus an interesting correlation between school engagement and family income (Cullnane & Montacute, 2020). So, in addition to changes in their personal lives (e.g., demands of their own school-age children, possibility of job loss by other family members that could impact the total family earnings and living style, and concerns about meeting their family's food and emotional needs), teachers also had to deal with changes in their professional lives by continuing to teach students who could not physically come to school. Teachers could not bank on their adaptive expertise to use their established lesson plans, educational resources, or long-practiced pedagogy to teach during the pandemic (Ross-Hain, 2020).

In a study by Trudel et al., (2021), teachers reported that they cared about their students and missed in-person interaction with their students. At the same time, they were worried about their home situation. They recognized the inequities that many students faced in access to online learning and tried to help those students, either with offline learning resources or by connecting them to the school district for help in getting internet access. While teaching online, teachers were vocal about the digital skills gap highlighted by the National Education Technology Plan (U.S. Department of Education, 2017).

The teacher participants also agreed that online learning heightened the need to engage students (Trudel et al., 2021). Teachers had to record video lesson and constantly, as the content demanded, switch between pre-prepared video lessons and hosting live teaching via Google Classroom™, Zoom™, Microsoft Teams™, and other such platforms. They needed to develop lesson plans as well as adapted worksheets, assessment sheets, and other materials way ahead of time that they usually did not have to do while teaching face-to-face (Kundu, 2020). However, this was all a steep challenge that they had not been prepared or trained for (Jain et al., 2021).

In a study by Amri et al., (2021), teachers felt stressed because, "Teachers felt burdened because there is not one method that can solve all the problems" (Amri et al., 2021, p. 4). Results from that study showed that teachers were not of the same opinion about school re-openings. Almost all the respondents (95%) agreed to continue conducting distance learning and/or using combined approaches between distance learning and in-class learning, and only around 5% of respondents agreed with coming back to full in-class learning (Amri et al., 2021).

When teachers were returning to face-face-face classes, teaching with face masks on and students also wearing face masks, many teachers noted that face masks have impaired the facial identification of students. Having met these students after a two-year-long hiatus, this proved to be a challenge for re-bonding with the students. Therefore, the social experience of teaching was also hindered because face masks blocked the emotional signaling between the students and the teachers. It also hindered communication, as teachers responded in a study by Spitzer (2020) that students had to take off their masks while speaking and that was against protocol. These teacher voices about everyday occurrences are critical to doing their work successfully on an everyday basis.

While returning to traditional face-to-face teaching, many teachers reported that they feared contracting COVID-19 from other colleagues or teachers (Weinert et al., 2021) but this did not hinder them from going to school to teach in the classrooms. In another empirical study (Wakui et al., 2021) the participant teachers expressed similar fears while returning to school.

Teaching and Learning During the COVID-19 Pandemic

Teaching online has come to the forefront of education strategizing due to the unforeseen challenges of navigating education during the COVID-19 pandemic. Most educational institutions across the globe mandated that all face-to-face classes be canceled, including labs, and decreed that faculty had to move their classes and instruction to an online format to continue learning for their students and therefore to help control the spread of the COVID-19 virus (Kronke, 2020). Moving instruction online can enable the flexibility of learning and teaching anywhere anytime, but in this situation the challenge was the speed with which faculties and teachers had to move to online instruction was unprecedented (Hodges, et. al., 2020). This is what Hodges et. al., (2020) has coined as the *emergency remote teaching* that left many teachers desperate and at the mercy of self-learning on YouTube™ and Khan Academy™ and other such online resources because campus and school support personnel for online learning was not able to provide support to a huge pool of teachers (Hodges, et. al., 2020). So we see that there is a clear distinction between teaching online and *emergency remote teaching* (Hodges, et. al., 2020).

Teaching Online

Zhao (2011) in their empirical work on online teaching stated that schools clearly must strategize to change their policies and practices if they wanted to adapt to online teaching and integrate technology to develop virtual technology competencies for their students. However, as noted by the National Education Policy Center, very little progress has been seen over the past few years for legislation, policy, and implementation of quality training for online teachers (Molnar et. al., 2017). Continual professional development must be offered to the teachers and several empirical studies have focused on this issue (Lewis & Garrett Dikkers, 2016; Parks et al., 2016; Riel et al., 2016). This is critical as this may aid the teachers in their online teaching pedagogies and technical skills. Many researchers have also argued the advantages of integrating online teaching pedagogies as a part of the pre-service teacher education curriculum (Archambault, 2014).

Without much formal or professional training on online teaching, teachers are often placed in online teaching roles, and it often falls on them to self-teach as mentioned above (Rice & Dawley, 2009). This manifests as a steep challenge for teachers among their other teaching and administrative roles. Therefore, school administrators must concede that online teaching requires specific skill sets and thus, adaptation to the relevant pedagogy (DeNisco, 2013).

Another interesting challenge that several teachers have talked about while teaching online, is a sense of alienation from their community as they are not physically meeting their colleagues as they would in a traditional school setting. Similarly, with students too they experience limited interaction (Hawkins et al., 2012).

As online teaching is evolving, many components of a traditional classroom, such as collaboration, have slowly found their way into the online space as well (Fu & Hwang, 2018). Interactions with the teacher and other students are crucial in motivating students to collaborate in digital environments (Cobb, 2009; Sung & Mayer, 2012) which of course teachers are trying to design and fit into their online spaces. Furthermore, teachers are trying to improve their own digital literacies as this may impact their students online learning too (Blau & Caspi, 2009; Porat et al., 2018). DiPietro (2010) noted that online learning has gained momentum because of a very important aspect of learning, being able to learn anytime, anywhere and other advantages such as living in a geographically remote place or belonging to a frequently moving family for reasons like agriculture, students who are differently abled and therefore not possible to access traditional settings (Deschaine, 2018).

One of the many challenges to online education is that underserved and marginalized students and communities find it difficult to meet the basic conditions for online learning, like access to a device or a stable internet connection (Ferri et al., 2020). Other challenges foreseen in online education is providing immediate feedback to students and covering content that requires practical or clinical work (Mukhtar et al., 2020). In response, the authors recommended that teachers develop lesson plans with reduced cognitive load and more interaction (Mukhtar et al., 2020) to prepare self-directed learners (Yusuf, 2020).

To implement online teaching effectively, Verawardina et al. (2020) suggested that instructors outline clear and actionable steps, learn about online teaching strategies and pedagogies, become familiar with current technology platforms, understand guidelines for teaching and learning (teachers and students, both), gain access to multimodal educational resources aligned with the curriculum, and implement a robust assessment system. Educators must view learning not just as a transfer of information but as a social and cognitive process and model their online teaching design to provide learning and interactions in conjunction with both processes (Hodges et al., 2020). Additionally, to improve students' engagement in online learning, researchers have suggested that policymakers incentivize IT companies to design engaging and effective educational games and learning environments (Thomas & Rogers, 2020).

Emergency remote teaching

Emergency remote teaching is a temporary shift of instructional delivery mode to an alternate mode due to any crisis situation (Hodges, et. al., 2020). The COVID-19 pandemic began in the late months of 2019 and by Spring of 2020, in an effort to limit transmission of the virus, schools across the globe closed and transitioned to emergency online teaching (Jelińska & Paradowski, 2021). Online instruction can undoubtedly create more flexibility in a learning environment, but during the COVID-19 pandemic, the speed at which this transition was made was unprecedented. This represented a critical phase in which to consider technology, pedagogy, and education (Starkey et al., 2021). In a different scenario, if instruction was being moved online, teachers would receive school district or campus support to learn about how to implement online teaching. However, during COVID-19 these forms of support fell short because of the stringent timeline and the staggering number of teachers and faculty who were making this transition (Hodges, et. al., 2020).

The principal objective of online teaching in a pandemic situation is not to restore or renew an already robust educational system, but rather to ensure that students have continued access to educational resources and instruction (Hodges, et. al., 2020). If we understand emergence remote teaching in this manner, we can differentiate it from online teaching and learning. Otherwise, there can be undue comparisons between *emergency remote teaching* (under the same umbrella as online teaching) and face-to-face instruction. Also, since some researchers and scholars consider online learning as lower quality than face-to-face teaching, considering *emergency remote teaching* the same as online teaching could promote an appraisal of online teaching as inferior to face-to-face instruction. But any instructor or teacher making a shift to online teaching in critical pandemic-like circumstances cannot design their online teaching to take full advantage of the affordances of technology and the online format (Hodges, et. al., 2020). Therefore, the adoption of online learning during a pandemic situation represents a need for an uncharted format of teaching and learning that has motivated researchers, policymakers, and experts to scout for new solutions that may be hi-tech, low-tech, and no-tech (Ferri et al., 2020).

The pandemic-created *emergency remote teaching* can be an opportunity to evaluate the challenges to education that emerge during critical and emergency situations and develop a robust online education plan for future emergencies. In this context, policymakers and researchers need to pay close attention to understand how technology and learning can be integrated more competently and productively to address student needs and the role of teachers in this effort (Ferri et al., 2020).

Emergency remote teaching during the pandemic gave rise to different approaches based on the affordances of the technology used for the learning purpose (Ferri et al., 2020). Thomas and Rogers (2020) noted that school-supplied IT systems may frequently become outdated and costly, so they suggested students using personal devices that are integrated into the school system. Another option is to use television and radio for *emergency remote teaching* (though preparing for this may be challenging) for students who have no access or limited access to the internet (Eder, 2020). Television and radio were used in the past during the 2014 Ebola crisis (UNESCO, 2020) and countries like New Zealand adopted different modalities during the current COVID-19 crisis to continue education, including television channels integrated with internet delivery and hardcopy curricular resources to bridge the digital divide (Ferri et al., 2020). A similar approach was followed in Queensland (Australia) where limited internet availability required educators to utilize television connectivity so that students would get support for their home-based learning (Ferri et al., 2020). In Portugal, too, schools ensured that hardcopy learning resources were delivered through a partnership with post office services (Drane et al., 2020).

Instructional Strategies Used During the COVID-19 Pandemic

Educational leaders and policy makers have attempted to mandate and support students in developing twenty-first century technology skills that will prepare them for college and career opportunities (International Society for Technology in Education, 2014; NGSS Lead States, 2013). School districts decreed that teachers integrate technology in their curriculum and that required them to adapt to different instructional strategies (Blanchard et al., 2016). However, due to the pandemic institutions had to cancel all face-to-face classes, thus upsetting all well-laid out lesson plans for integrating technology in the curriculum (Kronke, 2020). From the elementary to the tertiary levels, educational institutions had to seek an alternative way to continue providing education through an online mode via various digital learning platforms (Jandric, 2020a). This time frame of the COVID-19 pandemic therefore presented an opportunity to experiment with technology and pedagogy, and integrating new online educational resources in the curriculum (Starkey et al., 2021).

During the almost overnight switch to remote instruction resulting from the COVID-19 pandemic, teachers, in most cases, used trial and error methods to implement remote instruction (Jeong & So, 2020). Sometimes their online teaching strategies worked and sometimes they did not. Even students understood that this trial and error was necessary tome up with strategies could be further developed into successful instructional strategies. To adapt to the instantaneous shift to online teaching, synchronous online conferencing systems like Zoom™ and Google Meet™ allowed students and teachers to join and participate in online classrooms (Lockee, 2021). Other platforms included Microsoft Teams™, Canvas™, and Blackboard™ (Petrie et. al., 2020). These systems also allow teachers to record their instructional presentations for students to watch asynchronously (Lockee, 2021). These platforms also included the options for live chat, synchronous video meetings, and content repository to help with lesson organization (Pokhrel & Chhetri, 2021). These platforms support MS Word™, PDF™, MS Excel™, and various audio and video software and enable tracking student learning and assessment through quizzes and rubric-based assessments of assignments (Pokhrel & Chhetri, 2021). Teachers that taught subjects that required hands-on learning also designed experiential learning for their students through virtual labs and field trips (Pennisi, 2020).

Schools districts and other educational institutions created and offered an range of support and learning opportunities for teachers such as just-in time drop-in sessions, webinars, several blog posts, emergency policy documents to help teachers navigate any policy changes, social platform groups (Doucet et al., 2020). Teachers naturally had to adjust their instructional strategies so that students could also adjust to their new mode of online learning (National Academy of Sciences, 2020). For example, researchers found that during the *emergency online teaching* phase, when students experienced a lack of social interaction; teachers recognized this issue in their loss of engagement in learning, and prioritized student engagement by adjusting their instructional strategies and including more collaborative activities that could be conducted in an online space (Starkey et al., 2021).

Many researchers doing empirical work on learning during the COVID-19 pandemic have already discussed access to internet as one of the key challenges to learning during this time (Lockee, 2021). Schools and school districts attempted to mitigate these key challenges by coming up with innovative solutions, such as using school buses and school and library parking lots to provide mobile hotspots and improved signal strength, sending offline class packets by mail to student homes, and airing instructional presentations on local public broadcasting stations so students could watch their lessons on TV (Buffington, 2020; Lockee, 2021).

The educational landscape in both K-12 and higher education is changing at a very fast pace. Today, approximately 97% of teachers and students have access to computers during a typical school day, while others utilize smart boards, Apple and android tablets, and mobile wireless devices to assist in lesson preparation, assignments, communication with students and parent communities, and other classroom activities (Crowe et al., 2017; Gray et al., 2010; Kervin et. al., 2013; Miranda & Russell, 2012).

One of the most important components that leads to meaningful uses of technology for educational purposes in classrooms is a well-trained teaching workforce that can meaningfully use the technology available to them (Arshad-Ayaz, 2011). While technology integration is common in today's classrooms, technology can also exacerbate pre-existing inequities, establish new ones, and further sideline and marginalize communities that are already being affected by the loss of technology in their loves (Kimmons, 2019; Rogers, 2016). To this end, COVID-19 drew increased attention to issues of digital equity as distance or online education, in many cases, became the sole means for continued learning and instruction (Young & Noonoo, 2020). As inequities re-surfaced in responses to this pandemic, pre-service teachers and in-service teachers had unique opportunities to reflect on their own digital privileges, analyze data relevant to the digital divide, and critically observe their local districts' digital learning plans (Ferlazzo, 2020).

The COVID-19 stimulated innovations within the education sector (United Nations, 2020; Zhao & Watterston, 2021). Going forward it will be critical to understand the challenges that teachers faced while teaching during the pandemic in order to evaluate the instructional innovations made during this period. This will also help teachers sift between which instructional practices they thought were impactful and can be implemented in face-to-face classrooms and which were not. Table 1 presents some instructional strategies used in secondary schools during COVID-19 emergency online learning.

Table 1
Instructional Strategies from the Literature

Instructional Strategy	Description	References
Academic Language/ Vocabulary	Using academic vocabulary is helpful for students to understand instructions better, comprehend content, be introduced to domain-specific words, and build on disciplinary core ideas.	National Academic of Sciences, 2020
Activating prior knowledge through leading questions	Teachers can help students activate prior knowledge and eliminate any superfluous or incorrect information by scaffolding student conversations and research by relating their experiences to learning concepts to form explanations.	National Academic of Sciences, 2020
Adapting to different learning styles	Though the concept of different learning styles is controversial, teachers prefer to present content so that students can learn, remember, analyze, and apply knowledge in different ways, such as visually, linguistically, spatially, and others.	National Academy of Sciences, 2020

Instructional Strategy	Description	References
Brainstorming ideas	For inquiry-based learning units, teachers design collaborative online activities to encourage brainstorming, develop investigation plans, discuss data interpretations, and discuss how the evidence supports the explanation of a phenomenon.	National Academy of Sciences, 2020
Clear statement of expectations	Teachers try to provide clear expectations of requirements so that students can plan their work without being overwhelmed.	National Academy of Sciences, 2020
Close read	Content is approached through systematic exploration to uncover layers of deeper meaning, understand a phenomenon, or solve a problem.	National Academy of Sciences, 2020
Culturally responsive instructions and assignments	Designing instruction with inclusive pedagogies in mind that is culturally responsive helps students to contextualize themselves and engage with their learning, which is critical in an online learning environment. Learning experiences become valuable and equitable when students can make a connection between their existing knowledge and the concepts they are learning in class.	National Academy of Sciences, 2020
Direct instruction	Structured and organized instructional approaches to content are presented by the teacher. This includes identifying learning goals, providing descriptions, illustrating learning points, modeling, and providing feedback.	Babinčáková & Bernard, 2020; National Academy of Sciences, 2020; Ross-Hain, 2020
Discovery-/ Inquiry-based learning	Inquiry or discovery learning is a constructivist learning paradigm where students construct knowledge from the process of learning and their experiences. Inquiry-based learning units can use collaborative online activities to brainstorm, develop investigation plans, discuss data interpretations, and discuss how the evidence supports the explanation of a phenomenon.	National Academy of Sciences, 2020

Instructional Strategy	Description	References
Driving question	Teachers use cues and driving questions to help students recall prior knowledge, ready recall of what they have already learned, and eliminate inaccurate information.	National Academy of Sciences, 2020
Effective questioning	This instructional approach is a common classroom activity that allows teachers to focus on critical aspects of content and move to a higher level of questions in the online environment. Teachers often use this approach to create an engaging "hook" for introducing a new concept.	Ross-Hain, 2020
Evidence-based learning	This approach is used in inquiry learning to understand how evidence supports the explanation of a phenomenon	National Academy of Sciences, 2020
Experiential learning	Experiential learning is an instructional approach in which students learn from experience and by reflecting on their actions. During online teaching this was offered to students through virtual labs and field trips.	Pennisi, 2020
Exploring live, online, synchronous learning resources	This instructional approach allows teachers to build on core ideas, crosscutting concepts, and domain specific practices.	National Academy of Sciences, 2020
Exploring offline resources	This instructional approach allows teachers to build on core ideas, crosscutting concepts, and domain specific practices, keeping equity in mind, so that students can explore content at their own pace. The difference with using online resources is that teachers need to plan ahead and download these resources and have them ready in hard format that can be distributed to students who do not have online access.	National Academy of Sciences, 2020

Instructional Strategy	Description	References
Field trips/Field experience	Experiences outside the bounds of classrooms are valuable for students to connect them with real sites and fields of learning. This instructional approach was used during online teaching to engage students by taking them on virtual field trips. This instructional approach is aligned with discovery learning, experiential learning, and inquiry-based learning and provided more opportunities for students to relate their learning to their own lives and make it more relevant to them at home.	National Academy of Sciences, 2020; Pennisi, 2020
Focusing on critical learning content	This instructional approach allows teachers to focus on critical aspects of content because time is of the essence in online learning.	Ross-Hain, 2020
Formative assessments	Teachers and students use formative assessment during instruction to provide actionable feedback to adjust the instruction, assignments, and ongoing teaching and learning strategies. Teachers during the very first weeks of moving to online learning constantly solicitated student feedback on the assignments to know if students felt overwhelmed.	Ross-Hain, 2020
Hands-on learning	This instructional approach is aligned to experiential learning where students learn by doing. During the online teaching phase, teachers provided students with hands-on learning experience by creating videos of hands-on activities that aired on public television. So even though students could not conduct and experiment by themselves, they could watch how it is being done in the video. It is not the same as having a hands-on experience but the closest the teachers could get on giving students that kind of experience.	Buffington, 2020

Instructional Strategy	Description	References
Homework and practice	Traditionally teachers have used homework and practice to help students improve skills and master the content they are learning. Homework and practice were used by teachers during online learning by allotting time for asynchronous work to build on disciplinary core ideas.	National Academy of Sciences, 2020
Idea building	Students are encouraged by teachers to contribute to building ideas. The social connections that students form in school are not frivolous because students connecting to their peers and supportive adults creates a sense of belonging and students are potentially more likely to contribute to idea building in class, whether online or face-to-face. This instructional strategy can be used to build core disciplinary ideas or for online modeling to test ideas and other practices.	National Academy of Sciences, 2020
Identifying similarities and differences	This instructional strategy is used by teachers to compare and contrast two items that impel students to analyze content. This also helps students to shift their focus from *learning about* to *figuring out.*	National Academy of Sciences, 2020
Integration of content areas	Integrating content areas allows students to apply the skills they learn in one domain to another domain, like applying basic literacy skills to reading, writing, and math.	National Academy of Sciences, 2020
Journaling	Writing enhances learning in any subject. To that end, journaling is an instructional approach used to help students write about their reflections, visualize their designs, collect and write about data, and communicate their learning. It can be revised to align with students' learning progress and test ideas.	National Academy of Sciences, 2020

Instructional Strategy	Description	References
Lecture	This is a traditional instructional approach that teachers use to present new concepts and critical content, summarize contrasting concepts or resources, and provide critical information to students. Lectures can be supported by providing extra learning resources, using examples and visuals, summarizing learning points, and checking for understanding.	Babinčáková & Bernard, 2020; Ross-Hain, 2020
Modeling/Online modeling	Through this instructional strategy the teacher or another student can demonstrate a skill or a new concept that other students can learn about by observing. Online modeling tools like the Google Science Journal app can amplify students' ability to visualize their designs, collect and write about data, and communicate their learning. It can be revised to align with students' learning progress and test ideas.	National Academy of Sciences, 2020
One-to-one teaching/ conferencing	One-to-one teaching is an instructional approach that allows teachers to pay individual attention to students to discuss their problems and help them with challenges unique to them. During the online teaching phase, schools decided to reduce synchronous online class time while allotting tasks for asynchronous learning and office hours so that students could seek one-to-one conferences with teachers.	Doucet et al., 2020
Online discussions/ debate	Discussions or debates are a form of structured argumentation that impel students to engage in research, think critically, and develop listening and oratory skills. Teachers use this instructional approach for various academic pursuits, such as engaging in discussions on how the evidence supports the explanation of a phenomenon	National Academy of Sciences, 2020

Instructional Strategy	Description	References
Peer collaboration	Collaborative learning is built on the understanding that learning is a social construct. Peer collaboration involves students working in groups to discuss problems and find solutions. They do so by reviewing, organizing existing knowledge, filling the gaps in knowledge, and applying the knowledge to find a solution to a problem. For inquiry-based learning units, teachers design collaborative online activities to develop brainstorming, develop investigation plans, discuss data interpretations, and engage in discussions on how the evidence supports the explanation of a phenomenon.	National Academy of Sciences, 2020
Project-based learning	Project-based learning is an instructional approach that strives to address course content through relevant hands-on and rigorous learning. It allows students more choice in how a solution should look and students often build a project as a deliverable to demonstrate the outcome of the issue.	National Academy of Sciences, 2020
Puzzle solving	This is a cooperative learning instructional strategy that enables students to work in groups to put together different aspects of a topic. Teachers use this approach to shift focus from students *learning about* to *figuring out* to explain a puzzling phenomenon or solve a problem.	National Academy of Sciences, 2020
Reading and writing across the curriculum	In this instructional approach, basic literacy skills like reading and writing are integrated in other subject areas, as well. This develops students' understanding across curricular domains by building disciplinary core ideas and crosscutting concepts.	National Academy of Sciences, 2020
Rubrics for assignments	Using rubrics is an instructional strategy that supports students in the self-assessment of their progress and performance. Rubrics can include instructions and details of when and how students are expected to participate, what satisfactory participation looks like, and criteria for assignments.	National Academy of Sciences, 2020

Instructional Strategy	Description	References
Scaffolding student conversations	Though the goal of student learning is to help them develop useable knowledge, it must be done by scaffolding student conversations and research by relating their experiences to learning concepts to form explanations.	National Academy of Sciences, 2020
Specific feedback	Feedback is an instructional strategy that allows teachers to align learning outcomes with learning objectives and improve student achievement. Teachers during the very first weeks of moving to online learning constantly solicited student feedback on the assignments to know if students felt overwhelmed.	Ross-Hain, 2020
Structured instructions	This instructional approach is used to supply students with intentional and well-designed instructions to help them contextualize themselves and engage with their learning which is critical in an online learning environment. Learning experiences become valuable and equitable when students can make a connection between their existing knowledge and the concepts they are learning in class. To foster student agency during the pandemic, teachers developed clear instructions on how to set goals, monitor progress, and accomplish those goals.	National Academy of Sciences, 2020
Student goal setting	Teachers used this instructional strategy to foster student agency during the pandemic by providing clear instructions on how to set goals, monitor progress, and accomplish those goals.	National Academy of Sciences, 2020
Teaching through public television networks	This instructional strategy is tool based and is used in crisis situations when other networks of distributing knowledge are not available. Teachers can create videos of hands-on activities that to be aired on public television to mitigate the issues of access to quality broadband.	Buffington, 2020

Instructional Strategy	Description	References
Video recorded instructions	This instructional strategy is used to demonstrate activities, experiments, and model skills that the students can learn by observing and emulating. Teachers can create videos of hands-on activities, record instructions, provide optional learning materials, and recorded demonstrations to be distributed to students for synchronous or asynchronous access.	Babinčáková & Bernard, 2020; National Academy of Sciences, 2020; Ross-Hain, 2020
Visualizing	This instructional approach allows students to clarify their understanding, do modeling activities, understand and write about data, and communicate their learning.	National Academy of Sciences, 2020

Pedagogy for Continuing Online Instruction

The COVID-19 pandemic paved the way for introducing digital learning on a mass scale (Dhawan, 2020). Researchers highlighted that teaching online during the pandemic (i.e., *emergency remote teaching*) had certain shortcomings such as teachers' limited exposure to prior online teaching, an information gap about online teaching and learning, a lack of physical spaces and support for students learning from home, and the digital divide and students' lack of access to devices and/or stable internet connections. However, instead of flatly condemning *emergency remote teaching*, there is a need to evaluate how COVID-19 impacted teaching and learning and the challenges and opportunities it created.

E-learning tools and online learning platforms have played a critical role during the pandemic in continuing to provide educational resources and instruction to students (Subedi et al., 2020). Adapting to unfamiliar circumstances, student and instructor readiness needs to be assessed accordingly (Pokhrel & Chhetri, 2020). Learners with access and a growth mindset adapted to the new online learning format whereas students with access issues and fixed mindset found it difficult to adapt (Pokhrel & Chhetri, 2020). Further, there were different pedagogies for online learning that needed to be applied for students of different ages and to teach different subjects (Doucet et al., 2020). How an online educator applies online learning pedagogies depends on their expertise and exposure of the instructor to best practices for online learning (Pokhrel & Chhetri, 2020).

Many educators used the flipped classroom strategy for providing resources like articles, pre-recorded videos, and YouTube links for students' personal study time so that the online classroom time is used more productively to explore the content (Doucet et al., 2020). This pedagogy can encourage critical learning skills like problem-solving, self-directed learning, and critical thinking among students (Doucet et al., 2020).

Contribution of Parental Community in Student Learning During the COVID-19 Pandemic

In the spring of 2020, when the entire global education system moved to distance learning, parents became key learning agents of their children with the support of teachers, helping these students to understand how to continue learning using a new online mode of learning, how to use digital solutions, and how to support students in this process. For many parents this modality was as new to them as it was to their students. In just a few days, the learning process had to be transformed into remote education and many parents did not have the infrastructural requirements for their students to learn online. The concept of homeschooling, from its prior focus as a way to provide education at home to small groups of people, suddenly became a popular method of continuing instruction and parents had a viable part in it to ensure the success of their students. "Although parents and teachers have distinct roles in students' education, they have overlapping influences on student engagement" (Borup et al., 2014, p. 128).

Thus, this opportunity to learn online also depended on the social situation of families, such as whether the children could be provided with digital devices and support to access learning content or had the opportunity to set up their own learning space, or if their parents had the digital expertise to help students navigate their online learning, for example. Additionally, there was the issue of whether parents had resources to monitoring their students' learning process, because some parents' work was related to the provision of important functions, such as medicine, emergency services, and the supply of goods. Single parents, or parents who became ill with COVID-19 themselves, also could not be fully involved in the children's homeschooling support and process. Studies have already shown that families with higher incomes and higher levels of parental education were better able to cope with this crisis and were satisfied with the benefits of distance learning. Dong et al., (2020) stated that parental support was more crucial during the younger and formative years of the children during homeschooling. There were risks and dangers associated with digital literacies while leaving young children alone at home while parents had to go to work (Dong et al., 2020).

Ravichandran et al. (2020) drew attention to the apparent rise in children's home abuse and neglect during the homeschooling years. Also, parents' beliefs and attitudes about early digital and online learning have been polarized in the past decade, with some parents' opinions that it is the teachers' responsibility, while not understanding the constraint that the teacher is not present at home (Ravichandran et al., 2020).

Therefore school-community partnerships have been a healthy alternative for providing accountability for students' learning as well as their emotional well-being (Casto, 2016).The National Commission on Children and Disasters (2010) has put more stress on child well-being than completing a curriculum.

METHODOLOGY

The purpose of this research study was to discover how secondary teachers (middle and high school) experienced teaching online during the COVID-19 pandemic. I was also interested in examining how they adjusted their pedagogical and instructional practices for teaching online during the pandemic. I would like to note here that I was also interested in learning about my participants' perspectives on the pedagogical and instructional practices they used during COVID-19 pandemic that they reported incorporating in the following year when classes returned to face-to-face mode.

This was a basic qualitative study (Merriam, 2002). This type of study allows a researcher to explore how participants make meaning of a particular situation or phenomenon, which in this study was teaching during the COVID-19 pandemic. The interpretation of this meaning by the researcher was inductive and the outcome descriptive. Data collection was done through interviews (McClelland, 1973). By conducting a basic qualitative study, I hope to uncover and understand what it was like teaching during a pandemic, and the achievements and concerns of the participants (secondary K-12 teachers).

Specifically, the following research question was addressed in this current study (Kim & Bagaka, 2005):

- **RQ 1:** What were secondary teachers' perspectives on the impact of emergency remote teaching on their students as they returned back to face-to-face classes?

I begin this chapter by grounding my thinking in qualitative methodologies and discuss how these methodologies played a role in this research using critical events approaches (Butterfield et al., 2009) while collecting data, selecting research participants, and selecting research sites. I employed behavioral event interviews (Fernandez, 2006) for data collection and critical event analysis (Webster & Mertova, 2007) for data analysis.

Because I used the critical events approaches (Butterfield et al., 2009), it is important to understand what can be defined as critical events. Webster and Mertova (2007) stated that an event becomes critical when it has the "right mix of ingredients at the right time and in the right context" as cited in Webster & Mertova, 2007, p. 102). In the context of this study the COVID-19 pandemic was the critical event. An event turns critical when it exhibits a few of the following characteristics. It must have had an impact on the performance of the narrator (research participants) in their professional role. It may have some traumatic characteristics, such as excessive interest shown by the media or the public in general, or personal risk, for example, illness or other consequences. The most critical part of being a critical event is the impact it has had on the narrator, the research participants.

When the COVID-19 pandemic began during the first months of 2020, teachers became "first responders" as they decided how to continue their students' education in the face of school closures. Amri et al. (2021) found that teachers agreed that though they had to go online, there could not be a "one solution fits all" approach (p. 4). Teachers felt anxious because they did not know how long this predicament would last and were concerned about students' safety, education, and home situation (Wakui et al., 2021). These undercurrents of emotions and feelings of teachers often got lost in understanding the bigger phenomenon of the COVID-19 pandemic. Therefore, the goal of this study was to gain access to and amplify teachers' experiences and voices about teaching, professional support, their students, and how their own lives were impacted by the pandemic. The remainder of this chapter will discuss the participants, research site(s), context, gaining access, consent form and ethics, data collection procedures, data transformation and representation, and data analysis.

Participants

Purposive Sampling

Purposive sampling is sometimes referred to as nonrandom sampling (Fraenkel et al., 2015) because in nonrandom sampling the researcher consciously chooses some criteria that the sample must represent. Purposive sampling is used widely in qualitative research where there might be limited resources, to identify and select information-rich cases for the most effective capturing of relevant information (Patton, 2002). Using this sampling strategy allowed me to identify and select research participants who were experts in the knowledge that I required for my study and very experienced in my phenomenon of interest (Creswell & Plano Clark, 2011). In addition, these participants were available and willing to participate in my research study (Bernard, 2002; Spradley, 1979).

Purposive sampling is distinct from convenience sampling in that researchers do not study the subjects who are available, but those who they feel may be able to provide the information they need. One limitation of this form of sampling is that if the researcher is mistaken in their judgment of the participants' knowledge about the research topic, they might not be able to gather the required information. The next section delineates how I selected participants through purposive sampling for this study.

Participant Selection

The research participants in this study were recruited through their work email accounts and through a call for participation in social media. The participants were identified through three avenues: lists of school districts and schools (that contained some school principal and school teachers information as well) that was provided by a midwestern research university office which actively working with K-12 schools and an organization working with K-12 schools in another midwestern research university, and through a call for research participation in various social media on their K-12 school pages.

Upon receiving International Review Board (IRB) approval for this study, an email invitation was sent to the secondary school principals (Appendix A) and teachers (Appendix B) whose contact information was available in the lists received from the university office and the K-12 related organization. Simultaneously, a call for research participation was put out on social media platforms such as Facebook and Twitter (Appendix C). The participants were secondary teachers (grades 5-12) (as decided by the particular school district) in K-12 schools. I did not use a criterion based on the average number of years of teaching experience so that I could capture the perspectives of both new and experienced teachers. The only criteria for selection of participants were that they taught in secondary grades, they taught online during the COVID-19 pandemic, and they had returned to face-to-face teaching.

A total of 534 emails were sent to school principals (Appendix A) and teachers (Appendix B) out of which I was able to recruit three participants. From the references of two of these contacts I was able to snowball three other participants. However, before the interviews, three of these participants contracted the very disease that this study is about. Therefore, I decided to go forward without those participants. From the posts on social media (Appendix C) one teacher responded and I was able to recruit them and snowball one more participant through their reference. In total I was able to recruit and interview five teacher participants. Fortunately, there was a good amount of data convergence with some divergences in the data that I collected from these participants.

My teacher participants taught a variety of content areas. Specifically, the participants consisted of two science and technology teachers, one financial education teacher, one bilingual teacher, and one language (English reading) and math interventionist teacher. All participants met the three criteria of teaching in secondary grades, teaching online during the COVID-19 pandemic, and had returned to face-to-face teaching.

Participating Teachers and Institutions

My interview protocol (Appendix D) explicitly mentioned that I would maintain complete privacy of information about my research participants and the schools they represented. Therefore, I described my participants and their schools in the following manner:

Table 2

Pre-determined Criteria for Selecting Research Participants/ Matching predetermined criteria with participants

Criteria	Part. 1 - JS	Part. 2 - CS	Part. 3 - VS	Part. 4 - SD	Part. 5 - JR
Secondary K-12 Teacher in the USA	High School	High School	Middle School	High School	Middle School
Has taught online during the Covid-19 Pandemic	Yes	Yes	Yes	Yes	Yes
Returning to face-to-face teaching currently	Yes	Yes	Yes	Yes	Yes

Table 3ontext of the Study

Teacher Participant Demographics

Teacher	Educational background	Teacher training/ License	Years teaching / Years teaching secondary level	Years using tech for teaching	Current subject/ Grade level	Technology available in classroom?
JS	Master's in Education	Yes/National Board Certification	22/22	20	CS and Visual Communications / High school	Yes. 1:1
CS	Interdisciplinary Master's	Yes/Social Studies	37/32	32	Business/Finance and Traffic Safety/ High school	Yes. 1:1
VS	Master's in Classical Studies; Pursuing PhD	Yes/ Multiple subjects	14/1	14	English and Math Interventionist/ Middle school	Yes. 1:1 (Tablets are 1:2)
SD	Bachelor's in Engineering	No	7/7	7	Science and Math/ High school	No
JR	Bachelor's in Computer Engineering/ Master's in Educational Leadership	Yes/ Science and Spanish	14/9	14	Science and Spanish (Bilingual)/ Middle school	Yes. 1:1 (Tablets are 1:2)

Research Sites

This study was situated in intangible research sites. Interviews with research participants were conducted via the Zoom™ video conferencing platform (Zoom Video Communications, 2020). The interviews were conducted online due to the limitations of the pandemic situation when travel was not recommended. They were also done virtually to avoid overwhelming the participants who were returning to face-to-face classes after over a year, and who may not have the classroom ready for researchers and external observations. Also, schools might still have had restrictions about outside visitors, so the schools asked me to conduct the interviews via Zoom™.

Research Context

The schools that these participants came from were situated in cities (as described in the school district website). These schools were all 1:1 (i.e., they had at least one device for each student). (One-to-one, 2013). Additionally, students also shared some devices. Schools and school districts attempted to provide internet access and individual devices to those student and families who did not have it or could not afford it. Table 4 provides additional information on the five schools.

Table 4

Research (Participant Teachers' School) Context – Schools were 1:1 before the Pandemic

School # and Location	School Technology Resources
1. Northwestern U.S. state	The school is 1:1 with laptops in all classrooms. Students take classes on the Edgenuity platform, and the school provides Google accounts. For remote learning, laptops are given to students with no access to a device at home and the school district also assists with internet connectivity. For high school students, school supplies are covered, course fees are pardoned, and there are reduced fees for PSAT, AP classes, and athletic activities. Among 1200 students, 5% are eligible for free or reduced lunch. School technology questions are usually directed to the teacher.
2. Northwestern U.S. state	The school is 1:1 with laptops in all classrooms. Students take classes on the Microsoft Teams and Clever platforms and the school provides Google accounts. The school uses Skyward for parent communication and student records. Among 1255 students, about 36% are eligible for free or reduced lunch. School technology questions are usually directed to the teacher.
3. Midwestern U.S. state	The school is 1:1 with Chromebooks in all classrooms for some part of each day. The school offers internet access to students and staff, and students use Google Classrooms for online learning. The school provides student Google accounts, Zoom, Renaissance for accelerated reading, Aleks for math and science, and Harmony for parent communications and student records. The school also uses Scrip Fundraising (https://www.raiseright.com/#:~:text=What%20is%20gift%20card%20fundraising,even%20your%20family's%20summer%20vacation) as an easy way to raise funds for the school while purchasing everyday items like food, clothing, and other school essentials, without any added expense. All students are eligible to receive free lunch. The school has technical personnel who come in a few days every week to aid the teachers or the administration in solving technical issues.

4. Midwestern U.S. state	The school is 1:1 with laptops and all teachers have a laptop, projector, and access to numerous software programs and web 2.0 tools. Students use ECHO, a learning management system (similar to BlackBoard™) and Naviance™ by Powerschool™ is used for parent communications and student records. Among 653 students, 86.2% are eligible for free or reduced lunch. The school has a full time IT aide to assist teachers with technology in the building, along with an instructional technology coach.
5. Midwestern U.S. state	The school is 1:1 with laptops but students share tablets. During the pandemic, the school attempted to provide each student with a laptop to take home for remote learning and the school also supported the students and staff who needed internet access at home. The school uses programs such as Tyler SIS™, Google Suite™, SeeSaw™, and Wonders ELA/ Maravillas™. Among 365 students, 97% are eligible for free lunch and 2% for reduced lunch. The school does not have dedicated technical personnel but has access to the district technology help desk.

Consent Form and Ethics

Though I did not have a separate consent form for participants, I shared all of the recruitment materials with them: the email invitations that were sent to all the secondary school principals (Appendix A) and teachers (Appendix B) and the call for research participants that was put on social media platforms like Facebook and Twitter (Appendix C). Once recruited, I also shared my interview protocol (Appendix D) and recruitment flier (Appendix E) with them along with the IRB approval letter (Appendix F) and Indiana University Study Information Sheet for Research (Appendix G). Ethically, I had completed all the needed procedures to be able to begin data collection. There was no conflict of interest with any participant.

Data Collection

Behavioral Event Interviews

To answer the research question, I collected data through multiple sources such as interviews. With each participant, I conducted a one-to-two-hour behavioral event interview (BEI) (McClelland, 1973). BEI was adapted from the critical incident interview developed by Flanagan (1954). This manner of interview approach is usually used in business scenarios for interviews of job applicants for competency mapping. BEI was designed to demonstrate effectiveness based on the actual experience of the participants (Fernandez, 2006). The objective of a BEI is to elicit a detailed behavioral description of how a person conducts their work. In the context of this study, BEI interviewing provided an opportunity to explore in detail some of the following considerations: how the participants experienced teaching during the COVID-19 pandemic, what their highest and lowest points in those experiences were, and the teaching practices they continued to use (or not) when they returned to face-to-face teaching? Overall, the covered how K-12 secondary teachers experienced COVID-19 emotionally, procedurally, logistically, and strategically; what intentionality or innovations they used in their teaching; and what they actually experienced.

A major step in a BEI is to elicit behavioral events. The interviewee is asked to describe, in detail, five or six critical situations that they have experienced during a specific job or situation. The situations should include two or three high points, or major successes, and two or three low points, or key failures. These focused, recorded interviews can take up to two hours (BEI Toolkit, n.d.). To prepare for a BEI, the researcher follows a list of steps (Fernandez, 2006). Following is a description of the steps and how I have followed them, including where and why I deviated from the recommendations.

1) List the critical performance areas for the job: In the context of this study, this translated to teaching online and how teachers transitioned back to face-to-face teaching.
2) Create open-ended questions that can inform about the candidate's experience at those tasks: This delineated the online teaching experiences of teachers and their experience of transitioning back to face-to-face teaching. In this step I created open-ended questions to ascertain my participants' actual behavior and actions in relevant situations. An example was, "Can you describe your feelings and emotions when you heard the news of COVID-19 and subsequently the announcements about the closure of all schools?"
3) Gather data about STAR -Situation, Task, Action, and Result through the candidate's answer: This involved collecting data through interviews about their previous and current situation, the kind of work they were doing (teaching online), what actions they had taken to do so successfully, and what the outcomes were in terms of student attendance, engagement, and learning outcomes. In this stage I listened closely to the participants during their interviews, took copious and detailed notes to record what they were describing, and audio-taped the interviews (with permission) for transcription purposes. These notes helped me to quickly scan the participants' answers to see if something was missing and probe them gently to collect the missing information or get more in-depth answers. For the example of the question I cited in the last stage, probing questions could include, "What did you want to do in this situation?" or "Describe how you felt about learning new technologies?" This helped uncover more details and specificity in the participants' answers rather than only general comments like, "Usually I…"
4) Evaluate the answers for demonstrated job performance: In this stage I did not evaluate the participant teachers' job performance because that was outside the scope of this study, and I did not see myself in an expert role that qualified me to do so. This study was about uncovering teachers' voices and listening to their experiences, victories, and concerns.
5) Compare their answers to other candidates' answers (this is sometimes done with a point system): In the following chapter I have compared the teachers' responses to create a rich database of these experiences but did not use a point system because my intention was not to hierarchically rank the participants but simply to amplify their voices.

Designing Research Instruments

In this section I delineate the process of designing the interview protocol and the interview questions. While designing my research instrument, I was aware of the guiding directions for the BEI and was mindful of these when constructing interview questions.

Constructing the Interview Questions

Though the steps stated in the BEI were meant for job interview situations, what I followed most closely was creating a list of open-ended questions to explore in depth a participants' teaching experiences during the pandemic. Cohen and Manion (1988) stated that interview questions should be unambiguous and uniformly workable, meaning that they should minimize errors on the part of both the interviewer and interviewees. It is difficult to capture interviewees' personal beliefs, so as a researcher I had to rely on the honesty and accuracy of my participants' responses. Therefore, it was important that my interview questions were as clear and lucid as possible so as to not confuse the participants.

Interview Questions

The interview questions consisted of four sections. The first section collected information on the participants, names, their school, the name of the interviewer, and any interview comments. The second section was to be read out to the participants before the interview began and was part of the interview protocol (Appendix D) that stated the purpose of the interview, permission for the interview to be audio-taped for transcription purposes, and how the interview transcript would be shared with the participant for member checking.

The third section consisted of the interview questions. The participant number, date, and time of the interview were also noted. Interview items included the following:

- As a way of getting started, perhaps you could tell me a little bit about your work situation.
    - Can you describe your feelings and emotions when you heard the news of COVID-19 and subsequently the announcements about the closure of all schools?
    - What did you want to do in this situation?
- How did you experience teaching during the COVID-19 pandemic? Describe how you felt learning new technologies,
- After the initial reactions or feelings, if you had some time to think and plan, what were your plans (if any) for delivering education to your students?
- What actions or strategies did you decide to employ or had already employed?
    - What were you thinking, what were you feeling, what were you saying, what were you doing?
    - Can you think back to the time when you were redesigning/ reorganizing your learning resources and activities? Why did you make certain decisions of changing things or keeping them the same?
    - What circumstances did you consider?
    - What was the outcome? What happened?
    - What were you thinking about your students during this time? What did you actually do or say to them?
- Tell me about one or a few of the teaching strategies that worked very well for you and your students.
    - Walk me through how you came up with this strategy? Why do you think it worked out so well?
    - Can you please share your screen and show me what you did?
- Tell me about one or a few of the teaching strategies that were a total wreck.
    - What did you do to rectify the situation?
- How are the proposed strategies working so far, and what opportunities or challenges have you experienced?
- You volunteered to participate in this study because you identified yourself as a secondary teacher who experienced teaching online during the COVID-19 pandemic and now you are returning to face-to-face classes.
- What does "doing well" mean to you? What are the changes that have affected your work life?

- How have these changes affected your work life? (Probe, as needed: Are there any other impacts on your work?)
- How do you rate yourself on scale of 10, 10 being the highest?

The fourth and final section was the critical incident component of the interview questions. I asked follow-up questions on their wellness and well-being and the critical components of their experiences. These interview questions included:

- Helpful Factors and What They Mean to Participant
  You said that even with all these changes, you rated yourself as a [#] (whatever the participant rated him or herself above).
  - What has helped you in doing well with the changes that have affected your work? Probes: What was the incident/factor? How did it impact you? (For example, “Persistence is helping.” “How is it helping? Can you give me a specific example where persistence helped? How did that help you to do well in handling the changes affecting your work?)
- Hindering Factors and What They Mean to Participant
  - Are there things that have made it more difficult for you to do well? (Alternative question: What kinds of things have happened that made it harder for you to do well?)
- Wish List Items and What They Mean to Participant
  Summarize what has been discussed up to this point with the participant as a transition to the next question.
  - We’ve talked about what’s helped you to do well (name them), and some things that have made it more difficult for you to do well (name them). Are there other things that would help you to continue doing well? (Alternative question: I wonder what else might be helpful to you that you haven’t had access to?) Have you always handled change well? If not, when did this change for you?

Finally, I asked some demographic questions about their education, years of experience, and the grades and subjects they were teaching.

Data Transformation and Representation

Transforming qualitative data involves management, organization, interpretation, description, and analysis of data, in addition to documentation of the process used to transform the data into evidence that provides insight and answers to the research question (Lincoln, 2002; Wolcott, 1994). It is important to consider that this process may be iterative without any clear beginning or end. I was aware that the voices of the teacher participants about their experience of teaching during the COVID-19 pandemic could not be captured in their entirety. There would be layers of subjectivity which may disallow me to understand or interpret their perspectives completely. Regardless, I aimed to remain as close as possible to the data to allay the tension between data and the transparency it presented about the circumstances. My aim was to retain the data as the driving factor in analyzing the findings while using theoretical arguments to support the data. I did not want to limit the data with theoretical foundations. In this section I describe the process I followed for data management. coding, and representation.

Coding

After completing member checking, I organized my data as snippets of answers for each interview question. These snippets were kept on Google Sheets with several sheets for each question.

First Cycle Coding

On each sheet for a particular question, I performed a first cycle of coding using descriptive coding (Saldana, 2013). Descriptive coding summarizes, usually in short phrases, the basic topic in an excerpt of qualitative data. These codes are identifications of different topics and not used merely to abbreviate the data. After this initial first cycle of coding, 1,556 first codes emerged (729 for JS, 447 for CS, 164 for VS, 118 for SD, and 100 for JR). There were a huge number of codes because I coded everything that could be a code rather than leave a new meaning out.

I used descriptive coding at this beginning stage to identify the different topics that could potentially coalesce into themes. Descriptive coding led me to form a tabular account of the data's content that I have displayed below as an example (Saldana, 2013). This was essential groundwork for the second cycle of coding that needed further interpretation and analysis (Wolcott, 1994, p. 55). Table 5 illustrates an example of these coding cycles.

Table 5

Example of Coding Cycles Using Descriptive Coding (Saldana, 2013)

Transcript	**VS -** Yeah, so we we started, we did asynchronous from the beginning of the the totally online. So in the fall of 2020, it was synchronous classes in the morning, asynchronous in the afternoon. And at first it worked a little bit, you know, homework and checking in. So we just have a Zoom Room where if you didn't understand the homework, or you wanted to do a group project together, or something like that, and it didn't take, I don't know, maybe two months before, there was nobody in the afternoons and then talking to other teachers, it's like, we can't expect them to do any anything in that in the afternoon.	**VS -** The problem the problem that I had was getting our cameras on. I knew I as a teacher needed to see their faces because I couldn't gauge that personal connection. I missed that so much being online. That was the the biggest the hardest part for me. So if I couldn't see their faces, I didn't know what they were thinking, what they're not what they're thinking, but I couldn't see. Were they thinking about the problem were they distracted or were they doing something else? And because I couldn't see their faces. I couldn't judge what what they were doing. So I couldn't read their body language. So for me, that was the biggest part. I had the hardest time with that even to even to this day. I think if we haven't I still have a hard time with some students putting their cameras on.
1st Cycle of Coding	Asynchronous not working well	Access was an issue in how teaching online continued

After 1st Cycle Descriptive Codes (Themes)	Everyone described their emotions of what strategies were working	Teaching strategies that were a total wreck
2nd Cycle of Coding	Most emotions were driven by panic of the unknown	Teaching strategies could be both ways – successful and unsuccessful
After 2nd Cycle of Pattern Coding (Categories) - Themes	Initial Panic and Chaos	Wins and losses

After the first cycle of descriptive coding, I categorized the codes based on the relationships among them and the underlying meaning across the codes. I did not look at the coding frequencies because that was outside the scope of this study.

Second Cycle Coding

In the second cycle of coding (Saladana, 2013), I reorganized and reanalyzed the first set of coded data. The primary goal was to develop a sense of thematic or conceptual organization of the first cycle of codes. After the first cycle of codes, I used pattern coding (Miles & Huberman, 1994). Pattern codes are explanatory in nature and help infer or identify an emergent theme. They pull together many first codes to form a parsimonious unit of analysis (Saladana, 2013). This method aligned well with the exploratory and ontological nature of my research question and helped me to draw up a pattern that could narrate the experiences of the secondary teachers.

Pattern codes include a word indicating the inferred pattern or theme. After the first cycle of coding, 174 second cycle codes emerged (20 for JS, 15 for CS, 65 for VS, 40 for SD, and 34 for JR) that I could use for the second cycle of coding. I again used pattern coding (Miles & Huberman, 1994) to help identify the various themes and patterns that emerged from the data and formed relationships among them. These themes were grouped under similar categories based on the relationships among them and underlying meaning across the codes. After this second cycle of pattern coding, I examined the initial codes; identified trends, patterns and relationships; and finally assigned labels that I will call categories from hereon. Examples of the resulting categories can be seen in Table 5.

Data Representation

In representing the data, I attempted to remain close to the data despite some tension between teachers' voices and transparency. While I take complete responsibility for the decisions I made about data collection, management, interpretation, and analysis from theoretical influences, I wanted the data to be the driving factor, with theoretical arguments supporting the data.

Critical events analysis (Webster & Mertova, 2007) was the primary data analysis approach. The chronology of the events, rather than codes, were used to represent the findings and later lead the discussion. For example, the code "loss of connections to students" functioned differently in the different chronology of events and held different meanings that were negotiated differently by participants across different circumstances. Each of those negotiations or meanings that emerged from the transcripts, interacted in a complex manner with other aspects of the participants' experiences, legitimizing their feelings and experiences, however chaotic they may have been. Thus, to understand such blended aspects of analysis and reproductions of experiences and feelings of the participants, I needed additional ways of capturing the multiplicity of interactions between time, space, circumstances, events, negotiations, and contradictions, leaving some room for deferring immediate meaning making and limiting singular explanations.

I listened very closely to the conversation tapes multiple times and went over my notes in detail to obtain a sense of more than the textual representation of data, to remind me that some of those tacit data sources (like the lesson plans) also impacted, solidified, and shaped my understanding of the data. My initial analytic focus was loosely structured to explore how the participants negotiated their experiences, and to examine the contexts in which those experiences were produced. This focus allowed me to stay close to the data and unwrap more avenues of interpretation through writing about my analysis of the data. I reviewed the entire data set several times and began writing when a new topic emerged. This process helped me link several written accounts or analyses. These pieces did not exist independently but were connected to each other and created a network of shared experiences and feelings among the teacher participants.

I asked myself several times if had I missed a silence or a sigh and what it could mean? To quell my doubts, I conducted several member checks by email with the participants with additional questions at different stages to clarify any doubts. Their responses were then added to their stories as points of clarification that provided more depth to their narration and built on the complexity of their voices.

I created a demographic chart to better understand the participants' context and validate their voices. This chart contained details such as who the participants were, where the significance of some narrative points was attached, and what the outcomes of those were, and where and when these events occurred. This helped create a chronological list of events that I have used to represent my findings in Chapter Four.

Data Analysis

To investigate the secondary teachers' experiences teaching online during the COVID-19 pandemic, a critical event analysis (Webster & Mertova, 2007) method was employed. A significant feature of this method is eliciting critical events related to teachers' online teaching experiences during the COVID-19 pandemic. The research uncovered a variety of similar issues and concerns among the teachers about their teaching experiences. The term critical incident technique (CIT) (Butterfield et al., 2005) is known by many other names, including critical incident analysis (Gould, 1999, as cited in Butterfield et al., 2005), critical event technique (Kunak, 1989, as cited in Butterfield et al., 2005), critical incidents technique (Schwab et al., 1975, as cited in Butterfield et al., 2005), critical incident exercise (Rutman, 1996, as cited in Butterfield et al., 2005), critical incidents (Pope & Vetter, 1992, as cited in Butterfield et al., 2005), critical incident study technique (Cottrell et al., 2002, as cited in Butterfield et al., 2005), critical incident report (Kluender, 1987, as cited in Butterfield et al., 2005), and critical incident reflection (Francis, 1995, as cited in Butterfield et al., 2005). These are all examples of the term used for studies utilizing the CIT research method (Flanagan, 1954) that critical events analysis (Webster & Mertova, 2007) is based on.

Critical Events Analysis

Critical events analysis (Webster & Mertova, 2007) describes critical events, sometimes also referred to as critical incidents, that have the "right mix of ingredients, at the right time and in the right context" (Woods, 1993, as cited in Webster & Mertova, 2007, p. 102). In the context of this study, the critical event was the COVID-19 pandemic, and it produced an opportunity for educational researchers to explore teachers' teaching experiences as well as their innovations and failures in the context of *emergency remote teaching*. Critical events may be both positive and negative, but in the context of teaching and learning they have to be critically impactful, as in the case of the COVID-19 pandemic.

These events may be important because we believe that they set in order a subsequent chain of events that lead to certain outcomes. They may also be important because if the events were incorrectly taken away (or changed), the outcomes of interest would not have occurred or the outcomes may have been vastly different. The events on which we focus as critical events are usually conditional occurrences that could have turned out differently. Therefore, had these occurrences not taken place the trajectory of our lives may have been vastly different (Webster & Mertova, 2007). If the COVID-19 pandemic had not happened, we as researchers might not have found an opportunity to closely examine online teaching and the experiences of teachers involved in this format of teaching.

Distinctive Features of the Critical Events

Creswell (1998) stated that each qualitative method has its own distinctive features that make it unique, and the researcher has to understand those features to apply the methods in their study. For this study, Creswell's (1998) five dimensions of qualitative study methods was aligned with the critical analysis method (Butterfield et al., 2005, p. 483) to come up with its distinctive features:

1. Focus on critical events or incidents that effectively echo the experience of that event.
2. The origin of this discipline is from industrial and organizational psychology.
3. Data collection is done primarily through interviews.
4. The frame of reference is important for data analysis by forming categories that emerge from the data and determining how specific or general the categories will be.
5. A narrative form is adopted to describe the categories and definitions are operationalized with self-descriptive titles.

Choosing the Critical Events Analysis Method

Each qualitative research method can be applied to answer a different kind of research question. Each qualitative research method is designed and applied to answer specific types of research questions. For example, grounded theory explores the process of something, a case study provides a deep description of a person or a situation/case, phenomenology explores a person's experience of something. Critical events explore what helps or hinders a particular experience or activity (Butterfield et al., 2009, p. 483).

A critical event almost always is experienced as a change wherein the narrator expresses the differences between their ideal worldview and the reality of their experiences (Fay, 2000). Critical events are exploratory by nature and are suitable for use when a researcher is examining events or incidents that have not been understood in great detail. Therefore, this form of analysis is highly suitable for analyzing the interview data in the context of this study. According to

O'Driscoll and Cooper (1994) the advantages of the critical events method are that it links the specific actions or strategies an actor takes during specific events.

Five Steps in Conducting Critical Events Analysis

Critical events analysis has been built off Flanagan's (1954) critical incident technique (CIT). Flanagan (1954) describes CIT as having five major steps:

- Ascertaining the general aims of the activity being studied
- Making plans and setting specifications
- Collecting data
- Analyzing the data
- Interpreting the data and reporting the results

Each of these steps will be addressed in greater detail in the following sections.

Ascertaining the General Aims of the Activity Being Studied. In the context of this study, the purpose is to elicit the teaching experiences of K-12 secondary teachers during the COVID-19 pandemic. The purpose of the research interviews was to understand the strategies of the teachers as they experienced teaching online during the COVID-19 pandemic and as they transitioned to face-to-face classrooms.

Making Plans and Setting Specifications. Here the interview protocol (Appendix D) was developed.

1) Defining the types of situations to be observed: I did not employ any direct observations of the participants' teaching practices but relied on their reported experiences during the interviews.
2) Determining the situation's relevance to the general aim: The relevance of the situation was to collect data on how the secondary teachers experienced teaching online during the COVID-19 pandemic and how they returned to traditional face-to-face teaching.
3) Understanding the extent of the effect the incident has on the general aim: Determining through the interviews how COVID-19 impacted the participants' teaching.
4) Deciding who will make the observations: The researcher conducted the interviews that were reviewed by an expert.

Collecting Data. The interview questions were developed by closely following the BEI (Butterfield et al., 2009; McClelland, 1973). The format of the interview guide is important in a critical event study to ensure that critical incidents (CI) and wish list (WL) items are easily identified. It is also important that the supporting details for each item (an example and the importance of the item for the participant) are captured during the research interview. For this reason, CI and WL questions were embedded in the interviews.

Analyzing the Data.

1) Determining the frame of reference: What will the data be used for? In this study the data was used to examine how secondary teachers experienced teaching online during the COVID-19 pandemic and how they returned to traditional face-to-face teaching.

2) Formulating categories derived from grouping similar/same incidents: This entailed organizing snippets of participants' interview transcripts into similar categories and incidents.
3) Determining the level of specificity or generality to be used in reporting the data: This was determined by practical considerations such as project budget (this study was not a paid or funded study so there was no budget), number of people available to analyze the data (the data was primarily analyzed by myself, with some parts reviewed by a specialist, and peer reviews by other graduate students to establish inter-rater reliability (McDonald et al., 2019). Inter-rater reliability is the extent to which two or more raters/coders agree (Lange, 2011), the extent to which a few self-reported general behaviors of the participants will be useful compared to several dozen specific behaviors, and so on.
   a) Organizing raw data: This step consisted of coding the data (Saldana, 2013).
   b) Identifying the CI (critical incidents) and WL (wish list items): CIs and WLs were extracted at this stage. Questions about CIs, hindering CIs, and WLs were incorporated within the interview questions. After the interviews were transcribed, the CI and WL items were copied onto another document with the participant names and numbers. This document was sent to the participants for member checking for credibility purposes. A table was created for CI and WL items to let new categories emerge from this data, until data exhaustiveness was reached (Butterfield, et al., 2009).
   c) Creating the categories: CIs were extracted from the first transcript (Helping CIs, Hindering CIs, and WL items). A separate document of CIs and WLs was sent to the participants for member checking for credibility purposes. A table was created for CI and WL items to let new categories emerge from this data, till data exhaustiveness was reached (Butterfield, et al., 2009).

CIs, Hindering CIs, and WLs: Reliability and Credibility of Data. Butterfield et al. (2009) have suggested conducting a second interview, but this was not done in recognition of the participants' workload and time restraint. However, there were two to three rounds of email conversation with each of the participants while the member checking for the CIs was being done. This is one of the limitations of this study and is discussed in Chapter Five. Therefore, the sole interview had questions regarding CIs, hindering CIs, and WL items embedded into the interview questions.

The purpose at this stage is to create a new categorization scheme that summarizes and describes the data in a useful manner, while at the same time "sacrificing as little as possible of their comprehensiveness, specificity, and validity" (Flanagan, 1954, p. 344). Flanagan thought the categorization process was more subjective than objective, with no simple rules available to guide the researcher. In Table 6 I have described these new categories. Flanagan (1954) described the process this way:

> The usual procedure is to sort a relatively small sample of incidents into piles that are related to the frame of reference selected. After these tentative categories have been established, brief definitions of them are made, and additional incidents are classified into them. During this process, needs for redefinition and for the development of new categories are noted. The tentative categories are modified as indicated and the process continues until all the incidents have been classified. (p. 344–5)

I used two methods for establishing the credibility of the categories–participation rate and recruiting a coder who independently extracted critical incidents from the interview transcripts to see how they matched with the ones I extracted.

Table 6

Sample Table for Tracking the Emergence of New Categories

CI/WL Extraction Date	Participant # and Initials	Date Categorized	New Categories Emerged
Jan 6, 2022	1 JS	Jan 29, 2022	• CI - Self-care, taking online classes about happiness, off technology, work-life balance • Hindering CI - Developing more technology skills, administrative support • WL - Great planning for all the classes including lesson plans and scaffolding
Jan 6, 2022	2 CS	Jan 31, 2022	• CI - Self-care, exercising, drinking, and eating well • Hindering CI - Feeling helpless about not being able to help all students • WL - Better memory and able to access information quickly
Jan 16, 2022	3 VS	Jan 29, 2022	• CI - Flexibility to adapt to various situations • Hindering CI - Developing technology expertise, administrative support • WL - Administrative and parental support
Jan 16, 2022	4 SD	Jan 27, 2022	• CI - Well equipped technology support, support from administration and colleagues • Hindering CI - Unstable internet connection and bugs in software • WL - Connecting to global students through webinars
Jan 17, 2022	5 JR	Jan 31, 2022	• CI - Taking care of health, don't overdo the teaching part • Hindering CI - Administrative and parental support • WL - Administrative and parental support, scaffolding

Note: CI = Critical Incident; WL = Wish List

I recruited another graduate student as an independent coder who randomly chose 25% of the transcripts and extracted the CIs, Hindering CIs and WLs. Since I had five teacher participants, 25% of that would be 1.25 so I rounded that down to one transcript. The coder chose the transcript for teacher participant JS. Only in the CIs did a new category emerge: “Learning to say No.” Table 7 shows how the other coder extracted the categories for one category: “Administrative and Parental Support.”

Table 7

Sample Table for Tracking the Emergence of New Categories by Another Coder

Date of CI/ WL Extraction	Participant	Date Categorized	New Categories Emerged
Jan 31, 2022	JS	Feb 3, 2022	• CI - Self care, work-life balance, learning to say No. • Hindering CI - Developing more technology skills, administrative support • WL - Great planning for all the classes including lesson plans and scaffolding

Next, I calculated the participation rates. For example, to calculate the participation numbers for the category “Administrative and Parental Support,” three participants out of five mentioned this. So, we simply divide the number of participants for this category (three) by the total number of teacher participants (five) to get 0.6%.

Member Checking. These categorizations and percentage calculations were shared with the participants for member checking via emails. This ensured reliability of the data collected and credibility of the data. There were three rounds of member checking.

Interpreting the Data and Reporting the Results. The following section describes how I conducted the nine credibility checks for this study.

Audiotaping Interviews. The interviews were audio taped with the permission of the participants at the beginning of each interview for accuracy purposes and for ease of transcribing the interview later.

Interview Fidelity. An expert in the critical analysis method listened and checked to assess if the interviews were conducted in alignment with the BEI, to every third or fourth taped interview. The expert who performed this role was a professor of inquiry at Indiana University.

Independent Extraction of CIs. Another researcher who is a graduate student extracted the CIs from an original interview transcript to establish inter-rater reliability (IRR) (McDonald et al., 2019).

Exhaustiveness. Each interview was logged based on its CIs and WL. Questions about CIs, Hindering Cis, and WLs were incorporated into the interview questions. After the interviews were transcribed, the CI and WL items were copied onto another document with the participant’s name and number. This document was sent to each of the participants for member checking for credibility purposes. A table was created for CI and WL items to let new categories emerge from this data, until data exhaustiveness was reached (Butterfield, et al., 2009). This table for data extraction was only for the CIs, Hindering CIs, and WLs, questions about which were embedded in the interview questions. The rest of data was analyzed through the first and second cycles of coding (Saldana, 2013).

Participation Rates. Each participant name and number were mentioned in the categories document for CI and WL. This allowed for calculating participant rates to establish credibility of the categories as they were being formed and also for confirming the strength of a category when reviewing the results of the study (Borgen & Amundson, 1984). This percentage can be calculated by counting the number of different participants under each category (CI and WL) and dividing that number by the total number of participants. In this study, under the CI "Administrative and Parental Support," three participants provided items for this category out of five participants. So, I simply divided the number of participants for this category (three) by the total number of teacher participants (five) (Butterfield et al., 2009) to get 0.6%.

Placing Incidents into Categories by an Independent Judge. The purpose of this step was to have an independent researcher put 25% of the CIs and WL items into the categories that I created and to calculate the alignment between their placements and mine (Butterfield et al., 2005). I randomly chose 25% of the incidents within each category and sent them to an independent researcher (another graduate student), along with the category headings and operational definitions, asking them to place each incident into the appropriate category. I compared their placement of CIs and WL items into categories with my own placement of 0.6% for one category "Administrative and Parental Support." Andersson and Nilsson (1964) suggested a match rate guideline of 80% or better for this credibility check. In case of a discrepancy the participant determines in which categories their CIs and WLs belong.

Cross-checking by Participants. This step is to confirm with participants that the CIs and WLs have been placed in the correct categories. This was done through the second round of member checking of the categories document. This afforded participants an opportunity to review the categories and judge how well those categories captured their lived experiences of the COVID-19 pandemic. In the email accompanying the categories document the participants were asked: a) Are the helping/hindering CIs and WL items correct? b) Do you feel anything is missing? c) Is there anything that you need me to revise? d) Do you have any other comments?

After the participant reviewed the document and responded, the document was revised and again shared with them. The participants re-reviewed the categories into which the CIs and WL items had been placed and answered the following questions: a) Do the category headings make sense to you? b) Do the category headings capture your experience and the meaning that the incident or factor had for you? c) Are there any incidents in the categories that do not appear to fit from your perspective? If so, where do you think they belong? This iterative process ensured that participants' voices were honored and reported accurately which was the primary goal of this study.

Expert Opinions. The categories were checked by two experts in the field: a professor in the inquiry department and a professor in the instructional systems technology department, both at Indiana University. They were then asked the following questions: a) Do you find the categories to be useful? b) Are you surprised by any of the categories? c) Do you think there is anything missing based on your experience (Butterfield et al., 2005; Flanagan, 1954)?

Theoretical Agreement. This step was intended to identify assumptions underlying the study and comparing emergent categories with relevant literature. However, both my conceptual framework (ERTE: Emergence Remote Teaching Environment) and the theoretical framework (STF: Strategic Teaching Framework) were used to situate the study and create newer meanings, assigning more weight and significance to teachers' voices, feelings, and emotions.

The theoretical agreement has two parts. The first identifies and reports the assumptions underlying the study. In this study, some of the assumptions were that people are aware that they experience change and can describe their feelings, emotions, and responses; change is inevitable in people's lives and circumstances; and if there is change in the environment, the actor is not responsible for that change. My conceptual framework, ERTE, supported these assumptions and helped me understand and establish these assumptions at the beginning of the study.

The second part of the theoretical agreement compares the emergent categories with relevant scholarly literature. Relying on the STF framework allowed me to focus on the online teaching experiences of secondary K-12 teachers during the COVID-19 pandemic and to explore the relationships among the components (Ravitch & Riggan, 2017). However, I did not attempt to bound or limit my data within the understanding of the theoretical framework, but to free it up to create newer meanings and assign more weight and significance to teachers' voices, feelings, and emotions. The specifications of the STF helped me to interpret the findings without limiting the discussion of new emergent findings. These specifications included providing professional development opportunities for teachers, analyzing teacher and learner characteristics, defining tasks that are authentic and that help students engage in an online learning environment, helping learners identify their own learning needs, establishing school characteristics that either support the teacher or do not, and designing assessments that help students reflect on their learning.

To summarize, the nine credibility checks that were performed on the interview data and their accompanying results are shown in Table 8.

Table 8
Nine Credibility Checks

	JS	CS	VS	SD	JR
Audio-taped interviews	Yes	Yes	Yes	Yes	Yes
Interview fidelity	Yes				

CI extraction	CIs: Self-care, taking online classes about happiness, off technology, work-life balance Hindering CIs: Developing more technology skills, administrative support WL: Great planning for all the classes including lesson plans and scaffolding	CIs: Self-care, exercising, drinking and eating well Hindering CIs: Feeling helpless about not being able to help all student WL: Better memory and able to access information quickly	CIs: Flexibility to adapt to various situations Hindering CIs: Developing technology expertise, administrative support WL: Admin. and parental support	CIs: Well-equipped technology support, support from administration and colleagues Hindering CIs: Unstable internet connection and bugs in software WL: Connecting to global students through webinars	CIs: Taking care of health, don't overdo the teaching part Hindering CIs: Administrative and parental support WL: Admin. and parental support, scaffolding
CI and WL Log	CIs & WLs logged	CIs & WLs logged	CIs & WLs logged	CIs & WLs logged	CIs & WLs logged
Particip. rates	• 0.5% • 0.6% • 0.6% and 0.4%	• 0.5% • 0.2% • 0.2%	• 0.2% • 0.6% • 0.6%	• 0.2% • 0.2% • 0.2%	• 0.5% • 0.6% • 0.6% and 0.4%
Independ. categori-zation	Yes	Yes	Yes	Yes	Yes
Member checking	Yes				
Expert opinion	Yes	Yes	Yes	Yes	Yes
Theoret. agreement	Yes	Yes	Yes	Yes	Yes

Validity, Reliability, and Transferability

The data was triangulated (through multiple interviews and lesson plans) to ensure credibility (internal validity) and member checking that was conducted multiple times after the interview data was transcribed at different stages through email conversation with the participants. Similarity in responses by the research participants during the interview process helped me to corroborate the research instrument and ensure the accuracy of responses (Stevenson & Mahmut, 2013). To establish transferability (external validity), I provided "thick descriptions" (Geertz, 1973) about the participants, their work context, research context. I employed purposive sampling to recruit the research participants (Fraenkel et al., 2015). To maintain reliability of the analyzed data and establish inter-rater reliability, another doctoral student reviewed the interview transcripts and the emergent codes and themes (McDonald et al., 2019) for similarity in their findings. Inter-rater reliability is the extent to which two or more coders (or raters) agree (Lange, 2011) on the codes or themes that emerge. Out of the 174 second-cycle codes that emerged, the other rater agreed on 169 candidate themes, resulting in a .97 (97%) inter-rater agreement. To find this percentage I divided the number of the themes we both agreed on with the total number of themes that initially emerged, and then converted that to a percentage (Glen, 2016).

The trustworthiness criteria (Lincoln & Guba, 1985) of this study are illustrated in Table 10 (Anfara et al., 2002).

Table 10

Trustworthiness Criteria

Criteria	Strategy Employed
Credibility	• Triangulation (through multiple interviews) • Member checking (after the interview transcriptions through email conversations with the participants at different stages)
Transferability	• Provide thick descriptions (about the research context, participants and their work context) • Purposive sampling of participants
Reliability	• Triangulation (through multiple interviews) • Inter-rater reliability checking with another coder

Researcher Positionality

This positionality statement addresses my role in relation to the research I conducted for this dissertation. As such, the following section is meant to explore my beliefs, values, and experiences in relation to the research topic to provide the reader with insight about who I am and how my experiences may have influenced my perceptions and understanding of the teacher participants and their experiences.

I am an international student of Asian Indian heritage studying instructional systems technology and am a former middle and high school teacher and instructional designer. I approached this study with some understanding of instructional strategies used in K-12 classrooms, the experiences of K-12 teachers, and their challenges of teaching online during the COVID-19 pandemic. This understanding developed while I conducted my last study, Chaudhuri (2022) which helped me to understand that K-12 teachers do not use instructional strategies with a limited scope and they may use several strategies for a single lesson or assignment. My motivation for studying instructional technology came from my previous experience as both a teacher and an instructional designer, sparking my interest in understanding the issues related to using technology in a K-12 environment. With this background, I have studied the issues related to the use of instructional technology and strategies in K-12 schools and how they impact student achievement and learning outcomes.

As a former teacher and instructional designer, I am keen to understand and amplify teacher voices that are often lost in structural studies about instructional strategies teachers use, the challenges they face in using technology, student engagement, for example. Above and beyond these issues, teachers want and need to talk about what they feel, think, and do, such as in critical situations like the COVID-19 pandemic. In trying to understand the bigger picture of how they navigated education through an online platform during the pandemic, I realized that teachers' thoughts and feelings are neglected and fall short of making it to a larger audience. That said, the strength of my study lies in uncovering teachers' emotions and feelings about teaching online, how they attempted to engage students, the support or lack of it from their school districts, and the innovative manner in which they hurriedly put together content for unfamiliar online platforms, and work duress.

FINDINGS

This section presents findings of the data analyses associated with the one research question that guided this study: How did secondary teachers experience teaching online during the COVID-19 pandemic? A discussion of these findings is organized chronologically by themes that they took place, i.e., the emergent themes are discussed within the chronology. The chronology of events is presented as initial panic and chaos; springing into action; wins and losses; survival of the fittest; fallout; and teachers are people, too. This is followed by events identified as critical incidents, hindering incidents, and hindsight 20/20. General characteristics of the sample and respondents, and threats to the study's validity are also presented.

The findings are presented in a narrative manner (not as a narrative analysis) (Riessman, 1993). This allowed me to narrate the story of what the teachers reported to me and be true to their voices and emotions. Teacher participants acted similarly in some scenarios and differently in others. My intent was to stay as close to the teachers' voices and present their stories while incorporating my own perspectival analysis. I present the findings in a chronological rather than a categorized manner. My findings are not airtight but rather unbound and unconfining, almost flowing to the next one to complete the story. So, not only do the themes complete each other, sometimes the teachers' voices also add on to one another or differ completely to reveal a very real landscape of education during the COVID-19 pandemic.

A short writeup about the teacher participants begins the chapter. This includes not just basic demographic information but descriptions of them as people so that my audience can recognize and hear their voices.

Participant Teacher Portraits

The five participants in this study were recruited through several means, such as a university office that works with K-12 secondary schools, social media, and snowballing. All five participants are secondary teachers with different levels of experience, but a lot of experience using technology in teaching. However, using technology in teaching and teaching through technology are quite different things that my participants clarified in their responses. In the following section each participant is introduced in the order in which they were interviewed.

JS (Interviewed on January 6, 2022)

They were a teacher at a high school in a northwestern state. They were recruited through an email sent to a K-12 school list and they responded and agreed to participate in the interview. They had been a teacher for 22 years and teaching high school at their current school for 20 years. Because they had been teaching high school for so many years, they did not cope well with elementary or middle school behavior, a great issue coming back to face-to-face classrooms after the COVID-19 pandemic school closures.

JS had a master's in education and national board certification. At school, they taught a host of different classes including three different computer science classes, two of which were AP level. They also taught visual communications such as photography, Photoshop™, interior design, architecture, and video game design. JS looked tired during the interview and mentioned many times that their teaching load was huge with six different classes. On the surface this might just sound like an ordinary complaint, but on a deeper level it is speaking of the national school system and what it lacks.

CS (Interviewed on January 6, 2022)

CS was a high school teacher for over 37 years and also was recruited through official email, to which they responded and agreed to participate in the interview. They had taught in a couple of school districts and also overseas in Japan and Germany. They first started in the current district they are in, in 1998. It was a brand-new school. Then, four years later, in 2002, they went overseas to teach in Germany in a Department of Defense Dependent school for Army kids. They returned to their northwestern state and taught in the school district for 14 years, relocated to Germany for a few years, and finally returned to the school district they were teaching in at the time of the study. This was their fifth year in this position.

CS taught a host of subjects in business law and finds it very enjoyable to teach. There were always great students in that class and it was pretty popular. Personal finance was always popular and so those classes filled up easily. There was also a new traffic safety financial education class introduced where the number of sections grew from one to four. CS used to teach a technology literacy class to ninth graders but had given that up and gone with upperclassmen.

The technology literacy classes were also a very good for the students. Students learned a little bit about phone usage and how smartphones can affect their emotional state of mind and also about Microsoft Word™, Excel™, and PowerPoint™. Students take the Precision Exams tests in that class for CTE (CS for Career and Technical Education). Precision Exams are capstone certifications that students can take at the end of their CTE courses. CS claimed to have good rapport with the students, which came through in the interview. CS earned a bachelor's degree and a master's degree in interdisciplinary studies and had a teaching certificate. CS was a stockbroker before becoming a teacher.

VS (Interviewed on January 16, 2022)

VS taught as an interventionist for middle school grades in math and English at a private Catholic school. This means that they work with small groups of students that are struggling in math and reading on the Northwest Evaluation Association (NWEA) test that provides the measures of academic progress (MAP) for students (i.e., not every student at that grade level). The school used those test scores to see who needed extra help in those subject areas. VS pulls out groups throughout the day, four times a week, for math or for reading. They saw the students at least twice a day, twice a week. VS had been working as a teacher for 13 years and one year in their current job.

VS had a master's degree in classical studies and was pursuing a doctoral degree. I recruited them through snowballing from other participants. As a parent, they understand very deeply the conundrum that parents were in and yet wished that parents had been more understanding of the pandemic situation and where it left the school system.

SD (Interviewed on January 16, 2022)

SD was also recruited through a social media call and responded there and agreed to participate in the interviews. They had been teaching at a midwestern state school for three years and had been a teacher for seven years. They had schooling experience in a foreign country, giving them a unique perspective that came through in their interview responses. They had a bachelor's in engineering and taught science and math at the junior and senior levels.

JR (Interviewed on January 17, 2022)

JR was originally from Spain and was a bilingual teacher in a Midwestern state school. I recruited them through official email to which they responded and agreed to participate in the interview. As a bilingual teacher they taught all middle grade subject areas but they specialized in computers and technology. They had been teaching for a total of 14 years and were enthusiastic about making their students interested in science and technology subjects.

Interestingly, JR had a lot of experience in online learning, so that proved to be very useful once schools went online. They just completed their master's in educational leadership. JR was very vocal about teacher pay issues and felt that teachers' pay should be commensurate with the massive amount of work they are expected to do and, quite literally, they do. They work extra hours and weekends so I felt that they were justified in feeling that way. I heard this tonal quality from three other teachers, but they were vocal about being overworked.

After having presented the teachers' biographies, the next section will explain the thematic findings of my study. As mentioned previously, these will be presented chronologically.

Themes Identified

In this section I discuss the general findings under these themes: initial panic and chaos; springing into action; wins and losses; survival of the fittest; fallout; and teachers are people, too. This is followed by events identified as critical incidents, hindering incidents, and hindsight 20/20.

Figure 4

Emergent Themes

- Initial panic and chaos
- Springing into action
- Wins and losses
- Survival of the fittest
- Fallout and challenges to teaching
- Teachers are people too
- Critical incidents
- Hindering incidents
- Hindsight 20/20

Initial Panic and Chaos

Each of the teacher participants displayed and reported feelings of panic, fear, and chaos once they heard about the COVID-19 pandemic. In the early months of 2020, there was not much information about the disease to put the ill-at-ease teachers at rest. More than the disease itself, each participant reported that they were worried about their students' situations, how they would continue learning from home, their home conditions, if they had internet access and devices, and so on.

Everyone Described Their Emotions

As teacher SD said, though teachers took up the challenge in a matter of a single day, it was still a panicky time for the teacher community. Knowing that everything would be shut down, the home-based teachers were worried about continuing to impart instruction. All in all, it was an extremely challenging situation

JS said that in their state there was no quarantine in March 2020. They went fully online and ended up giving all students A's before the school district could decide how assessment and grading would be done for the rest of the school year. In the fall of 2020, they were still teaching remotely, so school started with all new students and classes remote and using Zoom™. Online classes were synchronous in the mornings and asynchronous in the afternoons. This allowed students to complete their homework or assignments or get clarification of doubts. Most students were on Zoom™ and excited to get back and participate in the class activities. There were, of course, students who were absent and despite many efforts the school could not figure out what was going on with them. As a teacher, what I heard in JS' voice was a sense of deep worry that not only were these students missing classwork but, more importantly, how they were getting through daily life. There was a deep sense of resignation in their voice that I later heard from other teachers, too.

Eventually, the school decided they would do every other day in person. Not only did teachers have to teach remotely, they also formatted the same content for face-to-face classes, as well. Here I take a moment to think about the workload and the amount of reorganization that teachers had to do on a regular basis. JS reported that in each class, about 15 students would come in and the rest would be online. Gradually students seemed to prefer the remote mode, so the number of students in the classes started dwindling.

The next semester, fall 2021, the school decided to return to fully remote. But in the spring of 2022, teachers started going into school every other day. Teachers came in for hour-long classes and if the students were there, they had to have masks on. If they were at home they could join by Zoom™. In the afternoons, it would be asynchronous so that students could get help for homework and assignments. Unfortunately, that did not work out well for most students and it was only the academically talented students that were able to do the asynchronous work.

By the fall of 2021, the school announced that teachers should expect business as usual and the school tried to prepare the teachers for the social and emotional upheaval of the students. Teachers had a presentation from a counselor where she said that middle school is all about making and breaking friendships and figuring out who you are. As a parent of a 20-year-old, JS was quite aware of that and felt empathetic toward the students.

When the students were back in school in Spring 2022, attendance was still not high. For students who were at school, they were in masks, socially distanced, and teachers could not engage them in any kind of group work that they used to do. Just as JS had said, face-to-face classes were not the same as three years back. I heard a sense of concern about this in the teachers' voices as they described struggling to bring back normalcy to their classrooms. It was not only about the curriculum, but the social-emotional connections of the students and improving the attendance numbers at school.

JS understood the need of the students and planned for students to be outside of the classroom more so that they did not have to wear masks and could mix more freely with one another. JS mainly taught computer-related subjects and for high school they did not usually prefer ice breaking activities. But this time was different. During the start of each class, for almost three weeks, they would have different ice breaking activities outside for the first ten minutes so that the students could bond with one another and find that rapport. The students enjoyed it at first but, with high school students, the activities were not sustainable. Many students felt uncomfortable taking their masks off, even if it was outside. So, JS stopped this activity because it was defeating the purpose. Instead, they tried to have conversations about different topics and issues, trying to make connections and learn about each other. JS mentioned substituting for a class which she had earlier taught when the students were freshmen and now when she acted as a substitute teacher, the students were juniors and it was hard for JS to recognize and reconnect to everyone. This made me consider that there is so much more to teaching than just covering the curriculum and how profoundly teachers think of making connections to their students.

One thing JS noticed when students came back to school was that their behavior had become very irresponsible and immature. As a high school teacher for around 20 years, they were used to students knowing how to conduct themselves in class, so this was a shock. Other teachers that I spoke to expressed similar feelings. Seeing a pandemic up close, students may have become reckless, especially when schools did not enforce consequences for bad behavior or failing grades and attendance. Students were coming into class, unplugging cords from computers, switching mice, vandalizing school property, and stealing JS's sweatshirt. On top of this there were bomb threats from a student threatening to blow up the whole school. The school had security precautions and guns on campus, things that no student should have to see. For JR this was the most horrible year in their entire teaching career.

So, once schools started reopening it was a whole new ballgame. No one knew for sure what the sanitization protocols were. Were students supposed to touch sanitizing materials? Parents did not want their students to touch sanitizing chemicals to clean the stuff they used in school.

When schools gradually started reopening, teachers had their own strategies for easing the students back to the face-to-face learning environment they had been accustomed to three years earlier. For example, JS considered ice breakers but realized they had done too many of those during the online classes and students were bored with them. Teachers had videos of the lesson plans and planned on utilizing them as students eased back into classes, especially for children who would be absent from class. They also started using Kahoot™ and the students found this quiz platform engaging because there was a component of competition that students appreciated. While the face-to-face-face option was now available, the teachers found it frustrating that the schools had only the face-to-face option and had completely removed the online instruction.

CS said they went back to face-to-face instruction in September of 2021 (Fall 2021), but some kids were catching the COVID variant and everyone had to be more vigilant. Those students had to go back to remote learning when, for example, 16 out of the 28 kids in CS's class were absent. If they school had completely removed the online learning option, it would be tricky situation. These details about schools reopening are not found in literature, although there will likely be more studies on schools reopening and the impact of that on student learning.

The variant that the students were being infected with was not as dangerous and most kids completed their quarantine and returned to class fairly quickly, but because of student quarantines some after school programs were affected. For example, the girls' wrestling team had to cancel a tournament with other high schools because many team members had contracted the variant. The wrestling team went on quarantine and CS had to plan hybrid classes to continue their instruction. When a class had to go hybrid, the teachers benefited from the online programs they had learned previously, for the face-to-face classes they continued to put assignments on Microsoft Teams™, and the students continued to use the personal finance curriculum online.

These are small and probably insignificant incidents in the bigger scheme of the COVID-19 pandemic. To the teachers, however, these were critical pockets of decision making and they had to make decisions for which they might have had to answer to administration for later. Communication with the school districts or administration was not always clear or instantaneous but the teachers did what the students needed during a particular situation. This study therefore is an important contribution to the study of the COVID-19 pandemic as a whole, especially when it concerns how teachers experienced teaching and the makeshift decisions they made to keep going.

For JR, just managing the students in a physical environment was challenging. Families had not stayed in touch with teachers, so it wasn't possible to talk with them about their children. The classroom situation was very different from what it was three years earlier, before the pandemic. Other teachers shared similar experiences. Students did not want to engage in the curriculum because there were no consequences for not being in school.

JR had been the bilingual teacher for the fifth and sixth grades, but began teaching a self-contained sixth grade class because teachers were leaving, resulting in a shortage of teachers. JR was teaching everything except special education. The teachers' contracts for that year precluded teaching remotely, but teachers could work with students online who were absent from in-person classes. The teachers could upload activities on Google Classroom™ and students could email teachers, but the teachers were not to use the videos of themselves they had uploaded previously, although JR uploaded some videos that just told the students what they needed to do. If students had questions, they could send JR an email. Out of 11 students only one emailed regularly. The focus became coordinating what was going on with the kids. Everyone had to wear masks and be vaccinated or be tested every week.

Again, such incidents were scarcely mentioned in the literature and the information gleaned from the participants made this study rich and well-informed. This applies most closely to the *inquire* component of the ERTE framework used in this study (Whittle et al., 2020). In this situation teachers assessed the resources they had at hand for face-to face teaching.

The most challenging part in this transition was trying to reconnect to the students. JS thought that blogging would still be a big part of instruction because it worked well online, but it did not work well when students returned to classes, probably because online fatigue had already set in. That was a failure and JS thought that students were burned out with online stuff and did not want more online activities. When they were all online it seemed more like a community of learners, which they would typically feel in their classroom. These kinds of empirical studies were not found on literature. The STF (Jones et al., 1993), however, included components such as required media, role of facilitators, and instructional strategies because the relationships among between these components made learning and teaching a rich and gainful experience.

While returning to F2F instruction, the biggest challenge was using strategies like collaboration and group work, because of social distancing and wearing masks. Students were not used to these protocols within the classrooms and therefore, as respondents noted, many classroom activities fell short of their intended outcomes.

Another issue absent from the literature is the threat of violence from students with guns and bombs as they returned to classes. JS mentioned that with the threat of violence they were not allowed to have more than one student outside of the class at a time and their attention was distracted by the bad behavior. Teachers felt they lacked skills to deal with student misbehavior, because they had never had to teach students to stay in class until the bell rang, for example. That was the pre-pandemic protocol. Teachers had always just taught, especially high school teachers, not dealt with classroom behaviors such as students not cleaning up after themselves. Circumstances and situations like these are absent from the literature. Going through so much and still doing their jobs with integrity and honesty, we as a nation should stand up and salute the teachers. Policy makers should pay more attention to teacher voices going forward.

In the face-to-face classes at JS's school, Wednesday was a non-student day so teachers could focus on lesson plans and other communications, and the students were given asynchronous assignments. JS's courses were very hands-on, so those lesson plans were challenging if students had to be home. Since students, built things in those classes, they needed supplies and it was difficult to organize the teaching if the students were at home since JS could not be sure if students had those supplies at home or arranging how they could pick them up from school ahead of the class. While teaching one group of students, JS had to plan for the next group and the project they would do. That meant buying the supplies and keeping them ready so students could pick them up a week before the project started. Parents and students would come in to pick up their books, art supplies, or the supplies for a project. This was like a cycle, constantly decoding what to do next, getting materials ready, and putting everything in packets. Unfortunately, there were students who were not connected or interested enough and had to be reminded repeatedly to come and pick up their stuff. Returning to F2F classes was challenging and it was not the same as three years back. These findings should contribute to a deeper understanding of the teaching experience during the COVID-19 pandemic.

JR was a bilingual teacher during the pandemic and was also teaching science, among other subjects. It is important to mention here that during that time the school did not have enough teachers to cover all grade levels, so JR was contained in the sixth grade. This meant that they were teaching all subjects in sixth grade because there were no other teachers who could cover any subject area in that grade level. Because there were too few teachers, the school was hiring unqualified substitute teachers. One of the substitute teachers that the school hired has been an army veteran all their life. So, they had skills different than what a teacher needed. JR's concern was that without specific teacher training, how would the substitutes address classroom management and student behaviors, let alone cover the curriculum.

There was also a discussion about dividing the bilingual group and this JR stood up against. The last five years the school had been constantly shifting their rooms. JR argued that they needed to keep their room because the students were accustomed to it, it helped to build a routine, and they did not have keep moving their resources. On a macro level, this might not be a problem, but on a micro level, it could be an obstacle for teachers to do their everyday jobs. In this study, I have attempted to listen to teachers at micro levels to amplify their voices that may not seem to matter when it comes to major educational narratives.

JR firmly stated that they stood up because they felt that all their life they had been saying yes. "Because I noticed also, there have been all my life being a teacher, that I'm the one accepting everything. Can you can you stay one more hour? Can you stay? Can you come to work? Yes, sure. Can you teach me? Yeah, sure. Hey, because I can, because I can. But it is certain point is it now you know, you're not giving anything in return?" Why were they working so hard under those stringent circumstances? JR said, "I'm doing because I'm work I want it for the kids. Not for any other reasons for the kids for the school." For me when JR was talking about this I had this feeling that teachers were really concerned about their students and would go that extra mile to see that the students were supported and they could succeed. But the issue was that only teachers would not help, if as a school system we needed to support students. It's true probably that it takes a village to raise a child. During the pandemic JR recorded videos and put them on YouTube™ for the kids to watch, contacted different people to be guest speakers in their class every week, and even managed to take the students on a field trip. What I heard from this is that teachers do not give up easily.

Never Experienced a Pandemic

The teachers mentioned that they felt so unsure about everything because they had not experienced a pandemic before. Neither were they initially prepared to understand the extremity of the situation. VS stated:

> When I first heard about COVID-19, I remember thinking it was just going to be a passing phase or I thought it was going to be just a phase. Kind of like with what we were dealing with when we had other types of excuse me, scares like with SARS with Mad Cow Disease, what was the other ones? The bird, the bird flu, but yes, so I thought it was gonna be just like one of those types of things because I've never experienced anything quite like the pandemic with COVID-19 before so I've never really had any any

> background knowledge on it. So, I was just assuming it was going to be something that's that we're going to have to just deal with and then you know, just move on quickly. I thought it would be a very quick situation. I didn't think it would have lingered as long so I was just expecting it to be something that I'll just have to deal with with the kids and just kind of just move on.

SD also thought similarly and stated to me that it was probably a passing phase and had no idea that it would last for more than two years. Another teacher, JS, mentioned that they remembered clearly that they were on a plane to Boston when they first heard about the pandemic. What ensued was pure chaos. Is one supposed to go home if they had sniffles? Were they to report they weren't wearing masks on the plane? How would one know if they contacted COVID-19? Were there any protocols or sanitization rules to be followed? They were not doing anything because they did not know what to do. The helplessness in their voice came out so lucidly.

Never having experienced a pandemic before, some schools did not have proper cleaning and sanitization procedures in place. JS told me that they were thinking about the cleaning procedures for the keyboards. Because many parents did not want their children to touch sanitization stuff, JR wanted the students to use their personal devices. But that did not work out because students did not want to take their personal devices to school. So, the teachers had to wipe down everything after the students used them. JS wanted to buy new mice and keyboards because theirs were old and had gross buildup that was difficult to clean. If any student did bring their own device to class they had to figure out how to connect the keyboards to their devices and how to update the software they were using. These were new problems that neither the teachers nor the students were prepared for.

There was still the question of easing students' fears about the pandemic. Teachers had to tell their students that they would all get through it together and to focus on other stuff. There was a particular student for whom talking about the pandemic was very triggering. There was also the issue of some student certifications not being available online and the teachers were not sure if they had to teach that curriculum or not. These certifications were separate from their regular curriculum and had a different curriculum. So, if a student wanted to take the certification test, they would study that particular curriculum, take the test and if they passed would receive a certification that they could put on their resume. So, if these certification tests were not available during a certain semester, teachers did not have to allocate time to teach the certification curriculum. That way teachers would have the freedom of including other things they thought critical for students to know about and change the curriculum.

Like SD, some teachers felt really helpless.

> There was nothing much to be done. So, sitting at home, taking precautions and taking care of their family and taking care of themselves, spreading awareness about the disease among their relatives, friends, and everyone else was the main motto of the day. So, once we started classes online, news started pouring in about people dying all over the world. So, it was a very difficult situation for everyone in the education community.

School Closure was the Main Source of Panic

Once teachers heard about school closures they felt a lot of uncertainty and feared for what was going to happen. How deadly was COVID-19 with people dying left and right? They felt emotions such as, "How are we going to fix this as a nation or how are we going to come back?" and "How are my kids going to be, how is my family going to be when we start quarantine or are in lockdown?" It was very overwhelming at the beginning. VS said,

> My feelings after I found about school closing as I was probably feeling very unsure. Very scared, and I'm some I would even say it's sometimes insecure, because I wasn't sure how I was going to to get my teaching them.

CS felt a lot of trepidation having not taught online before. They knew it would be an overwhelming task to develop a skill set for teaching online but they were up for the challenge. They and other colleagues had the right kind of attitude to face a calamity of this magnitude. They supported each other but that is not to say that the beginning was easy.

From what I heard, words like fear, insecurity, unsureness, nervousness were flowing out and I could gauge what unplanned and unknown situations the teachers must have gone through, knowing that they were responsible for figuring out how to keep instructing the students, keep them emotionally stable, and support them in their many needs.

Worrying About Students and Their Home Situations

In JS' school there were groups of teachers visiting students' houses and delivering pizzas, saying, "Hey, could you come back to school?" People really did try. JS felt it was harder to work from home for a lot of people. For example, they had a really good student who just had a lot of anxiety and could not perform well at all and had other students who had to babysit their siblings. When these students were engaged in their online classes, as JS said, "They just need someone by their side saying, hey, stop playing games get to this, you know." There were very few success stories the teachers could share about connecting to students and their families.

> School administrators figured out in the spring of 2020, when they first went on quarantine, about issues with internet access and devices and knew they could not count on all the students having stable internet or high bandwidth connections. The students always had devices, so there was no issue there, but some kids lost their chargers or devices. By the fall of 2020 everybody had internet access and computers.

Learning Resources

VS mentioned that they were able to reach out to the students and provide them with physical textbooks, but the problem was grading their assignments and returning them on time. They said,

> A lot of them didn't know how to scan or didn't have a scanner, or you know, and I couldn't collect them and then grade them and return them to them like I would in in the traditional classroom that brick and mortar classroom.

The big thing was that they were not able to look at students' work in a reasonable amount of time to determine if they understood a concept. Gradually, as technology became more available and they started to understand more of the predicament that they were in, technology was used more frequently, to send comments to the teacher through a chat box or to provide answers to homework problems. If the students could get the answer, VS was satisfied that students were able to grasp the content. The big problem was if a student got the answer wrong, VS would not necessarily know why they got it wrong. They had to follow up with the student and that became a headache, going back and forth until the issue was resolved. Two learning resources VS used are shown in Figures 2 and 3, and are examples of resources that could be used for both online and offline students.

Figure 5

Boxing Baseballs

Module 1
Session 4

Session 4

Boxing Baseballs

Summary

Students learn about a business owner who needs to decide how he will box 24 baseballs to ship to customers. After introducing the problem, the teacher sends students to work with partners to find all possible configurations. Near the end of the session, the class reconvenes to share a few of the strategies they've used to create as many different configurations of boxes as possible. Finally, the teacher assigns the Multiplication Connections Home Connection.

Skills & Concepts

- Find all factor pairs for a whole number between 1 and 100 (4.OA.4)
- Write numerical expressions with parentheses (5.OA.1)
- Write a simple expression to record calculations with numbers, and interpret numerical expressions without evaluating them (5.OA.2)
- Demonstrate an understanding that a solid figure that can be packed without gaps or overlaps by *n* unit cubes has a volume of *n* cubic units (5.MD.3b)
- Make sense of problems and persevere in solving them (5.MP.1)
- Look for and express regularity in repeated reasoning (5.MP.8)

Materials

Copies	Kit Materials	Classroom Materials
Problems & Investigations Boxing Baseballs		
TM T10 Boxing Baseballs **TM T11** More About Brad's Baseballs	• Omnifix cubes, class set (see Preparation) • Word Resource Cards: *dimension, rectangular prism*	• 12" × 18" sheets of paper (half-class set; newsprint is fine) • student math journals • a piece of copy paper to mask portions of the teacher master
Home Connection		
HC 3–4 Multiplication Connections		
Daily Practice		
SB 5 Facts & Boxes		

HC – Home Connection, **SB** – Student Book, **TM** – Teacher Master
Copy instructions are located at the top of each teacher master.

Vocabulary

An asterisk [*] identifies those terms for which Word Resource Cards are available.

base*
dimension*
expression*
height
length
rectangular prism*
width

Preparation

Prepare the Omnifix cubes (2,000 in all) for easy access and reasonably equitable distribution. If you have a class of 30, each student pair should get about 130 cubes, or enough to build about five different rectangular prisms with a volume of 24 cubes before some have to be taken apart to make others.

Note: From VS' lesson plans

Figure 6

Mathematical Background

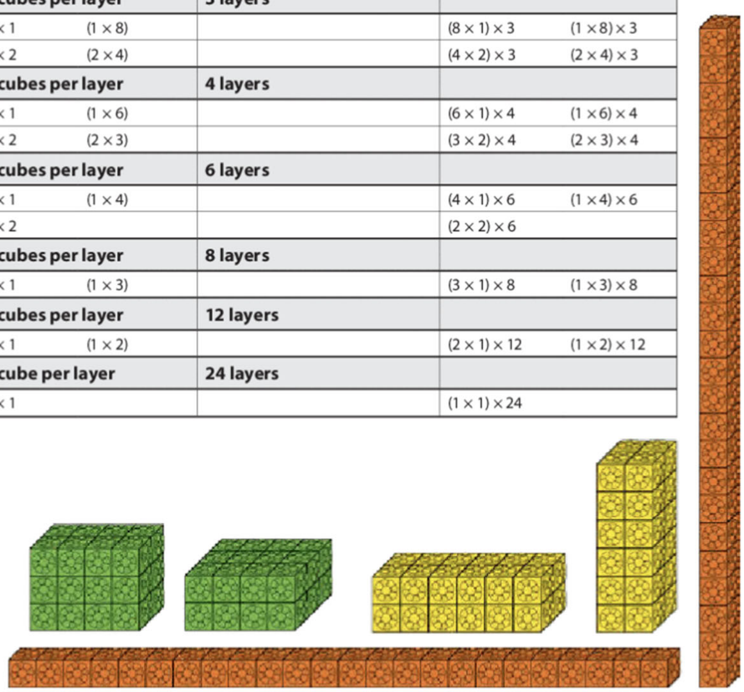
Mathematical Background

In this session, students are challenged to figure out all of the different ways they can arrange 24 cubes in the form of a rectangular prism. The problem involves a business owner who needs to figure out how to package groups of 24 baseballs, each of which is contained in a small cubic box, so that they can be shipped in a single, large box. He can arrange them in 1 layer of 24, 2 layers of 12, 3 layers of 8, and so on. The layers can be arranged in rectangular formations with dimensions that are factors of the total number of cubes in each layer. (See chart below.)

Students will conduct their initial exploration of the problem today and will return to it in Session 5 and in the following module. Sometime in Session 5, you'll need to press them to keep track of their work in a systematic way so that they can be certain they are identifying all of the possible arrangements of 24 cubes. Essentially, the problem requires that students use what they understand about factoring to identify the dimensions of all possible rectangular prisms with a volume of 24 cubes. By emphasizing the dimensions of each layer and the number of equal layers, we are moving students toward the formulas for calculating the volume of a rectangular prism ($V = l \times w \times h$ or $V = b \times h$), which they will address more explicitly later in the year.

Dimensions of Layers (Base)		Number of Layers (Height)	Expressions (Base) × Height	
24 cubes per layer		**1 layer**		
24 × 1	(1 × 24)		(24 × 1) × 1	(1 × 24) × 1
12 × 2	(2 × 12)		(12 × 2) × 1	(2 × 12) × 1
8 × 3	(3 × 8)		(8 × 3) × 1	(3 × 8) × 1
6 × 4	(4 × 6)		(6 × 4) × 1	(4 × 6) × 1
12 cubes per layer		**2 layers**		
12 × 1	(1 × 12)		(12 × 1) × 2	(1 × 12) × 2
6 × 2	(2 × 6)		(6 × 2) × 2	(2 × 6) × 2
4 × 3	(3 × 4)		(4 × 3) × 2	(3 × 4) × 2
8 cubes per layer		**3 layers**		
8 × 1	(1 × 8)		(8 × 1) × 3	(1 × 8) × 3
4 × 2	(2 × 4)		(4 × 2) × 3	(2 × 4) × 3
6 cubes per layer		**4 layers**		
6 × 1	(1 × 6)		(6 × 1) × 4	(1 × 6) × 4
3 × 2	(2 × 3)		(3 × 2) × 4	(2 × 3) × 4
4 cubes per layer		**6 layers**		
4 × 1	(1 × 4)		(4 × 1) × 6	(1 × 4) × 6
2 × 2			(2 × 2) × 6	
3 cubes per layer		**8 layers**		
3 × 1	(1 × 3)		(3 × 1) × 8	(1 × 3) × 8
2 cubes per layer		**12 layers**		
2 × 1	(1 × 2)		(2 × 1) × 12	(1 × 2) × 12
1 cube per layer		**24 layers**		
1 × 1			(1 × 1) × 24	

The table at left shows 16 distinct arrangements of 24 cubes because it treats rotations of the same cube differently. For example, 24 layers with 1 cube in each layer (a tower of 24 single cubes) is treated as a different arrangement than 1 layer with 24 cubes in it (a row of 24 single cubes lying flat). These rectangular prisms are congruent, and students might discuss that. If not, that is fine, too.



Each pair of rectangular prisms shown here is congruent, though they have different numbers of layers and each layer's dimensions are different. As a result, students will treat them as different arrangements for the purposes of this investigation.

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Note: From VS' lesson plans

Learning New Technologies

When teachers began teaching online during the COVID-19 pandemic, one of the major challenges that all my interview participants talked about was learning new technologies. All of my participants had prior experience with teaching with technology, but that was different from teaching through technology. They had to learn to use videoconferencing platforms like Zoom™, Google Classrooms™ and Microsoft Teams™ or using online whiteboards. So, their learning curve was steep and they either used Youtube™ to learn these or sometimes took part in PD sessions that their schools offered.

VS said**,**

> How was I going to start teaching the students I wasn't familiar with with doing online teaching. It wasn't something that I had been prepared with with my master's program. It wasn't something that I was willing. What really willing to willing to do because it's just not a part of, of what I had been taught, but it's something that I had to do. And I was going to do that for the kids, if that makes sense.

Although teachers felt hesitant about learning new technologies, they were ready to do it for the sake of their students. Such emotions should be amplified to understand exactly how far teachers are willing to go for the betterment of their students.

> I didn't feel good, because I knew, you know, but online teaching has been around for a while, and I hadn't seen anything about how to do it well, so all of my stuff was really doable at home, the students could do it. But the teaching the connecting part of teaching wasn't good, said JS.

They took an online class in the summer of 2020 about how to teach online classes but did not find it helpful. It was a new platform for them.

> They used Microsoft Teams™ and decided that the whole school would use it. So they had used a lot of online content provider kind of things. So putting assignments online and that kind of thing. I've done that for a long time. That wasn't that wasn't a problem for me, but like you said that the actual teachings through that was really, really hard. So a lot of the information about online schools is asynchronous. And so we weren't doing that we were doing teaching through zoom, which really, there wasn't a lot of information about. So from the online teaching course that I took, I learned a lot about, well, it's all about connecting. And that's not I don't, it's, it was really hard for me to do online really hard. And then especially when they they didn't even have their screens on and, you know, it's like, you couldn't even require that they have their screens on just maybe their internet isn't good enough. Or maybe they've got five other siblings in the room trying to do school at the same time. So that was the hardest part. And, you know, it was like the most important part, and I really couldn't figure out how to how to bridge that gap. So I ended up connecting really well with maybe a third of the class, and then the rest of the class, you're just hoping that they're there with you. But it was really hard to tell…'

CS reported that the tech team of the school was very supportive in helping teachers learn programs such as Skype™, Microsoft Teams™, and Zoom™. Zoom™ was popular in classrooms and they had to learn how to invite guest speakers to these online platforms. The school used a good finance curriculum from Ramsay classroom.com™, the Dave Ramsey program for financial algebra and the personal finance class. It is also used for the innovative combined traffic safety education and financial education class. These programs are expensive but very useful for students.

Teaching Online

CS clearly stated that teaching online is difficult because of the missing interpersonal component and inferior communication. If the teacher relied on interpersonal contact but could not see the body language of the students or how they reacted, the teacher had to judge a lot from the tone of the students' voices. Because teaching is so interpersonal it is difficult to replicate that in an online environment. Sometimes the names of the students were displayed in Zoom™, but when called on the students were not there. The schools worked hard to avoid discrimination by providing internet access and devices to students without them. CS said that their school was trying to be equitable and made sure that even students from a low socioeconomic background had their home internet working. They also shipped food to the students who qualified for free and reduced lunch.

The teachers were trying to be emotionally responsive but students did not reciprocate. The teachers realized that there were students who needed more support than others and teaching online also made that difficult. CS said,

> It's not only do you have to be able to communicate, but you have to be able to know that some of those kids out there are going to need more support because they don't have some of the things that some of the other kids have. So, the school district wanted to level the playing field and they get really good job of that. So so that yeah, so that emotionally it was very difficult for me.

For JS, their school had a mix of synchronous and asynchronous instruction from the beginning of the school closure. In the mornings they had synchronous class or guest speakers, in the afternoons, they were asynchronous for different types of extra work or assignment time. They had a Zoom room specifically for students to use if they needed help, but after about two months no students were coming in. Other teachers agreed that they probably could not expect students to do anything online in the afternoons. JS tried to engage students in the Zoom™ room by assigning group work where students could choose their own partners and work together in a breakout room. There was no fixed project that all students did in groups. They did some blogging and some students provided peer feedback.

Before the pandemic became very serious in the United States, JR already knew what it was going to look like based on news from their relatives in Spain and Italy. Anticipating going online, the state board of education contacted them and another teacher to rewrite the state Spanish curriculum standards, specifically for teaching online during the COVID-19 pandemic. JR and their colleagues designed the standards in a way that schools could function with health and safety measures, whether in a hybrid or totally online environment. JR was responsible for the hybrid part, possibly because JR had completed their college degrees all online and applied similar online learning principles for the standards. When the district rolled out the plan for going online, however, JR found that they had chosen the worst format of all. They did not understand why the district made use of their expertise if they would do it all wrong. JR had suggested one-to-one online sessions with each students and then asynchronous work. This would help them to pay individual attention to each student. However, when the school district rolled out the plans for online teaching, it said there would be synchronous classes so there would not be any time allocated for individual student session with the teacher unless any student requested it.

The district decided to freeze the grades for all the students, so students saw no point in doing any work. Following that was a mandatory summer school, but the next year no students attended the online summer school because it was optional. There were no repercussions when students put in no effort. JR said that perhaps parents thought that schools were like a daycare center where children go when parents are at work. I could imagine the frustration when teachers prepared to move everything online, thinking about what would engage the kids, and then the students did no work.

School Administration

JR found an interesting website for their students and talked to their school administrators because had to have a special permission from the district. JR filled out the forms and was in contact with the company, but the school administration turned down the request. JR found another program for the students and again requested permission. One administrator said that if the program was good, JR could use it, but later the administration no. These are a few of the examples of how the school administration was unsupportive of the teachers. Another example from JR's experience was when they received a $250 grant to buy board games, so they placed an order. But the paperwork was so difficult that the administration told them that they would have to pay the bill and be reimbursed in two or three months. JR mentioned to the person that gave them the grant, that JR, themselves, had already spent this like $600 for board games and other class equipment, so they could not afford to pay any more. Fortunately, they were able to buy a claw machine for the class that rewarded students when they grabbed something.

Springing into Action, Each in Their Own Way

Once teachers recognized the fact that COVID-19 would be around for a long time, they started to think about how to make their online remote teaching more connectable to the students. Most of the teachers that I spoke to reorganized the curriculum in some way to suit the online teaching and learning format. Most mentioned that their teacher training did not address different learning formats, so the redesign of the learning and instructional resources was commendable.

Redesigning Curriculum

CS said they remembered thinking that the current curriculum could in no way be covered online they were nervous about what to do in that case. They thought, "Wow, a kid's not going to get that unit" in an online format. So they prioritized some units over others, such as personal finance, one of the most important units. Then CS asked the students what they would like to learn, assuming that if the students had a personal interest in a topic they would try to engage themselves. The class said they wanted to study investment and retirement. They were not too interested in insurance, but CS put in a small unit of insurance, nevertheless, to make sure that the students were not missing out on an important topic.

To redesign the curriculum in this manner required changes to the assessments and grading, which took a lot of time and energy. CS had to redesign the assessment so students could take different tests. To build rapport with the students, CS used five-minute surveys to see what the kids wanted to learn and then they redesigned the content. The students understood that CS cared for them and had a good rapport with them. They mentioned one incident:

> I think I built some pretty good rapport with this one girl on my personal finance class and my internet went out. I mean, it was too windy one day out where I live in and I live quite away from the school. And my internet went out Oh, no, right in the middle of class. And I picked up about 10 or 15 minutes later in there was a girl in my class. What a blessing she was she actually took the discussion questions and ran with it, and she started to teach. She started teaching the class and And so that led me to believe that I really had built enough rapport that these kids really did want to learn and she was a real

> leader and she ended up getting ended up business student of the year we gave her that award at the end of the year. She had a lot of business classes and and I think that helped her also get into the University of Washington where she's going to try to become a dental student. So that that kind of thing, you know.

VS was unsure at the beginning about how the online learning would work. They had never been in that kind of situation and, in their own words, it was an "undiscovered territory" for them. Before teaching online, they first figured out the situation about internet access and personal devices for the students at their homes. If a student did not have these, they would arrange for a bunch of handouts or packets. VS was a veteran teacher with 13 years of experience behind them, so it was just a matter of learning the technology and understanding how the students would respond to it. VS noted that if they were to go back and redo it all they probably would include a lot more interactives games in their classes. They had used Kahoot™ for their classroom quizzes and thought the students enjoyed that, they reorganized their content in a way that would have more interactivity for the students. This also gave them an opportunity to provide instant feedback to the students.

> VS had some students who were offline and felt that there was a big difference. Between coming up with a bunch of handouts versus me actually teaching or using Khan Academy or any any type of online resource so there, there was that big divide. So that's what I would would work work on first. The second thing was kind of getting feedback from the students because that seemed to be well if you have a good rapport with your students that they're going to, they're going to be honest with you on whether or not they're learning the content, and whether or not they're engaged. Test scores of the students would show how they were doing in class academically, but VS wanted to know just CS, what they enjoyed better. Was it Khan Academy™ or BrainPOP™? For them student's engagement and interaction was a big part of learning.

JS mentioned that in the online class they took about teaching online, they learned a lot about connecting to the students and why that was important. At the beginning of the pandemic when online teaching had just started, all the students were given "A" grades. The assignments were already online but JS thought that they had to record the demos so that students could look them up anytime and also if they were absent. So, they put out a lot of assignments for the students, but the problem was that the students' devices did not have the software from their lab. They then had to change the curriculum completely, aligning it with what the students would be able to do. JS said,

> And then that was the whole issue of the, the tech part, we just didn't know like, will they be able to remotely log into the computers in my lab? Or will they have to use the programs on their laptops and will they, install the programs? And it was, it was very crazy.

On top of this, the communication with the district was not clear. If there were students who were absent for a long period of time they needed to think about how to make it up. If the students could not access the mandatory software at home, what would they do? So, most of the students were not completing the assignments and JS was still making the videos. With the tech help from school, it turned out the students were able to access some of the software from the lab, so JS had to again change the lesson plans they had made, keeping in mind that students would not have access to all of the software. Fortunately, the learning objectives were the same and they could record new videos with the software.

The district developed a different focus for what they wanted in the lesson plans at the beginning of the COVID-19 pandemic, but later cut it down to make it more manageable. While recording their videos, JS mostly focused on how to record what they were doing on the screen and how to write the directions. During Zoom sessions they had to keep an eye on the students to see whether they were doing worksheets or working on projects and they tried a mix of activities so students would not get bored. Making changes to lesson plans when one is teaching physically can be done instantaneously but when teaching online those changes need to be done ahead of time and posted online early.

In their school they had statewide exams for student certifications that appear on a student's diploma. Usually students do projects the whole year and then, at the end of the year, take the exams and if they passed they would get their certificates. JS clearly stated that it was not one of their favorite parts to teach, but they did it. In 2020-21, however, that certification was not available online and so they did not have to teach that part of the curriculum. They thought, in a way, that was good and they could teach more of what students preferred. They asked their students what they wanted, such as guest speakers or hands-on projects. An example was the bridge project, which was not a huge success but the students enjoyed it. They met with the students to test the bridge designs.

> So one at a time, they could come and it was outside, and it was really, really cold and yucky. But they could come and break their bridges. And it was a total failure, because the students, you know, seeing it over zoom, seeing what the testing apparatus looked like, and actually being there with it and building your bridge and knowing okay, this is how long it has to be this is where this the weight has to hang, you know, is completely different. So it turned out badly, but the kids at least they liked it, you know, it's like, okay, you tried now, you know, in the future, you'll understand that span means the width of the river, not the width of the bridge. So but yeah, yeah, so I learned a lot about, I don't know how I can do that much better, because it's just it doesn't really seem like reality. When when you're on Zoom™, you know, the kids were just, okay. Good enough.

Before the pandemic started, JR had their own Youtube™ site that was still up and running, so they already had a set structure for their classes. When there was need for a recertification they had to change things, such as reorganizing some content, cutting out parts, or including something else. Generally, when each year their subject area or grade level changed, they had to change their curriculum anyway, so they were used to it.

SD said that since most of their learning resources were already online they did not have to change their curriculum much. During March 2020 they had already set a structure and followed that, using recorded videos, digital whiteboards, and webinars that the students indeed loved to attend. Some of the examples of learning resources JS changed can be seen in Figures 4 and 5.

Figure 7
Vinyl Cutting

Vinyl Cutting Learn how to cut a vector logo in vinyl
Learning Targets: I can explain the difference between bitmap and raster graphics. I can produce 2D Vector Graphics. I can cut, weed, and apply vinyl graphics. I can share my designs with my peers.

	❶ Watch these videos **Click Here** and complete/watch steps 1-3 of the tutorial.
	❷ Explore Graphics Kahoot 2
	❸Analyze your Art Check your file then Save As EPS and upload it below for cutting.

	❹Cutting, Weeding, and Applying Teya's cutting video cut and apply your sticker
	❺Turn in Upload a picture of your applied vinyl logo. Briefly explain raster and vector graphics and why to use each type. Explain "resolution dependent" vs. "resolution independent".
	❻ Share Upload a picture your applied vinyl to our blog.

❼Check Out Your Peers' Work!

Respond to a few classmates. Remember to follow the example response video and Response Criteria:

- Be kind and empathetic.
- Listen before thinking of a response.
- Listen again to respond.
- **T** is it true?
- **H** is it helpful?
- **I** is it inspiring?
- **N** is it necessary?
- **K** is it kind?

Note: From JS' lesson plans

Figure 8

Affordable Housing

e2-**Affordable Green Housing**

I love this episode it's all about cool places in New York and interesting down to earth designs for communities.

Engineering Education

Standard 9.4: Understands the steps involved in designing construction projects (e.g., planning, generating layouts, developing drawings with measurements and details of construction considering constraints, selecting materials).

Standard 14.4: Understands how societal interests, economics, ergonomics, and environmental considerations influence a solution.

Standard 17.6: Understands tradeoffs among characteristics such as safety, function, cost, ease of operation, quality of post-purchase support, and environmental impact when selecting systems for specific purposes.

Technology

Standard 3.3: Knows that alternatives, risks, costs, and benefits must be considered when deciding on proposals to introduce new technologies or to curtail existing ones (e.g., Are there alternative ways to achieve the same ends? Who benefits and who suffers? What are the financial and social costs and who bears them? How serious are the risks and who is in jeopardy? What resources will be needed and where will they come from?)

Standard 4.6: Knows that a design involves different design factors (e.g., ergonomics, maintenance and repair, environmental concerns) and design principles (e.g., flexibility, proportion, function).

Standard 6.8: Knows different requirements for structural design (e.g., strength, maintenance, appearance) and that these structures require maintenance.

❶Previewing Questions

Answer or respond to a peer's answer about one or more of the questions below on the Teams General Post

1. What do you think of when you hear the term affordable housing? What images come to mind of both the buildings and their tenants?

2. What makes a neighborhood a community? List some of the elements in your opinion that are essential to a community.

3. Do you live in an area/community that is mixed-income or level income? Do you think much about it? If you experienced the opposite, how do you think it would influence you?

4. What are some places within walking distance of your home (e.g., stores, parks, theaters, community centers)? What are some places you would like to have and not have within walking distance of your home? Why?

5. Do you learn more when you talk to a person that is more or less like you? What about when you visit a place that is more or less like your hometown? Why?

Note: From JS' lesson plans

Reaching Out to Students in Times of Need

While the learning took place online, the tradeoff was that it just took longer. In CS' case, the school superintendent understood the issue and said, "Look, it is going to take a lot longer. And so we understand that you're not going to hit all the learning targets that you had wanted to, but we need to be able to help these kids survive this, as well," These thoughts about the students' wellbeing were at the forefront of many teachers' and administrators' agenda during the COVID-19 pandemic. They tried to connect emotionally with the students. Many times teachers would go when they delivered textbooks or deliver lunches and connect with a family or give the students something they wanted from their homeroom store. The idea was to make them comfortable.

CS mentioned visiting some students' houses in the school district where they got some Domino's Pizza scratch cards and the teachers would take them and sit down with the parents and chat with them. That really gave them an opportunity to understand the family situation better. CS said they could not reach all of their homeroom classes, but they did quite a few of them, and they understood a lot more about their current situation. But it also was very emotionally challenging and it really helped them connect with the kids.

Online Teaching Strategies

When they started teaching online, VS said that teaching via Zoom™ was very popular. Many teachers, public schools, and private schools used Google Classrooms™, as well. The challenging part was how to make the content engaging when meeting on an online platform. Teachers said,

> And that was what I was worried about the most was I wasn't sure how I was going to reach the students in terms of like keeping their attention where they because I could all I was seeing was a screen and sometimes I wouldn't even see their faces because a lot of times they wouldn't put their faces on on the Zoom™ link or this or that so I didn't know if they're even paying attention.

In a physical classroom the teacher can gauge the student's body language but on Zoom™ with the cameras off it was not possible. To engage students they picked engaging YouTube™ videos or used Khan Academy™ to teach concepts. They would sometimes record themselves solving a problem or explaining a concept on a whiteboard. For lower grade students they used videos like BrainPOP and videos that would help to break down concepts before talking about them in class. VS gave an example:

> Khan Academy™ was another one because especially with like math concepts, they could show more than one way to solve division problem. Exponents or whatever just depending on whatever topic we were teaching, or I was teaching. So that's what I did.

JR already knew from their family in Spain and Italy what was happening with COVID-19 and, therefore, had a little more preparation time. They were not new to technology and moving their resources online was not challenging. Their students were using a lot of Google Docs™ and Google Slides™ so the transition was not difficult for them, either. The key challenge was to make the kids show up to their online classes and pay attention. JR started using a program called Neo LMS™ that included a gamification component to engage the students. They had earlier planned to replicate the physical classes online where students watched videos and then would have one-to-one sessions with JR and keep in touch. However, the district mandated the use of Google Suites™ so the individual element was missing. Instead of short periods with each student, they had to stay in class for whenever a student might show up, potentially for six to eight hours.

There were also teacher meetings and lesson planning, so they had very little time left for actual teaching, their primary job. The one-on-one session could be used to give specific attention to each student every day but that was the tradeoff with their time. JR felt confident, though, that they had prepared their students well enough that if the teacher was absent, even without a substitute teacher the students would know what they were supposed to do that day.

For SD, teaching online was a wonderful and exciting experience. It was like they got an opportunity to implement the things they learned about online teaching in a practical setting. They felt that online teaching had become so popular that there might be a time when it would completely eradicate traditional teaching. The school initially supported the teachers in learning about the online platforms and then it was left to the teachers to keep themselves updated. SD also felt that Youtube™ played a big role in helping people learn new technologies, such as how to use a whiteboard in a video. SD mentioned,

> So, once you're using a teaching procedure, there are a couple of ways in which you can keep data you can put your camera in front of a whiteboard, you have which is a very old method. Okay, which is a very old method but this you have many new technologies right? Like you can share or share your screen and that there are some digital whiteboards which are available, both paid as well as free boards. So you can share whiteboard into other students can see what you're doing and writing just this like the Blackboard or the whiteboard that he was not interested, same type of feeling. But there are some ways in which you have the whiteboard in back of you and you can show your face also so that because sometimes students wants the reaction the facial expression on the teachers as well, because that also helps them to understand a lot of things. So this was very interesting for me because the other teachers that I have spoken to have said that when students keep their cameras off they cannot see the students' reaction.

But SD mentioned that the students also needed to see the teacher and their body language. SD used a lot of webinars to engage students and felt that having guest speakers in webinars really connected the students to the outer world and engaged them in the content. These webinars were both intra-school and inter-school so students could meet students in other schools.

JS mentioned that once they were comfortable with the online platforms (e.g., Zoom) they ventured on to invite guest speakers to their online sessions and noticed that the students enjoyed this a lot. They also had volunteers from British Petroleum™ (BP) demonstrate some activities in videos and, though it was not as engaging as the students doing it themselves, it still held their attention. JS also kept their videos organized for any student to view them as they needed.

Engaging Students

Teachers wanted to engage the students in their online classes and JS understood that students were bored with worksheets and Zoom™ discussions and would not show up. JS was already connected to British Petroleum™ (BP) volunteers who would conduct STEM activities every year for their students and there were local organizations who would come to class coding and debugging activities. Unfortunately, these projects would not work and turned into videos that the volunteers shot at their homes that the students watched, which was not as motivating. Ironically the students in computer courses were burned out from being on the computer and Zoom™ all the time.

The teachers had their lesson plans organized and their videos recorded so that students who were absent from classes could view them later. Most teachers were very organized. For example, JS substituted in another teacher's class and could not find the sub notes. The teacher had mentioned to JS that the students know how to find what they were working on. The students initially said they did not, but a student said the notes were on OneNote™, and everything was there, the slideshow and other resources. JR here mentioned that they relied on slideshows and kept them organized for the new lessons they were creating.

The volunteers from BP™ and two graduate students were available and kids could meet with them in their asynchronous times to help with career and technical education work. However, the BP volunteers said at a district meeting that it was frustrating because they did not have their tools and could not demonstrate things to the students. For example, if it was a welding class or a cookery class how could the teacher be sure that students could practice the demonstrations at home? Would they have the equipment for that? Would they have the supplies for a certain recipe?

The welding and other hands-on classes were not a huge success. Here is what JS had to say after talking to students:

> And so I was talking to a student yesterday who's in our aerospace program, and he's, he's like, in heaven, this class is so cool, they have all of these amazing tools. And it leads like, right to a career and, and he goes, there's only 15 of us in the class, because last year, it was so awful, because they weren't in the lab. So they couldn't learn anything, they couldn't do anything. You know, they they watched videos about other people doing stuff, but they couldn't figure out how to make the class work. And so not very many people signed up for it this year, because it just got a bad rap.

The same thing happened in the robotics courses. Usually with robotics the students have a team working on a robot, but they could not do so on Zoom so the school ended up buying each student a robot kit. It was still hard for the students to do it all by themselves and to admit on a Zoom meeting that they did not understand how the drive train worked, for example. As a result, it was not as much fun as when the students were in a lab and everyone else could see what everyone else is doing. There was so much more synergy there that could not be replicated on Zoom.

VS was worried about engaging the students because on Zoom they could not see the students, because the students would typically have their cameras and microphones off. As a teacher, they wanted to put the students at ease and make them feel secure. If they had that security they would be able to learn, but if they were insecure or unsure they could not focus on whatever concept was being taught. So, VS had to put on a brave face many times and say, "Okay, well even though we're not exactly sure how this is going to go or what next week's gonna look like, this is what today looks like. And this is what I'm going to try to teach you." They expressed to the students that even though they had doubts and did not know how things would turn out, they would focus on getting past that particular day. They tried to build a sense of classroom community they thought was essential and just moved on each day at a time.

SD tried to use whiteboards to engage students and teach conceptual subjects like math and science because that is what the students were used to. Sometimes they would record themselves standing in front of the whiteboard in the classroom and at other times use a digital one. When online teaching was the only option, teachers had to make it work. Gradually students got used to the online mode and were successful in understanding the curricular topics. This was especially important for the science and mathematics subjects that are a huge challenge to teach because they are conceptual and need to be understood very well.

JR tried to engage students with virtual museum visits, 3D printing, and even a field trip, but teachers need the support of the school administration and the parent community to do this. Regarding student engagement, CS said,

> I had to get their attention in the early stages, so I wear different hats. I you know, I wear a Japanese hat that a guard and a rice farmer would use and I and I brought in a Mexican sombrero and I did things just to get their attention and I had to maybe use humor quite a bit, to kind of to kind of get them to be more involved and engaged in learning. And so every once in a while, you know, we just we just take a little break and maybe high place, truth, truth, dare for a game I you know, just to just to help them connect. And so I say,

> okay, so and so, you know, to give us two truths and one lie actually, is to choose to lie. That's right. And so everybody had to guess what the lie was. And that made it a little bit more lively.

It helped kids to share some experiences with one another in the class. When CS learned more about each kid, it helped them connect emotionally. Some kids would do the assignments given on Microsoft Teams but just would not show up for class. CS allowed this a couple of times and allowed test retakes if they really did not perform well, but gave them a different test to reduce the possibility of cheating. CS wanted to give every student a chance to succeed and to improve their grades.

> So my grading my assessment had to be completely different as well. And so that was a lot of time and energy. To change my assessment to write different tests.

Wins and Losses: Effective and Ineffective Teaching Strategies

A lot of what the teachers were doing by way of teaching strategies was trial and error. Some strategies worked while others failed miserably. And some things worked with some students but not others. It was a huge conundrum for teachers that there was no single manner of successful online teaching. This was not a case of one size fits all. For example, in online math classes some students could adapt well to the use of online whiteboards just like the ones they used in their classrooms, while others could not learn in that manner. Teaching strategies also meant trying to connect to students to know more about who they are, what music they listen to, and the books they are reading.

Teaching Strategies That Worked Well

JS, while teaching on Zoom, used the breakout rooms quite a lot to connect to the students individually. Sometimes students got motivated by this and would say, “Do you want to see my dog?” JS noted:

> And so then you can talk one on one, because in the classroom, a lot of your connection is, you know, Hey, what did you do this weekend, but you're not saying it to the whole class, so that they have to present it to everybody. So I did a lot more of just one on one, like, I see, you're really interested in this thing. You know, I thought it was cool that you had this, you know, why did you do this? More of that connecting and, and trying to learn about them to figure out who they were, usually, I'm seeing what books they're reading, what clothes they're wearing, who their friends are at lunch? I mean, you just there's so much more to teaching than just giving them the curriculum.

JS’s winning strategy was connecting to students one-on-one, but there were also cases where students were actually asleep or playing video games during the Zoom™ sessions. JS tried to address this situation by letting the students choose their work group but it was a “win some and a lose some” situation. Students also used apps like Flipgrid™ and Google Jamboard™. Initially there was a good response to the weekly Flipgrid ™assignments where students were watching and commenting on their peers’ videos, but that interest slowly died down and the same happened with Google Jamboards™. Because these were tech classes, students needed something they could discuss and relate to, so JS started a blog about affordable housing for the poor and gave the students interesting videos to watch on this topic. Participating in the discussion was mandatory and this worked wonders because students had a lot of things to say.

Figure 9

Shed Design

JS got the idea from discussions with other teachers. It is important for teachers to be flexible and keep an open mind to understand what might work well with their students.

Note: From JS' lesson plans

CS mentioned that their strategy was to present themselves to students as another vulnerable human being. That, they thought, would help students relate to them. CS said,

> I would just I think mainly trying to engage them at the beginning myself with a with a

Sri and Austin

Frame a Shed Assignment, created by: Sri and Austin.

Architecture Period 3 2021-22

Step 1: Draw a sketch what kind of shed you would like to build.

Picture 1 Picture 2 Picture 3

^^^ Like brown shed above in width & length but incorporates the flat roof of the woodshed. Also, it's not going to be tilted.

Design Brief:

- We are going to design the framing of a 8x10 shed, we chose to incorporate the overall layout of picture one with the door and side window, (excluding the top window.) While using picture 3 as a example for our flat roof. We choose the flat roof to create further simplicity.

Possible objects

- Choosing the correct distance apart of each stud so that the structure will remain sturdy.

Solution^

- Following the code for wall stud spacing that is found online. Then sizing it down to 3/8 scale.

Pictures of Sketches with included dimensions below.

> little bit of information about you know, something that happened to me in my financial life, whether good or bad, and so that they could see that I kind of human that I'm not making all the right moves and and I think they they understood they understood that, that that I'm, I'm human and so on, and I think that that helps, but just the rapport that I built.

VS mentioned that because they taught math, a conceptual subject, they used a whiteboard frequently. Sometimes they used digital whiteboards while at other times they would video record themselves while solving a math problem in front of the physical whiteboard in the classroom. SD, who also taught high school math, mentioned using a lot of whiteboards and supplement it with websites like the Khan Academy™ to help students conceptualize a problem. That helped to show that there were multiple ways to solve problems.

JS also experimented with creating some Youtube™ videos, mostly by trial and error. Initially these were quite long, up to five or six hours, and there were a lot of views at the beginning but they dwindled over time. JS understood that middle school students were interested in video games, so they used gamification strategies and some online board games to motivate and engage with the content. The teachers also used some fun things in class, such as JR's claw machine.

> It's a machine that you put coins on it. They're fake coins. And then you move, and it's like a claw. And it goes down and you grab surprise? We have one, they are really, really engaged. We're doing all of that. And then when I said to administration, can you help me? The answer is no. But also, I found a web page. That was amazing. It's called a Stash 101. And it's like a bank for kids. It's everything is fake, and it's free. But they can have their own account, and they can have jobs in the class like absentee helper, if you're not there, that one person is in charge of that. Then I took that thing to my class that we're working on. But the web page is really cool, because it lets you do everything it pays every month or every week. You can have loans, you can have a market. It's really cool.

JR decided to record a video for the class to discuss to with students what they would do on a particular day, share other video resources, and give students activities to do. They also earmarked some 15-minute periods when students could talk to JR and clarify any doubts. That was the initial plan, to replicate a face-to-face class as much as possible so that the students would have a sense of the old routine. However, when the district went fully online, the 15-minute tutoring component had to be canceled and JR was no longer able to record videos because of time constraints. The online platform did not afford them that time because the children were always in synchronous instruction. JR tried to contact students' families to let them know what was happening in the online classes, and even tried to connect with them on Facebook™, to no avail.

Teaching Strategies That Were a Total Wreck

JR thought that traditional teaching strategies like copying answers or just a plain calculation did not work well unless the students were given the reason behind why they were doing that. VS felt that the most challenging thing was to get the students to put their cameras on. It was difficult to teach to a black screen and just names. They vented,

> I knew I as a teacher needed to see their faces because I couldn't gauge that personal connection. I missed that so much being online. That was the the biggest the hardest part for me. So if I couldn't see their faces, I didn't know what they were thinking, what they're not what they're thinking, but I couldn't see. Were they thinking about the problem were they distracted or were they doing something else? And because I couldn't see their faces. I couldn't judge what what they were doing. So I couldn't read their body language. So for me, that was the biggest part. I had the hardest time with that even to even to this day. I think if we haven't I still have a hard time with some students putting their cameras on.

CS felt that their inability to be very nimble with internet access was an obstacle. They often struggled to access information online and they admitted that,

> I would fumble around if I needed to show a resource it would. It might take me a while to get that up on the screen and screen share until I got really got the screen sharing aspect of that program down whether it be zoom or teams. Here is just an incredible challenge.
>
> And I sort of hate to explain this, but I think it's it's a must. I had a sergeant from the Bellingham Police Department in my traffic safety financial aid class. And it just turned out that my colleague couldn't run it. You know, a guest speaker. He just didn't have enough time and I had a little bit of time in my classes. And keep in mind that he and I teach we teach this class of 55 to 60 kids. So that's a lot of kids anyway. I to be able to, to let them in right at the beginning of the zoom for this guest speaker I let it go. I just let everybody enter that wanted to enter. And it just so happened I had you know, the chief, the chief of the Bellingham police, who was explaining from some questions that students had so I had, how did I do that? I had a Google Doc. And I let the kids write their questions on a Google Doc. And before he was the guest, the guest speaker and by the time that I got there, I put that up on on Teams™. I think that was a Teams one. And so the questions were going well, the officer could see the questions that the kids had written. And the kids asked them personally, and then I had a zoom bomber. This is a kid that's not in my class. And he came into the class and he started yelling obscenities to one of the African American kids in the class and and the African American kid's father said get that kid out of there and I had a really hard time figuring out where he was in that call because there's 55 to 60 kids in that Zoom call. And and he was hammering the girl plus he was hammering the the chief of police and it was it was just very difficult in three minutes. He did some damage I was able to get him off.
>
> And and so after that situation, I ended up making sure that I invited each kid into they had they had to come in through me. And so anyway, that was one of the things not only that, I experienced that. But there are other faculty on our staff that experienced that as well. And so we all had a faculty meeting that was zoomed. We all had to come in and kind of decide okay, we're gonna all have to invite people into our particular zoom. And so that we had that discretion finally, but, you know, took took us about half a year to figure that one out.

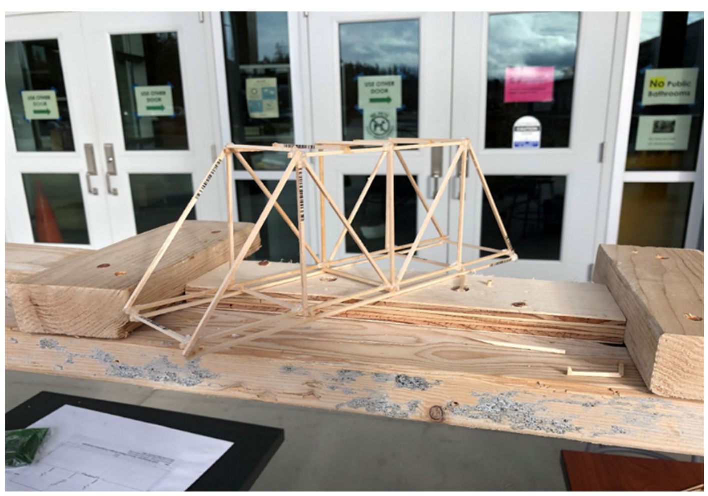
JS was very positive even about teaching strategies that were a wreck simply because the students enjoyed the process. To them, that was crucial. On example was when the students participated in a bridge building activity (Figures 7 and 8).

> Like I remember, we did bridge building, and then we were able to the, the only time I got to meet those students was we, we tested the bridges. So one at a time, they could come and it was outside, and it was really, really cold and yucky. But they could come and break their bridges. And it was a total failure, because the students, you know, seeing it over zoom, seeing what the testing apparatus looked like, and actually being there with it and building your bridge and knowing okay, this is how long it has to be this is where this the weight has to hang, you know, is completely different. So it turned out badly, but the kids at least they liked it, you know, it's like, okay, you tried now, you know, in the future, you'll understand that span means the width of the river, not the width of the bridge. So but yeah, yeah, so I learned a lot about, I don't know how I can do that much

better, because it's just it doesn't really seem like reality. When when you're on Zoom, you know, the kids were just, okay. Good enough. And, yeah'.

Figure 10
Bridge Design

Figure 11
Final Bridge Design



Another example that they gave was:
Yeah, when I'm thinking about it, I'm thinking about the one that we did with BP. So like the, the learning watching their presentations and watching them do the experiments for us, you know that that didn't work well, but then it at least connected the kids, I think enough that they thought that they thought more deeply about it, they could see that these volunteers were really passionate about, like, sustainable design. And so when we, after we did these things that showed how heat transferred and electricity and these kind of

things, those were not, I don't think they went very well, and that the students really learned much, but then many of them really dug into the project, then after that, so the project was design your own sustainable community. And I think they, they went deeper than with that.

Students came up with some pretty weird art. So in my photography, and digital art stuff, they, they did sillier things, I think, then than they've ever done before. There would just be a few of them that, that were really, you know, we used to enter a lot of contests. And we, we did not do so well, with those kinds of things, our FBLA group (Future Business Leaders of America), everything went online, which was kind of easy. So I didn't have to spend like my spring break, you know, watching students. So it was all virtual. And we did well with less, because not very many people participated. So we made it to Nationals for the first year, but not because we were any better or tried any harder, just because there was the lesson.

Working on Zoom was frustrating in courses that required hand-on activities and learning. JS would go into the classroom and cut out things on the latest laser cutter, things that they had designed. It was similar to the bridge project and students really didn't understand how it would work. The logistics were difficult because by the time students asked questions about the activity JS would already be in the classroom ready to cut it out. It became a long process of going back and forth, asynchronously, like “No, you have to change that line to be red, because that's the part that's cut out and this lets you know.” JS had to do that for almost every student because it didn't really make sense to them on Zoom. It wasn't obvious to the students how to do the laser cutting, so oftentimes they ended up doing it the way they thought that it should be done and it wouldn't work. JS found it depressing, as a teacher, to spend time demonstrating the laser cutting, only to find that students wouldn't even pick up their projects because they hadn't put any work into them. The students would ask, “Is that good enough? What do I have to do?” They worried that the project would not earn them the grade they wanted. As a result, when students were switching to online, teachers switched to different standards based on what the kids were able to make.

The students would repeatedly turn in terrible assignments and had to redo much of their work, asking, “Is this it? Is this it?” It was frustrating for JS when students wanted a good grade but didn't want to put effort into their work. It was a challenge to figure out how to not let the students fail. That was the directive from the district. Teachers could not fail any students; if a student had done anything in the class, teachers had to give them a P (pass) grade. However, this was not enforced consistently throughout the district. Some schools were saying, “Yes, teachers can give students a P for being a black box on Zoom,” even if the students had logged in but were not there. Other schools, such as JS’, said, “No, students have to do the work, but they have all year to do a semester's worth of work.” The teachers had to go back to those assignments to see the assignment’s purpose, how was it graded, and if the student’s work was at a passing level. A lot of frustration about projects and assessments was reflected in their voices. One example of an assignment is given in Figure 9.

Figure 12

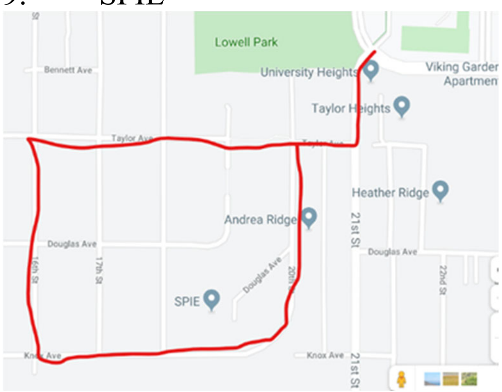
Assessment on Architecture

Architectural Styles Quiz

Name___________________

Recognize and explain 8 different house styles including 3 different roofs, doors, and windows. You may explain up to 10 houses. You may also change the address to the houses of your choice.

1. 900 16th St.
2. 914 16th St.
3. 1007 16th St.
4. Douglas & 16th
5. 1027 16th St.
6. 1612 Knox
7. 1720 Knox
8. 1034 17th
9. SPIE



While teachers like JS experienced intense frustration, other teachers said students were very understanding of the fact that this was all a trial-and-error process. SD said, "The students were flexible. They also understood the situation, that it was an experimenting time for all of us … and things only went better. … It never went from good to worse. It always went from worse to good."

Survival of the Fittest: Current Teaching Strategies

As schools decided reopen, teachers had to again reassess their teaching strategies as they would again be moving from teaching online to teaching face-to-face. However, this time it would be different as they had to ease back the students into face-to-face learning, reconnecting with their peers, and continue social distancing. This meant that prior classroom activities like group collaboration had to reassessed.

School Reopenings

Once schools started reopening it was a whole new ballgame. What were the sanitization protocols? Were students supposed to touch sanitizing materials? JS mentioned that,

> We had … staff meetings where we got in trouble. One of the secretaries said, 'Hey, stop telling students to clean things [and] some teachers were saying, 'Here's bleach, let's sanitize everything.' …at least one of our students got pulled out of school because their

parents were upset that they were touching these cleaning products… so it was like this big thing.

When schools gradually started reopening, teacher had their own strategies for easing the children back to the face-to-face learning environment they had been accustomed to three years earlier. At first JS considered ice breakers but realized they had done too many of those during the online classes. They had videos of the lesson plans and planned on utilizing them, especially for children who would be absent from class. They also started using Kahoot to engage the children. The teachers found it frustrating that the schools had only the face-to-face option and had completely removed the online instruction.

CS said that they went back to face-to-face instruction in September of 2021, but some kids were catching the COVID variant and everyone had to be more vigilant. So such students had to go back to remote learning, because for example, out of the 28 kids in CS', 16 are absent. The variant was not as dangerous and kids completed their quarantine and returned to class fairly quickly, but because of student quarantines some after school programs were affected. For example, the girls' wrestling team had to cancel a tournament with other high schools because many team members had contracted the variant. The wrestling team had to go on quarantine and CS had to plan hybrid classes to continue their instruction. When a class had to go hybrid, the teachers benefited from the online programs they had learned previously and for the face-to-face classes they continued to put assignments on Microsoft Teams and students continued to use the personal finance curriculum online.

For JR, just managing the students in a physical environment was challenging. Families had not stayed in touch so it wasn't possible to talk with them about their children, or students did one thing when they were asked to do something else. The classroom situation was very different from what it was three years earlier. Other teachers shared similar experiences. Students did not want to engage in the curriculum because there were no consequences to not being in school.

JR had been the bilingual teacher for fifth and sixth grades, but began teaching a self-contained sixth grade class because teachers were leaving, resulting in a shortage. JR was teaching everything except special education. The teachers' contracts for that year precluded teaching remotely, but teachers could work with students online who were absent from in-person classes. The teachers could upload activities on Google Classroom and students could email teachers, but the teachers were not to use the videos of themselves they had uploaded previously. JR uploaded some videos that just told the students what they needed to do. If students had questions, they could send JR an email. Out of 11 students only one emailed regularly. The focus became coordinating what was going on with the kids. Everyone had to wear masks and they had to be vaccinated or be tested every week.

What Strategies are Working Now?

JS explained that they had taught an eight-period day, teaching six classes, before the pandemic. When they finished the 2020 school year, they still had the six classes because they had started the year that way. In the fall, knowing it was going to be all online, the schedule changed to four classes per quarter and then switched to the four other classes for the next quarter. It was difficult for the students to sit still and do something when they had 80-minute class periods. Teachers had 25 to 30 students per class, plus a homeroom class. As JS noted,

> And then just trying to like, remember, so after you've never met these kids, and you barely see them online, and you haven't seen them for a quarter, and now they're back trying to remember who's who it was. It was very weird.

JS felt the return to the classroom was going okay and was more doable than 80 minutes. The strategy was to just settle down. Empirical studies may focus on strategies, but for a real teacher just setting a routine after two years of chaos can be a lot to handle.

CS planned to put all their assignments on Microsoft Teams and structured everything that way. They even had a lot of their instruction through Teams, though they eventually used Zoom and used Teams only for assignments. CS found that Teams did not work out some of the early bugs in coding, although they did later, which was helpful.

Online to F2F Strategies

The most challenging part in this transition was trying to reconnect to the students. JS thought that blogging would still be a big part of instruction, because it worked well online, but it did not work well when students returned to classes. That was a failure and JS thought that students were so burned out with online stuff they did not want more online activities. When they were all online it seemed more like a community of learners, which they would feel in their classroom.

Everyone in the tech industry has tried to become more collaborative and JR wanted more collaboration in the classroom. They wanted to recreate that collaboration from the online class to the classroom, but it was awkward with masks and the crazy student behaviors. That was the biggest thing they were trying to hang on to.

JS mentioned that with the threat of violence they were not allowed to have more than one student outside of the class at a time, and their attention was distracted by the bad behaviors. They felt they lacked skills to deal with student misbehavior, because they never had to teach students to stay in class until the bell rings. They had always just taught, not dealt with classroom behavior such as when students did not clean up after themselves. JS expected that when they were online and connecting with the whole class that it would continue when they began to meet face-to-face. JS made name tents and students wrote their name on the tents and on the inside of the tents the students would write whatever they wanted to tell the teacher each day. And then every day the teacher would read each one of them and responded to them. JS meant for it to be a way to get input from the students about what they wanted to discuss. At first that worked with students but later dwindled off.

In the face-to-face classes at JS's school, Wednesday was a non-student day so teachers could focus on lesson plans and other communications, and the students were given asynchronous assignments. JS's courses were very hands-on so those lesson plans were challenging if students had to be home. JS said, "So part of that what I was just thinking about was, we couldn't expect that students even had scissors at home, there was like, no, no supplies. So you had to really think about what projects in my stuff is all hands on, I have, like, vinyl cutter and a laser cutter." Since they built things in these courses, students needed supplies and it was difficult to organize the teaching. While JS was teaching one group of students, they had to plan for the next group and the project they would do. That meant buying the supplies and keeping them ready so students could pick them up a week before the project started. Parents and students were constantly coming in to pick up their English book or art supplies or the supplies for a project. This was like a cycle, constantly decoding what to do next, getting stuff ready for that, and putting everything in packets.

Unfortunately, there were students who were not connected or interested enough and had to be constantly reminded to come and pick up their stuff. JS said,

> So you know, I'd say, okay, you know, 10 of you still haven't picked up your supplies, and we need to start this project on Tuesday. So come and get them and, and then, like I said, there were people checking in, and lots of teachers and counselors and admins were dropping off all of these supplies to the students. So that was pretty cool. And then, you know, sometimes that worked.

Sometimes it was difficult. For example, one student had to go to India and needed to check out a camera. In class they usually shared cameras so there were not enough for individual borrowing. JS had to buy a whole set of cameras for the class, always with the thought that they might not come back to class. The cameras came back the next semester, although some had missing chargers, but the most difficult part was that the instructions for using the cameras were in Japanese so they had to switch the language in the cameras.

Fallout: Challenges to Teaching

There are more challenges when teaching online than only the technology not working or having to learn new online software. Let us see what some of the teachers say that is not often reflected in the research literature.

Bomb Threats

Teachers try to understand their students' situation under stressful circumstances. In this new school, this kid had not made any friends and he was lonely. The teachers had even discussed the student who threatened with guns and bombs in JS' class in their meetings, because teachers have students on their radar. He was a 10th grader and had not yet met the teachers face-to-face and the teachers did not know a lot about his background and other family situation. All of October to December, the teachers were thinking they were making connections with him and then the bomb threats happen.

JS told the principal they thought it was this student and sent the principal the email exchanges the teachers were having about the student that also mentioned some of the other problems he had caused in classes. In the face of all this, the student kept sending the threats, but the police did not know how to catch him doing it.

While talking to JS I could not imagine what they must have gone through. The police were combing the classroom to see if the bomb was left there or not. The first day of the investigation the police found a gun in a kid's bag. It was an airsoft gun and had nothing to do with all this. Later this kid was found by the police. But JS questioned, "It was really traumatic and just trying to talk to my class about like, how do you come back from that? How you were, you were framed, and you were terrorized? The most of the whole school? And this is all things that I've never thought about before."

JR also experienced similar threats to other students by students. There was one student, who during the whole of the online teaching maybe connected to JR only three times. They sent out messages like, "I am going to kill you." Because it was digital, JR had evidence of it. When JR talked to the administrators, they said they would talk to the student, but they did not so JR had to. They had a meeting with the family, and they said he was angry with the other student because they misspelled his name. For that he threatened everybody. JR told the family that there would have to be a police investigation and the kid said that he would take a knife and kill the police investigators. Still the school did not take any action. The administrators told JR it was a minor issue and they could handle the kid. JR also mentioned that when a fourth grader was misbehaving and he was taking the student to the office, the kid actually punched him in the face. The kid was yelling and kicking away. JR had to restrain the kid and just took him to the principal's office and said they did not want this kid in their class.

My thoughts after hearing all this was that I never hear about these experiences from the literature I read or in any journalistic papers. The teachers need an avenue to get it all out, for people to know about all this. These are terrifying and frightening experiences that they must keep pent up within themselves because no one is willing to listen.

Media

More challenges appeared for teachers in form of media disruptions. During online teaching there had been occasions with the "black boxes" on Zoom or Google Classrooms when students logged in but were "invisible," but that affected only the people in the class. But when students returned to the physical classrooms there was uncouth behavior from the students. For example, JS's sweatshirt was stolen and there were the "devious licks" of vandalism on TikTok.

Student Behavior

JR believed that the students' behavior when coming back to school had become increasingly notorious because the students could behave badly without repercussions. JS mentioned the same types of behaviors, such as students messing with computers and stealing. There also were no consequences for poor work on assignments; the students didn't worry they would fail a grade. JR tried to help the students understand the meaning of a school and why they were there.

> Why do we have schools, and we say, the school is a place to prepare you for your adult life, say, we have to prepare the kids for the adult life.

For the students' education to be robust, it needed the support of parents, as well.

JR tried a unique approach to engage students once they returned to class to hold them accountable and make them behave in a responsible manner. Every student would have a different job and be paid in "school money" they could use to buy things from the school store. To be hired, the student had to apply and write a cover letter to JR. If more than one student was applying for the same job there would be an interview where they had to explain why they were applying for the job, what made them the better candidate, and so on. If the students did not do their jobs responsibly for two days, that would be overlooked, but on the third day of this behavior, they would be fired and not get paid. Like in the real world, different jobs had different salaries. The students understood that in the real world they will be fired if they did not perform. JR said, "And I always tell them, the first thing I teach. The second time, I warned them, the third time, they have the consequences." There were students who were doing great jobs, such as a creative student who was the classroom decorator.

JR believed, like other teachers I spoke to in the course of my study, that student behaviors have significant bearing on the consequences they have to face. JR's school district did not have any consequences for failing grades, missing assignments, or even obnoxious behavior. For example, one student had not submitted anything the entire year. The school administration said it is not that the students cannot do the assignments, they just chose not to do it. So, it was both that students chose not to do the assignments and the administration chose not to punish the students. So, in both ways the teachers were not being supported and the administration rather than supporting the teachers, supported the students' behavior. This response from the administration was disappointing because teachers could not enforce rules.

Parent Community

JR, like many other teachers, expected more support from the parent community. In the first year of the school closure, parents were saturated with emails and messages from the schools and teachers. Parents would duly answer. But when the school returned to face-to-face classes, parents would not answer. For example, JR sent information to a family about their child who was not submitting assignments. The family said that their kid complained that he was being forced to talk to everyone. They were supposed to respond to basic questions, like what's your favorite color or book or game? JR told them that this was one of the standards to pass the sixth grade but they did not force the kid to talk and gave him the option of recording a video and submitting it, instead.

The school used Tyler™, a platform for communication, for parent communication and however many messages JR left for parents, no one would respond. Before the pandemic, JR's efforts have been to engage students. They had a Youtube™ channel with live streaming for students to join - https://www.youtube.com/watch?v=tDJ3KIOia38 and https://www.youtube.com/channel/UCz7LHduFzQArrYtQ36hQAzg. And that was really hard because it was like a TV show six hour long every day that they had to have content for six hours. So, student engagement has remained an issue of huge magnitude and the pandemic situation has only worsened it. Parents also did not encourage their students to watch this channel or maybe they were too tired to pay attention to what the students were doing at home.

JR wondered how, when both the parents and students were at home during the COVID-19 pandemic, the parents did not notice that the kids were playing all day and not attending their online classes? The parents needed to be more alert. JR understood that parents had a lot going on but they still needed to be vigilant about their own kids.

Teachers Leaving

JR thought that in the coming years the school system as a whole would face a huge problem because the good teachers were quitting. They were overworked with no help or support, not paid extra for the extra work they did, and their basic pay was very low. Teachers said, as JR reported, "I will find a new job, even I don't know, as the garbage man, I don't care. Another job. And some other teachers telling the same thing. And the good teachers do. They say, I don't care, I will go to for a week, or I will go to Walmart to work there. I don't care it will be better." So why did JR go to school every day? Their families had always been in the teaching profession, for one thing, and they went to school for their colleagues and their students. Even though the students said, II hate school," JR kept trying to engage and educate the students. Occasionally they would get support from the school administrators, such as an administrator what resources were needed for their classes. That was very encouraging and teachers need this support and encouragement to go on.

Teachers are People, Too

Teachers have been overworked, especially during the pandemic. This is no news. Their sleep was disturbed, they were under tremendous stress, they did not switch off from technology. The community of parents, students, and school administration have thanked them for all that they did. But were they asked about their wellness? Had they been thought of as human beings who experience physical and mental tiredness, emotional disbalance, helplessness, loss of professional development, not being able to provide for their family, and so many other things. How they taught during the COVID-19 pandemic was studied, what technologies they used, what worked, and what did not. But were they well?

Doing Well

Doing well means different things to different people. JR felt that just being alive sometimes can mean doing well. They were happy with their job because they were good at it and that also was part of being well, for them. They spent their own money to buy games and other equipment expecting to receive a grant but they were never reimbursed. However, there was a limit to what they could do for their students and they learned not to feel guilty about it. That also helped them to stay well, emotionally, and on a scale of one to ten they rated themselves a five or a six.

SD thought they were doing well by staying at home, although they wondered if they may have become a little lazy. The workload did not decrease; in fact, to prepare study materials and resources for online classes and deliver lectures required more planning. SD rated themselves a seven or an eight on a one to ten scale for wellness. They felt that the support they garnered from the school administration, colleagues, and even students was very important for their wellbeing. Additionally, almost any information about the new online platforms for teaching was available online or on Youtube™ so that felt so helpful to SD if they had to learn any new technology.

VS was very stressed about their job so wellness-wise they rated themselves as a six or seven. They thought that even though they went back to the physical classroom they had to be prepared to go back online at any time.

> Um, I had to I have to be prepared to go virtually. So I so that's something that I still have to be conscious of. Even though I'm back in the classroom, with the omicron and the cases rising, I have to be prepared to go virtually at any time. So I have to have like a backup plan and I had to be ready to go. So it's not something that I can when I had when we have a pandemic the school took off a week we had a week to prepare. So we were able to get lesson plans started to get the devices in hands and things of that sort. Now if we go virtual, it's going to happen the day of and I have to pull out my virtual lesson plans as they go. So like everything will be on for example, like Google Classroom. On Google Docs, I have to have that prepared. So that takes some extra time. Especially if I'm moving from different subject matter. I have to have classroom plans and then I have to have although a lot of those are similar in terms of like what videos we might watch or the concept might be it. It takes an extra step to transfer it from my classroom lesson plans to the virtual lesson plans.

JS found everything quite challenging. One good thing was that they received a fellowship for practicing equity in computer science, and that was great for motivation. They participated in a national group that got together and were all very positive. That was their self-care, to be in those meetings and working on national issues. In their own classroom, they hoped to work on inclusion in diversity issues, but the real question was about how to connect with students that do not even want to be in the classroom. JS had a lot more support in their school with people who were ready to give teachers a break when they needed one so that there was a supervising adult in the classroom. That created a feeling of wellbeing for JS. But otherwise, the class was moving at a slower pace than ever before. Even face-to-face it was nothing like the pre-pandemic times. JS said emphatically, "I don't think I don't know that we'll ever go back to the pre-pandemic life that I didn't even know how good I had it back then." Everything was very stressful, with the added baggage of a lot of meetings and dealing with policy changes, for example.

Their home scenario also changed when their son went off to college. What I heard in her responses was a lot going on at the same time and the feeling of being extremely overwhelmed. It was good, however, to hear that amongst all this they were trying to do well. Another thing they mentioned that helped them do well was meditation. On the wellness scale they rated themselves a five because they felt they were going through a lot and not feeling good about it. They felt that, compared to a lot of people, they did not have to be perfect.

CS felt that when they were teaching at home, they had time for exercising and eating and drinking well. Later, time at school was critical, so they were gaining weight and it was not good for them psychologically and emotionally draining. Additionally, they spent an extra two hours at work that they were not paid for. They said something very important:

> Not only is everything psychology draining for teachers, but teachers have to wear different hats. And you know, some of the mental health issues of the kids are difficult so you end up being a counselor. You end up being you know, definitely a teacher, you end up having to be a master mind at motivating and coaching. Coaching meaning, you know, sort of emotionally support them and in give them some, some ways that they can do things differently and then put out there something that that they can shoot for, whether it's college or or what have you. So that's been very draining. To say the least.

As mentioned, they rated themselves a five on the wellness scale. When at home, eating right and drinking a lot of water helped them cope physically and emotionally, but it was rough overall with news of fires and flooding coming in.

Critical Incident Components

The critical event analysis method has a critical incident component. This includes probes about what factors helped the participants with their self-care and hindering factors that challenged their self-care. It also explores items that may be on a participants' wish list were such a pandemic-like situation happen again that could impact education in many unknown ways. The following sections discuss the findings related to these factors.

Critical Incidents

Teachers found that there were some critical incidents or components (Butterfield et al., 2009) that helped them do better in terms of emotional health and their work during the COVID-19 pandemic. Some of those are described below. Teachers responded differently about what were critical factors for them and let their voices be heard.

Self-care

Self-care is the crux of being able to do one's work well. JS took two online self-care classes and started reading books on happiness. There was also an equity fellowship they received and that made a positive difference to how they viewed their work. This kind of validation makes one more motivated to do better. They took a break over Christmas and responded to student emails sparingly because their "me time" was critical. Of course, there was anxiety about the news of forest fires, flooding, and the weather, but these methods helped them to stay grounded. CS added that exercises and eating and drinking a lot of water to keep hydrated was a key factor in how well they did their job.

Administrative Support

CS and SD both responded that supportive colleagues and any support from the administration made a huge difference in their ability to teach online during a pandemic phase. It reflected the trust that school had on teachers and encouraged them to engage more with the students.

Teacher Flexibility

Teachers need to be ready with backup plans constantly and not only in the context of online teaching if technology does not work on a certain day. This kind of flexibility that teachers develop, VS thought, was a critical component in their success. A teacher's Tuesday is not going to be the same as their Wednesday. It is said that in a day, teachers make more decisions than a surgeon makes. VS told me,

> In a day, teachers are constantly maneuvering and shifting and learning new things and how to do something. So I think that strategy that I that I had has prepared me to do well in the pandemic. I wasn't always successful, but there but you know, as I said, my Tuesday was different than my Wednesday. So I had success and I had failures. So I've learned from them. If I'm a good teacher, I know that I have a good rapport with my students. That's definite. My test scores are not as high as I like to be but then again, where we were going, that's another subject. But six or seven was is me being honest, and saying, I have good days and bad days, and this is where I'm at right now. And I'm doing the best I can to adjust in the pandemic.

JS also began getting more flexible in order to understand what students wanted to learn. What can I do to get your interest?" Though they were unable to reach all the students, at the beginning of the pandemic students were more engaged but that gradually diminished. JS also brought up the issue of special education students, like her son.

> And my son was in special ed. So I kept on thinking about him. And you know, if he was in this situation, what would I want the teacher to do to try and wrap around him and get him to do things, but there wasn't really a lot that that worked? Yeah, I just tried to try to talk to them and reassure them that I'll accept whatever you want to do, you know, what, what part of the class? Did this look interesting? You could go back and do that part, you know, or how about this one and, and then when they finally came in face to face, a lot of those kids that were not connected, we kind of trickled them in. So the ones that were failing, were the first ones that we had in class. So then, you know, you only have like two kids. So you could say like, really? Okay, let's let's do this and try to put lots of energy into those kids. And because the bar was set, so low for passing, it did work to get most kids did still pass just getting something through there. But it definitely wasn't the same experience they would ever have in that class again.

It was crucial that teachers were thinking of them because in the chaos of things it was easy to overlook so many things that were critical.

Support from Colleagues and Students

Though many teachers did not receive support from school administrators, they always found that support in their school colleagues. JR went to the extent of mentioning that on days when it was difficult to be motivated to go to school, they would do it only for their colleagues. This showed that we may take it for granted that teachers will show up in school no matter what, but they too have bad days and good days and need that motivation to show up. SD said to me,

> There was complete assistance from my co teachers from my colleagues. From school fraternity from each and every one of us, and with time the students also went very well equipped with this methodology. They started doing more than the teachers you know, sometimes the students also helped us a lot of slowly and gently they mastered the content.

CS also corroborated the feeling that supportive colleagues and any support from the administration made a huge difference to how well teachers were able to teach online during a pandemic phase.

Hindering Incidents

Teachers found that there were critical incidents that hindered them from doing the best they could during the COVID-19 pandemic. These are called hindering incidents (Butterfield et al., 2009). Teachers responded differently regarding the most hindering factor for them and a few examples are discussed below. This is a way of letting teacher voices be heard and validated.

Technology Skills

Teachers started teaching online during the COVID-19 pandemic almost overnight, scrambling together the resources they had. There was really no time for them at that point to plan out how this online teaching would look or even assess if they had the necessary skills to be teaching online. All of the participant teachers mentioned that they had to be up to speed on how to use the internet and different other technology platforms. A few schools provided some scant training, but largely they were left on their own to learn the new technologies.

This is not to say they had never used technology before, but navigating online teaching, deciding how to put resources online, how to engage students online, and how to conduct online assessments was all different. VS stated,

> I think my my ability to do well on the internet was I mean, I can run, I know how to show videos and stuff in class. I know how to, to look at test, test data on the internet. I know how to do the basic stuff that you do when you're in the classroom, but to deliver lessons online, to learn how to use Zoom, or all these other formats, platforms that became available to us during the pandemic, I had no, I had no background, I had no schema. So that's where it took a lot of ingenuity and willingness to learn. Because if I didn't have that, I would not have been successful when I'm able to do my job. So having to jump in and get my feet wet, so to speak. And make make some wrong clicks here and there. What was it was a big learning experience.

Managing Student Behavior

High school teachers often find it exhausting to put up with immature elementary or middle-school behavior. JS told me,

> I think we just don't have the skills. I'm, I've always been a high school teacher. And so these kids coming in with middle school behaviors or elementary school behaviors, and we really don't know what to do. We don't know what to do. So I'm being told that I can get help. But I don't even know what the help would, would be. And I don't think anyone

does. So all of these crazy behaviors and kids just not being ready to learn in our classes has been really, really hard. Yes, yeah**.**

Internet Access

In SD's school district, they were still struggling to provide students with internet access and personal devices. SD said, "There were instances in which a lot of like, internet connection, proper establishment of data and everything which is to be presented to the students, which was a little intense, and especially like the internet sometimes, you know, because of weather thing, the internet connections are not very good."

Software Bugs

SD also mentioned that initially when everyone was trying to use Zoom, Microsoft Teams, and Google Classrooms, they had problems with bugs in the coding which is why there were a lot of Zoom bombings that disrupted classes. Later these companies solved those issues and using the systems became more routine. SD observed that,

> Google Meet™ in the very beginning had some problems. Zoom™ in, in the mid time also had some privacy issues that you must be knowing about it. Yes. So when encryption problems they had and now things are okay, they have their lockers have blocked on it, and now they are now that's all fine. Okay. No more.

Helping Students and Their Families

Some teachers like CS felt extremely uncomfortable that they were limited in their ability to help students and their families. In such situations they turned to God.

> Ahh hindering factors. Well, just just the fact that you go to sleep every night and you still got a lot of kids on your mind. Your brain is just constantly moving, trying to figure out how can I save this kid you know, what can I do here? And I really love kids and it's, it makes me cry to think about, you know, what's, what's going on with some of our youth right now some of the difficulties that they're having and so on. So, you know, I go to prayer, I go to God and I would get on my knees and I pray for some of these kids. Because it just I couldn't help them. There's no way I could help them. And so I went to the Father in heaven, say, kids, let the kids have strength, you know. And so that that was something that I would do on a regular basis.

CS also tried to connect to families of students by visiting them. There were many single parents and they were struggling at this time. CS tried to help them, at least listen to them in these critical times. Sometimes if someone listens it makes a lot of difference. In this study that is what I aimed to do, to lend the teachers my ears. CS mentioned,

> Sometimes you talk with a parent and then the in and I'd say, you know, what can I do to help motivate them or what can I do in in and they would give me some clues and that would be that would be very helpful. But some some of the parents that I talked to were just say help the ship is sinking, you know? It feels like I'm going down with the ship. And it's so hard, hard for, for me to with parents that I had I need to be a support for parents as well. Especially some of these single parents out there. They're having having difficulty in their own life as well, you know, and, and so, here's another thing that's that. That's hard to stomach. That is that when kids are abused, you know, it's it's, it's we're in person, we kind of know how to handle that. But when kids are remote learning and you know, and you don't, there's maybe more abuse taking place that you don't know about,

> which makes it hard to stomach as well. So so that's that's why I go to my knees in prayer, because those are things that I can't deal with, you know, unless I know about it. So yeah, that's that's the darker side of it. But you know, that's that's the honest side of it.

I feel like CS's presence in these families' lives saved them from that "sinking with the ship feeling," someone to hold on to is what they gave the families. CS explained:

> Yes. Yes. So one of the families for example, their apartment complex and I went out to this is a single mom and she's got four kids. And you know, I think I had her in school also she said that Yeah, I had you for for a class in school and I in so I said that must have been way back when I started at Bellingham at my school. And she goes, Oh, yeah, it was hit a sibling rivalry. And so you know, it's it's I've taught for a long time. Some of these parents are students that I did have and so it just it was good. In that case, I was able to her son really had it was really hard. For him to open up in class. And it's so that really helped me with him, especially and he did open up in class and it was very I could see that this was going to be a good thing, but it just it's tiring. You know, it just wears teachers out to have to do these little things.

Hindsight 20/20: Wish List Items

Wish list (WL) items include people, supports, information, programs, and circumstances that were not present at the time of the participant's critical experience, but that they believed would have been helpful. For this study, these WL items might have been useful for the teacher participants to cope with teaching inline during the COVID-19 pandemic.

Administrative Support to Teachers

Most of the participants stated that they had expected more administrative assistance and support from the school and school district. Teacher JS said that these supports could have been in the form of giving teachers more time to draw up and finalize their lesson plans or designing the scaffolding for teachers who taught multiple courses and grade levels. It was especially true for them because much of what they taught was hands-on. One teacher, VS, said, "I understand that administration was in a bind themselves, and they were making decisions based on the minute and we had to go with it. But I didn't feel supported as much as I would have liked by administration." Another teacher, JS, mentioned that in their school district students were not allowed to use cell phones within classrooms, but when a teacher tried to enforce that rule in the classroom, they got a letter in their file. Schools also did not enforce any consequences for students during the COVID-19 online schooling period who did not complete a single assignment.

While many teachers did not feel supported by school administrators, there were teachers like SD who felt extremely supported by the administration, be it with the availability of technology they needed or the training to learn new skills. This difference in teacher voices reflects the differences in school districts, their resources, and their willingness to support the teachers. These voices, be they similar or dissimilar, need to be amplified so they do not get buried under larger narratives that gained momentum during the COVID-19 pandemic. One example of those distracting narratives was that of questioning whether online remote teaching was a success or a failure and how technology was used during online teaching.

Parental Support to Teachers

Teachers continued to say that they expected that parents would have been more supportive. VS observed that parents were appreciative at the beginning of the virtual learning and recognized that the teachers had a difficult job. But once students began trickling back to the physical classrooms, that appreciation seemed to dwindle. VS gave an example of what was going on with the Chicago school system where parents were going head-to-head with the teachers' union. That was not a healthy circumstance.

Teachers realized they needed to get the children back to school and VS, as a parent, understood that. Teachers who were also parents had to figure things out at their home and their school, but they needed that parental support to help guide the virtual learning and the gradual return of children to school. It was not easy when the parents are not at least "gracious in understanding what kind of predicament or pickle that we're in," according to VS. Everyone was in it together trying to teach the students.

Another teacher, JR, also mentioned that they had a fallout with the school administration when a parent reported that they were forcing a student to complete an assignment, when the student had not completed one single assignment throughout the year. Parents even pulled their students out of school if they were required to sanitize the stuff they used.

Professional Development for Teachers

Many of the teachers mentioned that some form of professional development on online teaching tools, strategies, and pedagogies would have been really beneficial to them when they began teaching online during the start of the COVID-19 pandemic. They had no idea how long it would go on for and as time went by they gradually found it very difficult to continue teaching online. In-depth professional development could have been provided to teachers based on what they really needed. For example, CS said they needed more practice and knowledge in accessing stuff online. They also needed to remember the needs of the students, but when helping over 150 students, better technological skills would have come in very handy, they felt. VS also said that they wished they could have had more preparation.

Proper Vaccination Procedures Declared

School districts had to have very specific vaccination procedures. This enabled teachers to invite volunteers to help them with classroom management, parental communications, and help with scaffolding. JS said, I teach six different classes, so there isn't, there's not really time to go like today's lesson plan for this one, here's how I'm going to teach it to this section of the class, here's what this section of the class is going to. So more time more support for that….They (the volunteers) don't have to be experts in my curriculum, but just behavioral management help would be really nice, so that I can help those middle of the road kids. The teacher's frustration at not being able to garner any additional help with their massive workload comes through in their tone and voice. They felt that with everything they had to do they really had very little time left for actual teaching which was their primary job. School administration, parents and students need to really validate these kinds of emotions.

School Systems

Teachers deserved to know how the school system was being run during the pandemic and their knowledge about the curriculum and the students should have been taken into consideration. JR, a bilingual teacher, was asked by the school district to chart out their online teaching plan and when it was rolled out it was the complete opposite of what JR had designed. Teachers' expertise must be respected or the school system could end up in a disaster. VS noted,

> I think that's something that we need to look at in case something like this happens again, or if this is something that's going to become a permanent part of, of who we are as an education foundation here in the school systems. I think it's probably gonna be here to setting I think it's gonna be permanent. I think. That's my personal opinion. And I think that the value lessons or the lessons that I value that I've learned firsthand, I think have really helped change that perspective. Because I think my perspective would have been quite the opposite had it not had this been pre-pandemic?

JR thought that in the coming years the school system as a whole would face a huge problem because good teachers were quitting and the people who replaced them were, in most cases, not qualified to be teachers. They just did not have those credentials. "We are leaving our children to people who are not qualified to be teachers. Would we do the same with doctors or even car mechanics?" JR asked. It was an earnest question that this nation must think about profoundly. What can be done to rectify the situation of teachers leaving in droves and employing others without teacher credentials? JR had a sick day and had to visit the doctor. Coming back to school they heard from students and other teachers that the substitute teacher in their class was sleeping. There was no one to check on what they were doing. In that school the substitute teacher could have a high school diploma or a college degree, but how could they be expected to manage a class of rowdy kids? In whose hands are leaving our kids and who can at least manage them in a controlled environment?

On top of this, some schools force teachers to teach subjects they are not qualified or ready for because the schools do not have enough teachers. JR had a coworker studying to be a teacher who was a teacher's aide. She was forced to teach Spanish then they coerced her into teaching math. She repeatedly said she did not feel ready because she felt she did not have the knowledge to be teaching math. But the administration forced her, nonetheless. Was this completely legal?

Webinars

During the COVID-19 pandemic, seminars were replaced by webinars and they became very popular. Both SD and VS used and made their students participate in a lot of webinars. Webinars where international students also joined removed the geographical boundaries and made them feel very connected. SD said,

> Yeah, getting getting in touch with students all across the globe, you know, it was not possible for me to deny they were things would have been offline. So taking webinars because theoretical webinar doing webinars with students all across the globe was was a dream for me and talking to different students of different culture, students of different religions, and all across the globe. Was the was the best thing that I had. That was almost like a dream.

Chapter Summary

In this chapter I described my findings under different themes and categories. I have tried to substantiate these findings with actual teacher voices from the transcripts and offered my own understanding about these conversations. In the next chapter I will complete my discussion of the findings and write about the study's implications, the limitations of the research, and my conclusions.

CHAPTER FIVE: DISCUSSION, IMPLICATIONS, LIMITATIONS AND CONCLUSION

In this chapter, I discuss the main themes of the findings in relation to conceptual and theoretical frameworks and the extant literature about secondary teachers' experiences while teaching and learning during the COVID-19 pandemic. I contend that teachers' voices often went unheard and remained in the background of seemingly more critical research questions pertaining to technology use or school policies during this time. I then argue that teachers' voices are critical in our understanding of a larger and, at the same time more in-depth, picture of education during the COVID-19 pandemic. I examine implications of this dissertation study in terms of research and practice, discuss the limitations of the study, suggest recommendations and contribution to literature and finally present my conclusions.

Discussion

Though the COVID-19 pandemic needs no separate introduction, I will begin my discussion by saying that it actually started spreading by the late months of 2019 and by March 2020 had spread all over the world and had in an unprecedented manner impacted the education sector. From elementary to tertiary levels, educators were in a bind as to how to continue instruction for their students. It was obvious that since schools had already closed, students had to continue their education in a distance education manner and because of the availability of online learning, most educators reverted to *emergency remote learning* through an online format. This study is situated in a space when COVID-19 pandemic is fading out. Conceptually, I have placed this study within the Emergency Remote Teaching Environment (ERTE) framework as it offers me a model of how K-12 teachers may have shifted their entire teaching to an online platform by inquiring into the existing circumstances of the students primarily, and the teaching resources they have, classifying what resources can be moved online immediately, attempting to design an online teaching plan and format to engage students and also evaluate their experiences. In this study through their experiences, my participant teachers have spoken about all these phases mentioned above and their voices have become the instrument through which I have tried to understand the enormity and the breadth of the COVID-19 pandemic. However, in this discussion I will very loosely associate with this conceptual framework so it does not limit what I have heard and learnt from my participant teachers and gives me the opportunity to discuss it beyond the walls of this framework.

I have also used a theoretical framework, the Strategic Teaching Framework (STF) (Jones et l., 1993) to help explore the relationships among related components (Ravitch & Riggan, 2017). This has enabled me to contribute richly to my understanding of the teachers' perspectives and sense-making of the data (Neuman, 1997) while not limiting the data to the confines of the framework. Therefore, the data in this study will not be bound or limited within the framework but freed up to create new meanings and to assign weight and significance to teachers' voices, feelings, and emotions. Some of the components that are common between both the STF and this study are the goals that drive the learning and instruction, learner characteristics, teacher characteristics, tasks that define the nature and level of achievement, school context, and principles of assessment. These component tie in a way in this study where I might see that during the COVID-19 pandemic situation, the primary goals of the educators are not to complete the curriculum but to keep in touch with the students, bond with them, reassure them about the looming danger, engage them and support their mental health in a balanced way.

The student and teacher characteristics are crucial because they show how students are engaging in the online learning process and how teachers are also doing so with the level of technical expertise they have. The tasks talk about how teachers are redesigning the curriculum, setting new assignments, and trying to engage students through those assignments. The school context has been discussed under Findings as the support that school administrators are providing to their teachers. And of course, the assessments talk about how the schools are deciding to grade assessments.

Though all of my teacher participants mentioned that they have not experienced anything like the COVID-19 in their lifetimes, school closure and impediments to learning are not new in history. As I have stated in Chapter 2 (Literature Review), there already exists a long history of school closures (Ross-Hain, 2020) for reasons such as natural disasters, weather, political conflicts, threat of violence, war, refugee situations, pandemics, and health crises (Baytiyeh, 2019; Tsai et al., 2017; Wong et al., 2014). In some of these situations, there were efforts to continue student education. For example, during World War II, there were instances of using the mail service in France to send educational materials to students (Ross-Hain, 2020). Former versions of distance education would entail students completing assignments and mailing them to the instructor, receiving feedback, and incorporating feedback in the next assignment (Pryor et al., 2020). Some school closures occurred in 1957 during the respiratory virus and Asian influenza pandemic in the United Kingdom (Vynnycky & Edmunds, 2008). Similar school closures were again seen in 2009 during the novel H1N1 virus in the United Kingdom, Australia, Hong Kong, and Bangkok (Chieochansin et al., 2010; Effler et al., 2010; Wu et al., 2010). However, there is not much literature available on how students continued their education during these closures. In that respect the research that is ensuing about the continuance of education in the face of this pandemic is a novel effort. The 2020 school closures due to the COVID-19 pandemic were unique because schools and school districts made an almost overnight transition to *emergency remote teaching* to continue the education of their students. The US education system was not designed to deal with extended school closures like those during the COVID-19 pandemic.

The COVID-19 pandemic began in the late months of 2019 and by spring of 2020, in an effort to limit transmission of the virus, schools across the globe closed and transitioned to emergency online teaching (Jelińska & Paradowski, 2021). From what I heard from my participant teachers and the school districts they represented, they followed the plans laid out by the administration, though sometimes they responded that these plans did not work to the benefit of the students or did not even support them in ensuring student discipline. Recall that JR was asked by their school district to write about an online teaching plan, where they made sure that each student was cared for. However, when the actual plan was rolled out, they saw it was completely detrimental to student engagement during online learning. Another time, JS reported that when their colleague asked a student to put away their cell phone in class, the teacher instead got a letter in their file for disciplining the students. With incidents like these, teachers did not feel supported by their administration. To me it seemed that this added to the frustration and stress that they already were experiencing due to teaching and handling students online. Had they been supported by the administration, COVID-19 pandemic may have looked a little different in terms of how education was imparted.

Administrators cannot be totally blamed for this because school administrators, teachers, students, and even the parent community faced unprecedented disruption due to education during COVID-19 pandemic as it instigated multiple challenges for them. School administrators, district leaders, and principals had almost no training in managing schools during a crisis situation. They were as much in a chao as the rest of the school community and the students and their families. Teachers were now confined to their homes, their existing lesson plans falling short of the current needs, physically removed from their students, and quickly learning and transitioning to new technology platforms to continue teaching (Baird, 2020). For example, CS mentioned that at home they were able to take care of their physical health, like exercising regularly, drinking and eating healthy but while returning to school they could not maintain that meticulously and were gaining weight. So, it seemed to me that teaching from home in certain ways paid off better because teachers were able to spend time on self-care and that is an important component of staying well. With the humongous workload they had, the teachers that I talked to stated clearly that without some form of self-care they could not manage the stress that they were going through. Other teachers like JS mentioned that while at home, they read a lot about happiness and specified their work hours during Christmas to take some 'me time'. Though students kept emailing them the whole time, they made it a point to answer those emails at very specific times which they earmarked as 'work time'.

Of course, when schools were closing due to the pandemic, teachers were hit by a series of emotions that they described as insecurity, worry, lack of proper information and a sense of void. Some school districts did not have any specific plans for grading assignments or assessments and I recall JS saying that during the first few semesters of school closure, all the students were given A's. I understood from the tone of her voice that this was frustrating to them because they knew that some students put in more effort than others and then there were students who did not turn in even one assignment, so this kind of grading system was absolutely unfair for the students. But the teachers were not in a position to argue about these issues with the administration.

From the participant teachers' stories, we see the individual detail of what it meant to be faced with the challenge of emergency teaching and have no road map … the challenge permeated their personal lives and not just their professional time 'at work' lives. Some of the challenges that they described were being worried about the home situation of their students, especially if they belonged to a low-SES background. Issues about access to devices and the internet were taken care of during the first phase of the COVID-19 pandemic in most school districts. However, there were still students who did not have their personal devices, sharing deices with siblings or were facing food insecurities in their families. I remember JS telling me that representatives from their school would visit student homes with pizzas. What issues these solved I do not know, but it definitely gave students the understanding that their schools cared about their well-being. At a time like this, this kind of insight was crucial for the students. CS had also reported to me visiting students' homes to understand their home situation better so that they could design their online learning environment in a way that provided a kind of security to these students. They also mentioned having a long conversation with the mother of a student who was a single mother. To me this shows ways and means that teachers went beyond their regular duties to support their students. These stories bring out these in a way that would have been totally missed by bigger research questions like what technologies did your students use? Some teachers like SD were more buoyant than my other participants because they worked with students who belonged to a more stable financial background. So, they did not mention visiting students' homes or worrying too much about their home situations. So, these brought out the fact that all teachers did not react similarly to the pandemic situation. Some teachers, like CS, felt extremely uncomfortable at how limited they were in their ability to help students and their families. As mentioned, the pandemic exacerbated issues of poverty and financial well-being, and school-supplied meals that were a major source of nutritious foods were no longer available (Van Lancker & Parolin, 2020; Walters, 2020).

Studies in K-12 settings during the COVID-19 pandemic looked extensively at online learning, and student and teacher well-being. Dorn et al. (2020) discussed the learning losses that were happening during the pandemic that were especially pronounced for students from low socio-economic backgrounds and those with Black and Hispanic heritage. These students not only faced loss of learning, thus worsening the existing learning gaps, but many were forced to drop out for reasons such as family poverty, lack of learning space, or food insecurities (Dorn et al., 2020; Ferri et al., 2020). During school closures these inequalities were amplified by the lack of resources, including devices for online learning and stable internet connections; a lack of physical spaces to continue learning from home among students; and a lack of support for home-based learning for students from underserved, low-SES, or marginalized backgrounds (Ferri et al., 2020). To overcome these concerns, some researchers recommended that school districts provide improved access to the internet and other e-learning platforms for their students and provide continuous professional development opportunities for their teachers to learn online teaching strategies and pedagogies (Yusuf, 2020). These recommendations are aligned with the question of equity and inclusion that are central to *emergency remote teaching*.

Students' socio-emotional learning becomes critical at a time of crisis when they are removed from their usual learning environment, friends, and teachers. Venet (2020) outlined how teachers can stay connected to their students to ensure their emotional well-being and learning progress. Evidence suggests that when students do not go to school regularly (for example, during breaks or holidays) they become less active physically, engage in longer screen time, and experience food issues and irregular sleeping patterns that could result in weight gain and loss of cardiorespiratory fitness (Wang et al., 2020).

While the physical issues are worrisome, students' mental health can also be affected when they are at home during a pandemic. Stressors such as fear of infection, lengthy home confinement, boredom and frustration, a lack of information about the current situation, lack of in-person contact with classmates and teachers, financial anxiety at home, and lack of personal space may have adverse effects on children and adolescents and may affect their mental health (Wang et al., 2020). Sprang and Silman (2003) stated that children who have been quarantined experience post-traumatic stress four times more than children who have not been quarantined. The authors also mentioned that although there are many common factors between pandemics and other disasters, such as community impact, fatalities, and long-lasting effects, the response to pandemics is unique because being with others is discouraged resulting in isolation (Sprang & Silman, 2003). Quarantine can be associated with insomnia, feelings of grief, frustration, confusion, anxiety, and anger that students and teachers alike may have felt during the pandemic and that may have affected their learning and teaching (Brooks et al., 2020).

JR and VS were also very worried about their students but instead of visiting their homes they tried to keep in constant touch through emails. That of course, was another impediment, as parents simply did not answer emails. At the beginning of the COVID-19 pandemic, the parent community were extremely sympathetic about the teachers and praised their efforts a lot. But as they had to get back to work, they probably found less and less time to communicate with the teachers or even help their students with homework and assignments so whenever teachers wrote to them about a truant child, they ignored those communication. It seemed as though they were trying to express through their silence that the whole responsibility of the students' education and their behavior was the school's and the teacher's responsibility. JR went as far as to vent that probably parents thought of schools as some sort of daycare facility.

One of the most challenging issues that some of my teacher participants faced were regarding student behavior. Here I am not referring to juvenile behavior like messing with computer mice or stealing JS' t-shirt or even as JR said, completely disobeying to complete an assignment. What I am referring to is more serious and has no reference in literature. JS stated that they received bomb threats from a student and a threat to shoot and kill. I still cannot forget JS' voice as they narrated that incident. Their voice was literally shaking, and they were hugging themselves as if protecting themselves from those memories. As a mother myself, I cannot imagine what the teacher and students might have gone through, being incarcerated in a classroom for hours, while the police were searching the entire school building, to the point that the teachers were thinking that they should have buckets in the classroom for the students' bodily needs so that they would not have to leave the classroom. Such stories are fearful but true and would have been unheard had not the teachers spoken openly about it. JR also mentioned disobedient students and one class that actually refused to do one assignment completely. These stories are unique and have not made it to the current literature, but it paints a more truthful picture of education during the COVID-19 pandemic.

During these student disobediences, my participant teachers mentioned explicitly that they did not receive any support from their school administration. So, I agreed completely that technology and online teaching will have more impact on student achievement when schools adapt to instructional changes according to the platform they are teaching in and how teachers are supported in these efforts (Barbour, 2012). When JR told them about one particular student who did not answer certain verbal questions that were part of a standard and was tied to the promotion of the student to the next grade, the administration said that probably the kid knew the answer but did not want to tell it. In my span of work as a researcher and a former teacher myself, I have really not heard a funnier answer. They paid no attention to the fact that this was tied to the promotion of the student because it was probably decided that all students would be promoted no matter what. JS and VS had mentioned that their schools had decided that all students would be promoted even if they had attempted one assignment only, throughout the academic year. Efforts to talk to the parents also fell flat. About this single student that JR had mentioned, when the parents came to talk to JR they said that probably the student did not understand the question. JR said they did not know how to react. The student did not understand the meaning of questions like 'What is your favorite color'? JR said that they really had nothing to say to this. High school teachers often find it exhausting to deal with immature elementary or middle-school behavior. JS told me that as high school teachers they probably did not have the skills needed to handle immature student behavior or classroom disruptions. JR reported similar feelings and they both felt that incidents like bomb threats or classroom vandalism were ultimately a result of juvenile student behavior. However, I did not find any relevant literature on this and feel this finding is an important contribution to the understanding of education in a crisis situation.

Literature mentions that under the disorderly circumstances of the pandemic, school leaders and administrators had to address the significant change in pedagogies and teaching formats teachers needed to adapt to almost overnight, while using new tools and new time management strategies (Vu et al., 2020). But it does not mention these small snippets where teachers found themselves abandoned by the administration. JR mentioned that when they bought some games for their classroom because they were told they received a grant and would be reimbursed; the reimbursement process was very complicated. These experiences are worth being added to the knowledge base of literature so that audiences can read about a true picture that took place during the COVID-19 pandemic. I felt that during these stressing times the least the teachers could count on was support from their school administrators and support from the parents because the students were at home and without constant communication with the parents the teachers would not know

When talking to my participant teachers it was clear to me that they were highly stressed. In literature I had read about somatic burden (Ryan and Deci, 2017) that teachers might be experiencing. Though my respondents did not mention about somatic or sleep related issues, they vented a lot about emotional exhaustion, and stress-related change (Ryan and Deci, 2017). In fact, because I was in Zoom call I could actually see how tired they looked. They would yawn and stretch often and it made me understand the tremendous physical and emotional stress they were experiencing. Ryan and Deci (2017) investigated the roles of two forms of leadership that may impact teacher performance, autonomy-supportive and autonomy-thwarting leadership, factors that may impact personal workplace buoyancy. Collie (2021) sought to explore these leadership types and personal resources like workplace buoyancy as predictors of teachers' stress outcomes during the COVID-19 pandemic. To me it seemed like their performance as teachers though were not impacted by autonomy-supportive leadership while they also did not display any form of autonomy-thwarting leadership factors. To me it seemed like they used their own workplace buoyancy (Collie, 2021) to keep performing at their best.

Sometimes the strategies that teachers used while teaching were very successful and other times they were not. JR thought that traditional learning strategies like copying answers or just plain calculation did not work well unless the students were given the reason behind why they were doing that. JS would go into the classroom and cut out things on the latest laser cutter. It was similar to the bridge project and students didn't understand how it would work. The logistics were difficult because by the time students asked questions about the activity JS would already be in the classroom ready to cut it out and it became a long process of going back and forth. These examples tell other teachers that the effort matters, not the outcome. If teachers are motivated to try new different things, their students understand that kind of effort and put it back in their work.

VS felt that the most challenging thing was to get the students to put their cameras on; it was difficult to teach to a black screen with just names showing. Most of the teachers mentioned this issue and agreed with this. CS felt that their inability to be nimble with internet access was an obstacle. They often struggled to access information online. Therefore, continuous PD opportunities are crucial to keep teachers updated on online teaching strategies. JS was very positive even about teaching strategies that were a wreck simply because the students enjoyed the process. To them, that was crucial. One example was when the students participated in a bridge building activity that was discussed in the previous chapter. As a researcher, I understand the success of a teaching activity does not depend on whether students are able to complete that activity correctly, but what they are learning in the process. Literature does not include such incidents where instructional strategies are a total failure. Working on Zoom™ was frustrating in courses that required hand-on activities and learning. More challenges appeared for teachers in the form of media disruptions. During online teaching there were often "black boxes" as I mentioned above, on Zoom™ or Google Classrooms™ when students logged in but were "invisible."

While teachers like JS experienced intense frustration, other teachers said students were very understanding of the fact that this was all a trial-and-error process. SD said, “The students were flexible. They also understood the situation, that it was an experimenting time for all of us … and things only went better. … It never went from good to worse. It always went from worse to good.” These stories make teaching and learning during the COVID-19 more palpable and relatable to other teachers who were not able to speak about their experiences. But all was not so gloomy. CS mentioned that their strategy was to present themselves to students as another vulnerable human being. That, they thought, would help students relate to them. This may not be an instructional strategy, technically speaking, but it worked well with the students because it was relatable to them. Again, this was not mentioned in the literature. VS noted that because they taught math, a conceptual subject, they used a whiteboard frequently. Sometimes they used digital whiteboards while at other times they would video record themselves while solving a math problem in front of the physical whiteboard in the classroom. SD, who also taught high school math, mentioned using whiteboards frequently and supplementing it with websites like Khan Academy™ to help students conceptualize a problem. That helped to show multiple ways to solve problems. Similarly, whiteboards, though they seem to be very popular, were not mentioned in literature. JR understood that middle school students are interested in video games, so they used gamification strategies and some online board games to motivate and engage students with the content. They also used some fun things in class, such as JR’s claw machine. Gamification, though it is fun for the students, is not included in literature for instructional strategies. JR earmarked 15-minute periods when students could talk to JR and clarify any doubts. That was the initial plan, to replicate a face-to-face class as much as possible so that the students would have a sense of the old routine. Again, such strategies are not mentioned in the literature review. Stories like this told me how much the teachers thought about engaging their students and trying to help them relate them to the content they were learning.

The effort that the teachers really put on wanted me to make me ask my participants about their wellness which I have spoken about briefly before. Doing well means different things to different people. JR felt that just being alive sometimes can mean doing well. They were happy with their job because they were good at it and that also was part of being well, for them. But they also had concerns, both emotional and financial for their families. CS felt that when they were teaching at home, they had time to exercise and eat and drink well. This manner of self-care was crucial for teachers and the literature reported it as such (Amri et al., 2021). This was reflected in literature, as well Vu et al., 2020). VS was also similarly stressed about their job and did not feel good in terms of wellness. They anticipated that even if they returned to the physical classroom they had to be prepared to go back online at any time. There is no denying this was a challenging period for teachers and the pandemic truly upset their professional lives (Collie, 2021). Prior research on major societal disruptions has shown that they have a negative impact on teachers’ wellbeing, increasing the potential for teachers to experience maladjusted outcomes (Malinen et al., 2019).

SD thought they were doing well by staying at home, although they wondered if they may have become a little lazy. The workload did not decrease; in fact, to prepare study materials and resources for online classes and deliver lectures required more planning. These stressful feelings and increased workload were, in fact, studied by Kaden (2020). They felt that the support they garnered from the school administration, colleagues, and even students was very important for their wellbeing. Literature shows that school districts tried their best to take care of their teachers, but it was new kind of crisis for school systems, as well (Baird, 2020). They did try to ask teachers to take time off technology or sent teachers thank-you baskets, but the support that teachers were expecting was more work related.

JS found everything quite challenging. One good thing was receiving a fellowship for practicing equity in computer science, and that was great for motivation. They participated in a national group that got together and they were all very positive. This kind of positive workplace buoyancy is crucial for teacher performance. Since workplace buoyancy means the capacity of a teachers to navigate adverse challenges at work (Martin & Marsh, 2008) I see it as a highly relevant factor in truly understanding what the teacher community faced during the COVID-19 pandemic. JS had a lot more support in their school with people who were ready to give teachers a break when they needed one so that there was a supervising adult in the classroom. That created a feeling of wellbeing for JS (Ross-Hain, 2020).

All of the teacher participants reported that communication with parents was a big challenge because parents would not respond to messages. This also was reflected in literature; Cullnane and Montacute (2020) noted that this additional duty expanded the teachers' workload. Most of their participants also reported a notable decline in students' engagement and learning outcomes, plus an interesting correlation between school engagement and family income (Cullnane & Montacute, 2020). My respondents reported being worried about their students and about not being able to see them in person. In a study by Trudel et al. (2021), teachers reported that they cared about their students and missed in-person interaction with them. At the same time, they were worried about their home situation. They recognized the inequities that many students faced in access to online learning and tried to help those students, either with offline learning resources or by connecting them to the school district for help in getting internet access. Teachers have long been vocal about the digital skills gap highlighted by the National Education Technology Plan (U.S. Department of Education, 2017). These stories about doing well are not only about doing well but trying to do so. In the midst of everything what looms large is the teachers always worrying about the wellbeing of their students too (Trudel et al., 2021). Policymakers should understand that while not being a key job responsibility of a teacher, they do it nonetheless because they care. This should be reflected more clearly in literature and such stories are the main contribution of this study to the researchers on COVID-19 pandemic.

While returning to traditional face-to-face teaching, many teachers reported that they feared contracting COVID-19 from other colleagues or teachers (Weinert et al., 2021) but this did not hinder them from going to school to teach in the classrooms. My participants reported the same and so they followed strict social distancing protocols within their classrooms.

The most interesting part of this study is finding out about what the teachers think as the critical components of what made their jobs more meaningful or more challenging. Teachers found that there were some critical incidents or components (Butterfield et al., 2009) that helped them do better in terms of emotional health and their work during the COVID-19 pandemic. Teachers responded differently and let their voices be heard about what the critical factors were for them. Even if we do not look at critical incidents as a methodology approach, as an educational researcher these incidents indicate the most critical issues in a crisis that policy makers and future researchers can use as a precedent for charting a risk management plan. Some of those critical incident components are described below. Self-care as I mentioned before is the crux of being able to do one's work well. JS took two online self-care classes and started reading books on happiness. Receiving an equity fellowship also made a positive difference to how they viewed their work and provided motivation. They took a break over Christmas and responded to student emails sparingly because their "me time" was critical.

Vu et al. (2020) looked at these self-care measures that teachers took to maintain their emotional and physical health. Of course, there was anxiety about the news of forest fires, flooding, and the weather, but these methods helped them to stay grounded. CS added that exercises, healthy eating, and drinking a lot of water to keep hydrated were key factors in how well they did their job. Kaden (2020) talked about stressful factors that harm teachers' professional performance.

VS talked about teacher flexibility as a critical factor during the COVID-19 pandemic. In a crisis situation when not even the school administration can offer them a fool-proof risk management plan, teachers have only themselves to rely on. At that point, if they can be flexible with their pedagogies, instructional strategies, and teaching and learning resources, they can connect to students more effectively. The teachers always needed to be ready with backup plans constantly and not only in the context of online teaching, for example if the technology did not work. This kind of flexibility, VS thought, was a critical component in their success. The literature does not talk about teacher flexibility but there are indications that, in times of need, teachers are able to alter their instructional strategies (Pennisi, 2020). It was crucial that teachers were thinking of this because in the chaos it was easy to overlook many critical issues. This is an interesting take on a critical component.

Though many teachers did not receive support from school administrators, they always found that support in their school colleagues. This was a crucial component in helping teachers excel at their work and feel less stressed emotionally and mentally. JR mentioned that on days when it was difficult to be motivated to go to school, they would do it only for their colleagues, showing that teachers will show up in school no matter what, but they too have bad days and good days and need motivation. SD shared that there was significant assistance from their co-teachers and colleagues.

Examples of employee wellbeing include connecting to others (colleagues, friends, community), giving (supporting others), being active (physical activities), taking notice (being more mindful and intentional), and continuing to learn (learning new systems) (Malinen et al., 2019). CS also corroborated the feeling that supportive colleagues and administration made a huge difference to how well teachers adapted during the pandemic.

Teachers found that there were critical incidents that hindered them from doing the best they could during the COVID-19 pandemic. These are called hindering incidents (Butterfield et al., 2009). Teachers responded differently regarding the most hindering factor for them and a few examples are discussed below. Hindering incidents are reflected in literature as challenges that teachers faced during the COVID-19 pandemic. This is a way of letting teacher voices be heard and validated.

Teachers started teaching online almost overnight during the COVID-19 pandemic, scrambling together the resources they had. There was really no time for them at that point to plan out how this online teaching would look or even assess if they had the necessary skills to be teaching online. All of the participant teachers mentioned that they had to be up to speed on how to use the internet and other technology platforms. A few schools provided some initial training, but largely they were left on their own to learn the new technologies. Teachers were confined to their homes, their existing lesson plans fell short of the current needs, they were physically removed from their students, and needed to quickly learn and transition to new technology platforms to continue teaching (Baird, 2020). So, literature reflects the same struggles that my participants discussed with me. These struggles were real and researchers, school administrators, and policy makers had a lot to contribute to the alleviation of these struggles.

Teaching with technology was a steep challenge for teachers (Yusuf, 2020). This is not to say they had never used technology before, but navigating online teaching, deciding how to put resources online, how to engage students online, and how to conduct online assessments was all different. Dorn et al. (2020) discussed the learning loss that was happening as a result of online learning during the pandemic that was especially pronounced for students from low socio-economic backgrounds (SES), and those with Black and Hispanic heritage. These students not only faced loss of learning, thus exacerbating existing learning gaps, but many were also forced to drop out for reasons such as family poverty, lack of learning space, or food insecurities (Dorn et al., 2020, Ferri et al., 2020).

The inequalities during school closures were amplified by a lack of access to resources, including devices for online learning and stable internet connections; a lack of physical spaces to continue learning from home among students from underserved, low-SES, or marginalized backgrounds; and a lack of support for home-based learning for students from underserved, low-SES, or marginalized backgrounds (Ferri et al., 2020). To overcome these concerns, some researchers recommended that school districts provide improved access to the internet and other e-learning platforms for their students and provide continuous professional development opportunities for their teachers to learn online teaching strategies and pedagogies (Yusuf, 2020). These recommendations were aligned with the question of equity and inclusion that were central to emergency online teaching.

The issue of internet access loomed large when the COVID-19 pandemic began. Before this time, empirical studies showed that the digital divide was closing (van Deursen & van Dijk, 2019), but in SD's school district they were still struggling to provide students with internet access and personal devices. SD said, "There were instances in which a lot of like, internet connection, proper establishment of data and everything which is to be presented to the students, which was a little intense, and especially like the internet sometimes, you know, because of weather thing, the internet connections are not very good." This issue has not been well discussed in literature, though some studies point out related issues.

The pandemic acutely exacerbated issues of poverty and financial well-being. For many students, school-supplied meals are their main source of nutritious foods (Van Lancker & Parolin, 2020; Walters, 2020). Additionally, students in low-income families were especially at risk of receiving very little to no support for their learning at home while navigating new technology. There is also the issue of bad quality internet or no internet access that can result in a "homework gap" where students are not able to complete assigned homework because of their internet problems (Consortium of School Networking, 2017). SD also mentioned that initially when everyone was trying to use Zoom™, Microsoft Teams™, and Google Classrooms™, they were problems with bugs in the coding which is why there were a lot of Zoom™ bombings that disrupted classes. Later, these companies solved those issues and using the systems became more routine. This issue was real but there were few empirical studies on it so this finding may be important for school administrators if classes need to revert to online teaching.

Another interesting factor that the teachers talked about was some of the wish list items that would have made their jobs easier and probably more interesting. Wish list (WL) items include people, supports, information, programs, and circumstances that were not present at the time of the participant's critical experience, but that they believed would have been helpful. For this study, these WL items might have been useful for the teacher participants to cope with teaching inline during the COVID-19 pandemic.

As I have already talked about how teachers wanted more administrative support, most of the participants stated as one of their wish list items that they had expected more administrative assistance and support from the school and school district. Teacher JS said that these supports could have been in the form of giving teachers more time to draw up and finalize their lesson plans or designing the scaffolding for teachers who taught multiple courses and grade levels. It was especially true for them because much of what they taught was hands-on. Of course, the teachers understood that the administration was also in a bind, but they still expected support in times where there were policy or discipline related issues. Though the literature shows that school districts and administrations tried to help the teachers in whatever they could, and this might have been true in some cases, my participants felt desolate. This feeling of desolation must be validated because it was true and affected their work life.

Teachers continued to say that they expected parents would have been more supportive. VS observed that parents were appreciative at the beginning of the virtual learning and recognized that the teachers had a difficult job. Once students began trickling back to the physical classrooms, that appreciation seemed to dwindle. The concept of homeschooling priorly had its focus on smaller groups of students who may not have had access to brick-and-mortar school buildings for various reasons. However, now, due to the occurrence of COVID-19, homeschooling has become a favored method of continuing instruction and parents had a critical and operational part in it to ensure the success of their students. "Although parents and teachers have distinct roles in students' education, they have overlapping influences on student engagement" (Borup et al., 2014, p. 128).

This opportunity to continue student education also depended on the social situation of students' families, such as whether the students already had or could be provided with digital devices and internet access and support to access learning content or had the opportunity to set up their own learning space, for example. Another factor was whether parents had the opportunity to monitor their students' learning process, because some parents' work was related to the provision of frontline functions, such as medicine, emergency services, and the supply of goods. Similarly, some parents who had to go out of home for work, were less likely to be involved in supporting their students' education. Single parents, or parents who became ill with COVID-19 themselves, could also not be fully involved in the children's homeschooling efforts.

Studies have already shown that family's higher financial means or higher levels of parental education were able to cope with this crisis more preparedly and were satisfied with the benefits of distance learning. Dong et al. (2020) believed that parental support was more crucial during the younger and formative years of the children during homeschooling. There were risks associated with digital security, like a student visiting restricted sites (Dong et al., 2020).

Ravichandran et al. (2020) drew attention to the apparent rise in child abuse and neglect during the homeschooling years. Also, parents' beliefs and attitudes about early digital and online learning have been polarized in the past decade, with some parents convinced that it is the teacher's responsibility, while not understanding the constraint that the teacher is not present at home (Ravichandran et al., 2020). Therefore school-community partnerships have been a healthy alternative for providing accountability for student learning as well as their emotional well-being (Casto, 2016). The National Commission on Children and Disasters (2010) has put more stress on child well-being than completing a curriculum.

Many of the teachers mentioned that some form of professional development on online teaching tools, strategies, and pedagogies would have been beneficial when they began teaching online during the start of the COVID-19 pandemic. They had no idea how long it would go on and as time went by they found it difficult to continue teaching online. In-depth professional development could have been provided to teachers based on what they actually needed. Most of the participants mentioned that they would have loved to participate in regular PDs and that it should be included in pre-service teachers' curriculum, too. Most school districts did have several days earmarked for teacher PD and this was encouraging to see. What schools need work on is what PDs they should focus on.

School districts had to have very specific vaccination procedures, but these procedures were not consistent across states and school districts. This made it difficult for teachers to invite volunteers to help with classroom management, parental communications, and scaffolding. The literature does not include much research in this area, suggesting the potential for future research directions. Never having experienced a pandemic before, some schools did not have proper cleaning and sanitization procedures in place. JS told me that they were thinking about the cleaning procedures for the keyboards. Because many parents did not want their children to touch sanitization stuff, JR wanted the students to use their personal devices. But that did not work out because students did not want to take their personal devices to school. So, the teachers had to wipe down everything after the students used them. JS wanted to buy new mice and keyboards because theirs were old and had gross buildup that was difficult to clean. If any student did bring their own device to class, they had to figure out how to connect the keyboards to their devices and how to update the software they were using. These were new problems that neither the teachers nor the students were prepared for. These are issues that are very pertinent to everyday teaching but have not been stated explicitly in literature. This further contributes to building up a richer knowledge of teachers' experiences.

Teachers deserved to know how the school system was being run during the pandemic and their knowledge about the curriculum and the students should have been taken into consideration. JR, a bilingual teacher, was asked by the school district to chart out an online teaching plan and when it was rolled out it was the opposite of what JR had designed. Teachers' expertise must be respected, or the school system could end up in a disaster. Zhao (2011) found that schools had to strategize to adapt their mindsets, policies, and practices about technology to develop virtual technology competencies. Technology and online teaching have little impact on student achievement unless schools also change how instruction is designed, delivered, and supported (Barbour, 2012).

On top of this, some schools forced teachers to teach subjects they were not qualified or ready for because the schools did not have enough teachers. JR had a teacher's aide coworker, studying to be a teacher, who was forced to teach Spanish and math. She repeatedly said she did not feel ready because she lacked the knowledge to teach math, but the administration forced her, nonetheless. Was this completely legal? The literature has not stressed the impact of school systems on education during the COVID-19 pandemic, but this is critical because one school or one teacher cannot make a huge difference. Policy makers should focus on this issue if in the coming years they want to see better student outcomes.

During the COVID-19 pandemic, seminars were replaced by webinars and they became very popular. Both SD and VS used and made their students participate in a lot of webinars. Webinars where international students also joined in helped to remove geographical boundaries and made them feel connected. Again, webinars were not frequently mentioned in the pandemic literature, but they were effective at reaching multiple students on a single platform.

These critical components, the hindrances and wish list items are truly unique because they bring out the most crucial aspects of teaching during the COVID-19 pandemic and are not linked to any particular literature. As educators, researchers, and policy makers these components are what we want to look at, ponder about and design our education policies around. This brings us to end of the discussion section and I hope I have been able to uphold the teachers' voices, their stories and their experiences that had truly painted a slightly different picture of education during the COVID-19 pandemic.

Implications of the Study

The implications of research on teacher voices and their experiences of teaching during a critical time, such as a pandemic or wartime, for example, are critical for giving teachers a chance to speak without restrictions. This study is one of only a handful that exist documenting the experiences of secondary teachers who taught during the pandemic and later transitioned back to face-to-face classes.

Implications for Research

The findings of this study suggest that secondary school teachers have a positive attitude about integrating technology in the curriculum. They receive formal and informal learning opportunities and support for using technology that could take the form of technology training during pre-service teacher training programs as well as conferences, webinars, and training provided by companies whose products a school or school district is using. This did not however, prepare them fully to teach for more than two years on an online platform.

More than technology awareness and skills, teachers and students alike experienced a kind of tiredness from dealing with technology all day long. This had not happened with in-person human interactions and is an avenue of potential research. Teachers began using technology in an incremental manner, but they felt that technology could be overwhelming, and they needed to keep up. It took an investment of time to learn new technologies that they could integrate in their classrooms. Also, there are some technologies that need to be used in certain courses and if students are learning from home, teachers needed to plan ahead and make sure that students have those specific technologies on their home devices also.

The teachers' level of technology skills affected how students used the technology and the teacher participants in this study expressed the need for continuing professional development for upcoming technologies. Schools and school districts need to explore avenues of funding to support their technology integration plans so that teachers and students do not experience an interlude in their technology experiences. Another part of support from the schools and schools and districts would be paying attention to what the teachers are saying on different levels and include that knowledge in their actions and policies.

The teacher participants in this study used several technology platforms in their classrooms for teaching and classroom management. Like other research on technology use in secondary classrooms (Kormos, 2018; Polly & Binns, 2018; Ritzhaupt et al., 2016), this study's findings have indicated the importance of how technology can be used in classrooms in a planned and purposeful manner. This applies even in schools with fewer resources or that are located in remote regions if the teachers are motivated about using technology, have planned well, and have the support of their school administrators. School support was a major part of my findings and teachers need this to perform their jobs successfully.

When schools closed due to the COVID-19 pandemic, schools and school districts faced the consequences of their students' families' internet access issues even though the literature indicated the gap had narrowed considerably (vanDijk, 2006). Schools also saw that many students did not have their own devices to learn at home, so they solved this issue by distributing laptops or tablets to their students. However, the more significant issue was the lack of access to a quality internet connection.

The issue of access also brought to the forefront the issue of families' circumstances, including how students had to take on extra responsibilities and the rise in child abuse during this time. These issues should not be taken lightly, because for students who face this, school is a refuge, and their friends are their society, especially in the secondary years. There should be a deeper look at active policies to improve the overall lives of students in their homes.

The findings of this study also brought to the forefront how teachers hit the ground running and faced steep learning challenges to adapt to online teaching. The National Education Policy Center maintains that very little progress has been noted over the past few years for legislation, policy, and implementation of quality training for teachers to teach online (Molnar et al., 2017). Many researchers argue that online teaching pedagogies should be integrated in the pre-service teacher curriculum as well (Archambault et al., 2014).

Implications for Practice

In light of the previous discussion, the findings in this research suggest that schools and school districts should provide continual professional development opportunities for their teachers to help them integrate technology in their curriculum in a planned and effective manner. School districts, especially the ones who have limited funding or technology resources, may explore new avenues of funding to help support their technology integration plans. This study also brought out the need for including online teaching pedagogies in pre-service teacher curricula as recently discussed. This would help teachers to continue teaching seamlessly in the face of emergencies or teaching online for other purposes.

It is clear that teachers need more support from qualified volunteers or teacher aides to relieve them of some administrative tasks so that they can focus more on their teaching responsibilities as it is quite known that teachers have overwhelming workload. Schools and school districts should investigate this and make serious efforts to recruit supplementary staff if they want to stop qualified and experienced teachers from leaving. This workload and pay gap are unbearable for teachers in a very real-world sense.

As this study shows, many students do not have access to technology at home or do not have access to quality internet connection. This issue became more acute during the pandemic when students had to continue online learning from their homes. It is crucial that researchers, educators, and policymakers make this issue a critical one in their current agenda. The findings about students lacking access and/or parental support may also have practical implications for how to improve students' experience using technology to improve their learning outcomes.

Teachers in this study expressed that the parent community also needs to show solidarity with the teacher community instead of blaming them when their students are unsuccessful. They need, most essentially, to keep communication with the teachers open so that any issues may be sorted out without delay. This measure has implications for students' academic success because research shows that students with parental involvement at home showed higher average achievement scores than those who did not (NCES, 2018b). This could also impact issues of achievement gap that shows that the United States ranked 18th out of 37 countries for high school graduation rates in 2018 (Organization for Economic Co-operation and Development, 2020). Technology has become integrated tightly with education by ushering in a new format of learning where technology has been shown to scale and sustain instructional practices that in in-person learning situations may prove to be too resources-intensive (Mohammed, 2019). To integrate technology in education successfully, we may consider discussing pertinent issues with the teachers and keep them in the fold.

Limitations of the Study

It is essential that I acknowledge the limitations of this study. First, it is important to revisit the epistemological and methodological foundations of this dissertation. As a basic qualitative study (Merriam, 2002), the focus of the research was on local meaning-making that occurred in one bounded system, that is, the feelings and experiences of secondary K-12 teachers during the COVID-19 pandemic. Therefore, claims about the generalizability of this research must be approached carefully because there is no expectation that the contextualized data analysis and interpretation conducted during this research would affect the overall treatment of teachers in schools and education policy.

That said, the lack of generalizability does not mean that these findings are not useful to policymakers, educators, and researchers in education. However, readers should consider the recommendations made with a critical eye to deliberate how these insights may be useful and applicable to a variety of educational contexts. While data were triangulated internally between teachers and documents, there was no opportunity to triangulate information about students' experiences of learning during the COVID-19 pandemic and after returning to school. In addition, the study highlighted the teachers' perspectives, but the perspectives of school administrators, students, and the parents or guardians were not examined because they were out of the scope of the research.

Furthermore, the constraints on generalizability inherent in a basic qualitative study, several methodological limitations are important to discuss. First, the context of this study was K-12 secondary schools in three states. Because it was outside the scope of the study and my focus was on teachers' experiences, I did not collect any data from any other school authorities, students, or parents. Due to the time constraints, I could not reach out to teachers in all 50 states. However, as a researcher I recognize that each region has their own unique issues that need to be addressed and research needs to continue by recruiting participants from all states and longitudinal studies are needed, as well.

I selected secondary teachers to explore their teaching experiences, feelings, and emotions during the pandemic and after they transitioned back to face-to-face classes. This research focus might lack some crucial facets of particular technology platforms that teachers use that did not surface in the research participants' narratives because the focus was on their feelings, emotions, and experiences.

The interview data was collected based on the teachers' answers to the interview questions. Therefore, the data may have been affected by some self-representation bias of the teacher participants. However, I tried my best to make my participants comfortable so that they could speak without feeling that they needed to answer in a manner where they thought that they were saying something that I may want to hear vis-à-vis what their actual perceptions were. There might be subjectivity in the responses but that is what I meant to explore in terms of the teachers' own experiences and feelings.

The interview response rate is also a potential limitation. I had originally expected to talk to at least eight participants and envisioned some data convergence at that point. I had to abandon this plan when, ironically, three of my participants fell sick from the disease under discussion. Fortunately, with five participants I found a healthy amount of data convergence and interesting divergence that I did not explore further the recruitment of any other participants.

Since data sources of this study were from the United States context only, the implementations of the findings in another context should be done carefully by considering cultural, social, and geographical variables. Additionally, I may have missed some relevant studies during the literature review if they did not use the same keywords I searched with.

While this research represents some of the issues that I experienced during my four years of doctoral studies, prior research, and working with K-12 schools and teachers across the United States, it is only a beginning. In no way would I claim this study to be conclusive. Without a doubt, further research is needed to understand the voices of teachers and include them in the day-to-day running of schools, decisions made there, and policy decisions. Teachers know the students best and what they need, so making them a critical part of all this is important. More comprehensive data collection is needed to shed light on leadership practices and what influenced policy decisions during the pandemic, and on ways to support teachers as essential partners in children's education.

Conclusion

The purpose of this dissertation was to examine the experiences, feelings, and voices of secondary teachers who taught online during the COVID-19 pandemic and later transitioned to face-to-face education. In doing so, I conducted a five-month basic qualitative study that included behavioral event interviews (BEI) with secondary teachers. The data from this study demonstrated that teachers experienced worrisome situations regarding their students and words like panic, nervousness, and insecurity came up when they talked about COVID-19. Amongst all this, they felt ill-prepared to teach online, though they did so for more than two years. The teachers who faced the most difficulty was those who taught courses requiring hands-on knowledge. Teachers were also vocal about the lack of support from school administration and the parent community. Most interestingly, they talked about teaching strategies that worked and the ones that did not. They also pointed out the critical components in their teaching experiences.

Carried out as a basic qualitative study and critical incident analysis, this study was an exploration of the teachers' experiences, emotions, and feelings while they were teaching online and during the transition to face-to-face learning. The complexity of emerging technologies and teaching with them during pandemic situations and their impacts on the fabric of societies as well as our bodies, cultural norms, discourses, and social interactions are a critical research problem.

The secondary K-12 teachers helped the secondary students to learn through interactional patterns via technology that were similar to their in-classroom learning and play experiences, while trying to satisfy their need to interact with peers, therefore empowering them by building their confidence in learning various subjects. The students' feelings associated with their positive and dynamic social experiences (Wood & Baker, 2004) while learning different subjects online, and the recognition and respect accorded by the online teacher, made the synchronous instruction valuable for them. This finding suggests that online education for secondary students should adapt to, respect, and make use of their life experiences, their history and local wisdom, and their identities. This is an important aspect that teachers should pay importance to while designing online lesson plans.

Although the online classes worked well in general with some pitfalls, teachers found classroom management difficult. It warrants reiteration to point out that the online teachers needed to find strategies to maintain their student-friendly demeanor, build online intimacy with the students, and maintain an active and encouraging learning atmosphere. They also would benefit from class volunteers or teacher aides to manage students who take advantage of the absence of classroom discipline. Voluntary teachers realized that their dream of making a difference was hard to accomplish due to the unresolved issues of administering and supporting the program. In addition, the rotation of new, inexperienced, and unqualified teachers with a "get used to it" attitude will continue, and students will be at the losing end.

The school administrators' traditional views of student learning achievements limited the online teachers' pedagogical choices, so they had to switch from student-centered pedagogy to lecturing in order to deliver as much textbook content as possible. At the same time, the teachers did could not completely eliminate student-centered pedagogies and they tried to incorporate as much as student interaction in their lesson plans as possible. Behind the school administrators' dogma was the dilemma of how to fulfill the educational policy requirements, approaches, and assessments set for secondary schools despite school realities and the challenges related to the students' personal traits, family backgrounds, and financial status.

Teacher demotivation was another important issue found in this study. Most of the teachers shared similar frustrations about working in secondary school schools, especially with no administrative or parental support. Their demotivation revealed that simply bringing in new, unqualified teachers to replace experienced teachers or introducing new technologies would not solve the real problems facing these schools. Fundamental changes that empower students and teachers both open doors to a better future cannot happen unless the system, curriculum, and evaluation practices change. Investment in infrastructure and technology, donations of materials and equipment, and the policy of fixed-term voluntary teacher allocations need to work together with policies that are adapted specifically to secondary education to address student graduation rates of students and college preparation.

Limited access to innovative instruction is far from enough to transform education to benefit secondary students. To truly improve the quality of education for underserved students, educators and researchers should demand better opportunities to accommodate students' needs, build their confidence, and develop their strengths in learning. Therefore, efforts by and collaboration among different sectors of the educational system are needed. New technology-inspired forms of learning, despite their future potential, are means, not ends, in the long journey toward true educational equity and justice.

But all was not bleak during the COVID-19 pandemic. The pandemic encouraged better communication between parents and teachers, in many cases, and homeschooling required parents to support their students' learning, both economically and socially. The use of online platforms such as Google Classroom™, Zoom™, virtual learning environments, social media, and group forums like Telegram™, Messenger™, WhatsApp™, and WeChat™ were tried and tested so they could be leveraged more successfully in future online teaching circumstances (Pokhrel & Chhetri, 2020). These options can be explored further, even in face-to-face instruction and the platforms can provide additional resource to support students (Pokhrel & Chhetri, 2020).

Teachers collaborated more actively within their communities to come up with creative initiatives, develop collaborative ventures, and explore new tools (Doucet et al., 2020) and many organizations offered their tools and solutions for free to school districts and their students to support teaching and learning in an engaging and interactive environment (Pokhrel & Chhetri, 2020).

In conclusion, I want to reiterate that this research study answered the research question, 'How did secondary teachers experience teaching online during the Covid-19 pandemic?' through the eight main themes: Initial panic and chaos, Springing into action, Wins and losses, Survival of the fittest, Teachers are People too, Critical Incidents, Hindering Incidents, and Hindsight 20/20. The Critical incidents, Hindering incidents and Hindsight 20/20 especially helped me to understand and also contribute to the literature what teachers thought were the key issues that were critical for their teaching support and self-care during the COVID-19 pandemic, the challenges they faced that brought out some crucial factors outside of what I have found in previous literature like student behavior, and what were on the teachers' wish list items that probably would have made a better impact on their professional lives during the COVID-19 pandemic. The findings of this study show that though my participant teachers never experienced a pandemic before, they all had unique feelings and thought about the ensuing crisis. Though learning new technologies presented a steep challenge to them, all my participants responded unanimously that at that time their primary thoughts were about their students. Though each participant found their unique ways in which to plan out their online teaching strategies, most of them responded that they would appreciate more support and understanding from the school administration and the parent communities. Like learning new technologies, redesigning the curriculum for an online teaching format also presented a challenge, but some teachers faced a greater challenge in managing difficult and threatening student behavior. But this did not impede them from reaching out to students and their families in their times of need. Some of the most crucial findings were about the critical incident and their wish lists that would probably have made a greater impact on how secondary K-12 teachers experienced teaching online during the COVID-19 pandemic.

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APPENDICES

Appendix A: Letter to School Principals

Request for Teacher Recruitment for a Dissertation Study

Hello,

Hope this email finds you well. My name is Parama Chaudhuri and I am a fifth-year Ph.D student at the Department of Instructional Systems Technology in Indiana University Bloomington. My research advisors are Professor Elizabeth Boling and Dr. Anne Leftwich (Dept. of Instructional Systems Technology).

I am aware that I am writing to you at an extremely busy time while you are transitioning to complete online teaching but I ardently hope, as someone closely associated with education, you will lend me a patient hearing. I will be brief. My research broadly engages with teaching and learning using technology. My specific interest lies in exploring the teaching experiences of secondary K-12 teachers during the Covid-19 pandemic. A fundamental question that drives my research is how the teachers experienced Covid-19 pandemic, teaching during and through it and amplifying their voices about underlying concerns and achievements during this time. I will not take more of your time to offer the redundant rationale as to how and why this and any research needs the support of actual practitioners and as in my case, secondary school teachers. I understand that you are extremely busy and therefore the only time commitment will be for one interview. Each interview will be between 1-2 hours and no longer. I can interview you online via Zoom or any other platform of your choice. The anonymity of your participation will be completely respected. The interview protocol will be shared with you before the interview. Participation of course is completely voluntary. This study has been submitted to Indiana University Bloomington IRB.

Please feel free to write to me at pbhatta@iu.edu for information you would like and interested participant teachers can also write to me at pbhatta@iu.edu or connect to me at (812)-955-8775. Here is the link to the recruitment flyer:
https://www.canva.com/design/DAEq1wFlmr0/XWRneIc2PVOwrZvzwRTsgg/view?utm_content=DAEq1wFlmr0&utm_campaign=designshare&utm_medium=link&utm_source=publishsharelink

Hope to hear from you soon.

Thanking you,

Sincerely,

Parama Chaudhuri
pbhatta@iu.edu
812-955-8775

Appendix B: Letter to School Teachers

Hello,

Hope this email finds you well. My name is Parama Chaudhuri and I am a fifth-year Ph.D student at the Department of Instructional Systems Technology in Indiana University Bloomington. My research advisors are Professor Elizabeth Boling and Dr. Anne Leftwich (Dept. of Instructional Systems Technology).

I am aware that I am writing to you at an extremely busy time while you are transitioning to complete online teaching but I ardently hope, as someone closely associated with education, you will lend me a patient hearing. I will be brief. My research broadly engages with teaching and learning using technology. My specific interest lies in exploring the teaching experiences of secondary K-12 teachers during the Covid-19 pandemic. A fundamental question that drives my research is how the teachers experienced Covid-19 pandemic, teaching during and through it and amplifying their voices about underlying concerns and achievements during this time. I will not take more of your time to offer the redundant rationale as to how and why this and any research needs the support of actual practitioners and as in my case, secondary school teachers. I understand that you are extremely busy and therefore the only time commitment will be for one interview. Each interview will be between 1-2 hours and no longer. I can interview you online via Zoom or any other platform of your choice. The anonymity of your participation will be completely respected. The interview protocol will be shared with you before the interview. Participation of course is completely voluntary. This study has been submitted to Indiana University Bloomington IRB.

Please feel free to write to me at pbhatta@iu.edu for information you would like and interested participant teachers can also write to me at pbhatta@iu.edu.

Hope to hear from you soon.
Thanking you,
Sincerely,
Parama Chaudhuri
pbhatta@iu.edu
812-955-8775

Appendix C: Social Media Post for Teacher Recruitment

Hope this email finds you well. My name is Parama Chaudhuri and I am a fifth-year Ph.D student at the Department of Instructional Systems Technology in Indiana University Bloomington. My research advisors are Professor Elizabeth Boling and Dr. Anne Leftwich (Dept. of Instructional Systems Technology).

I am aware that I am writing to you at an extremely busy time while you are transitioning to complete online teaching but I ardently hope, as someone closely associated with education, you will lend me a patient hearing. I will be brief. My research broadly engages with teaching and learning using technology. My specific interest lies in exploring the teaching experiences of secondary K-12 teachers during the Covid-19 pandemic. A fundamental question that drives my research is how the teachers experienced Covid-19 pandemic, teaching during and through it and amplifying their voices about underlying concerns and achievements during this time. I will not take more of your time to offer the redundant rationale as to how and why this and any research needs the support of actual practitioners and as in my case, secondary school teachers. I understand that you are extremely busy and therefore the only time commitment will be for one interview. Each interview will be between 1-2 hours and no longer. I can interview you online via Zoom or any other platform of your choice. The anonymity of your participation will be completely respected. The interview protocol will be shared with you before the interview. Participation of course is completely voluntary. This study has been submitted to Indiana University Bloomington IRB.

Please feel free to write to me at pbhatta@iu.edu for information you would like and interested participant teachers can also write to me at pbhatta@iu.edu.

Hope to hear from you soon.
Thanking you,
Sincerely,
Parama Chaudhuri
pbhatta@iu.edu
812-955-8775

Appendix D: Interview Protocol (Behavioral Event Interview) (BEI)

School: ____

Interviewee (Title and Name): _______________________________________

Interviewer: ____

Topics Discussed:____

____

Documents Obtained: ____

____

____

Interview Comments:

____

Introductory Protocol (For interview)

Thank you for participating in this interview to assist me with my research project. I aim to understand how teachers use technology in their classrooms and how that affects their classroom practices. I will not be asking you multiple questions. Rather, I am interested in your voice and experience, especially your experience about teaching during the Covid-19 pandemic. Though it is not exactly a think-aloud procedure but it s drawing from similar methods where the participant voices elicit the information that I am looking for.

To facilitate our note-taking, I would like to audio tape our conversations today. For your information, only the researcher on the project will be privy to the tapes which will be transcribed and presented to the interviewee for member checking. I can stop the interview at any time during the interview upon your request.

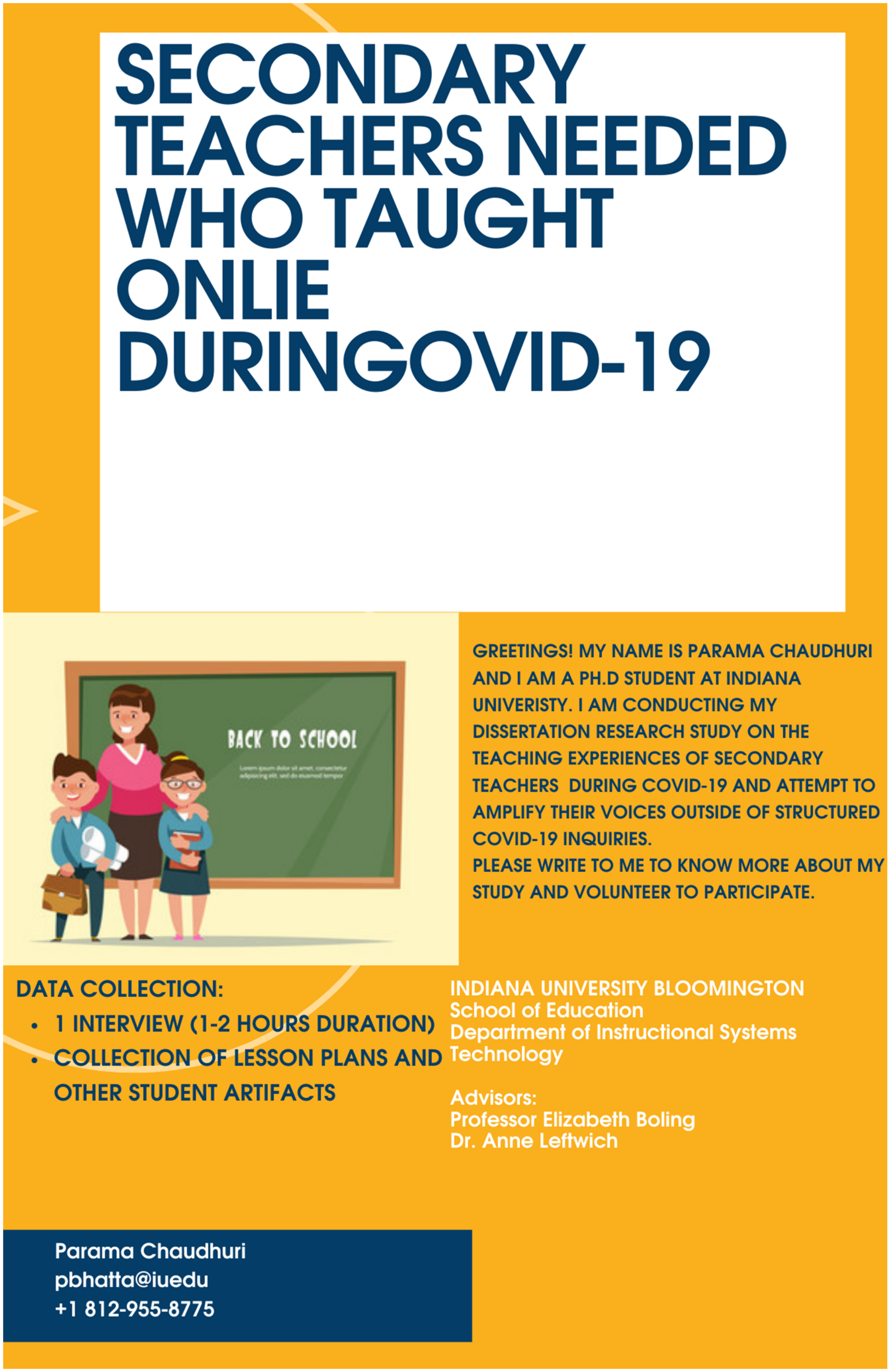
I have planned this interview to last no longer than two hours. During this time, I have a few in depth questions that we would like to cover. When we reach 1:15 minutes I will check in with you to see if it is alright to extend the interview for another 45 minutes.

Interview Questions

- Can you describe your feelings and emotions when you heard the news of COVID-19 and subsequently the announcements about the closure of all schools?
    - What did you want to do in this situation?
    - How did you experience teaching during the Covid-19 pandemic? Describe how you felt learning new technologies?
- After the initial surprise, if you had a little time to think and plan, what were your plans (if any) for delivering education to your students; what actions or strategies did you decide to employ or had already employed?
    - What were you thinking, what were you feeling, what were you saying, what were you doing?

    - Can you think back to the time when you were redesigning/ reorganizing your learning resources and activities? Why did you make certain decisions of changing things or keeping them the same?
    - What circumstances did you take into account?
    - What was the outcome? What happened?
    - What were you thinking about your students during this time? What did you actually do or say?
- Tell me about a teaching strategy that worked very well for you and your students?
    - Walk me through how you came up with this strategy? Why do you think it worked out so well?
    - Can you please share your screen and show me what you did?
- Tell me about a strategy that was a total wreck?
    - What did you do to rectify the situation?
- How are the proposed strategies working so far, and what opportunities or challenges have you experienced?

Appendix E: Recruitment Flier



Appendix F: IRB Approval Letter

PROTOCOLS

Bhattacharya, Parama

APPROVAL LETTER

To: Boling, Elizabeth

Protocol #: 12141

Protocol Title: A Study of Secondary Online Teaching Experience During the Covid-19

Type of Submission: Initial

Level of Review: Exempt

Approval Date: Monday, December 13th 2021

Expiration Date: no date provided

**If Expiration Date = "No date provided," this research does not require annual renewal; thus there is no expiration date.*

The Indiana University HRPP approved the above-referenced submission. Conduct of this study is subject to the IU HRPP Policies, as applicable.

Additional Notes:

This research is exempt under the following category: -Category 2(ii)

Documents approved with this submission:

Attachments

Study Information Sheet	iu-hso-sis-exempt-template.docx
Protocol	Behavioral Event Interview (BEI) Interview Protocol.docx
Recruitment Materials	Recruitment Appendices for Dissertation.docx

You should retain a copy of this letter and all associated approved study documents in your research records.

If you have any questions or require further information, please contact the HRPP via email at irb@iu.edu or via phone at (317) 274-8289.

Appendix G: Indiana University Study Information Sheet for Research

Study Sheet

- They are being asked to participate in research,
  Secondary teachers will be asked to participate in this research study via their work emails through the following avenues:
  - Lists provided by a midwestern research university office actively working with secondary schools,
  - Reaching out to an organization working with secondary grades in K-12 schools,
  - Through a call for research participation in social media on secondary school pages.
  - Ask recruited participants to refer names of other secondary teachers who taught online during Covid-19 and use this snowballing sampling for further recruitment of participants.
- What they will be asked to do,
  Teachers will be asked to talk about their experiences of teaching online during the Covid-19 pandemic covering topics like what challenges they faced, what kinds of support they received from the schools/ school districts, how they adapted their instructional strategies, did they find any of these strategies useful? In what way? Will they adapt any of these strategies for their face-to-face classes? Why or why not?
- Their participation is voluntary
  Participation is completely voluntary.
- The risks and benefits of participation
  There are no risks involved. The benefits are that if this research gets published it could benefit other secondary teachers or other stakeholders involved in online teaching or adapting instructional strategies from online teaching to face-to-face teaching.
- Who to contact with any questions about the research.
  pbhatta@iu.edu

Sociomaterial Entanglement Theory (SET): The New Technosocial Reality

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Facultad de Educación
Universidad de Murcia, Murcia, Spain

Abstract

The cognitive sciences remain oblivious to the medium or material that shapes human interaction and agnostic of its affordances and how they influence the manner in which people act, perceive, or think. Sociomaterial Entanglement Theory (SET) is proposed as a theory that embodies the sociomaterial entanglement with which people learn and the technosocial reality we live in as well as an approach that enacts contemporary ideas about how people learn.

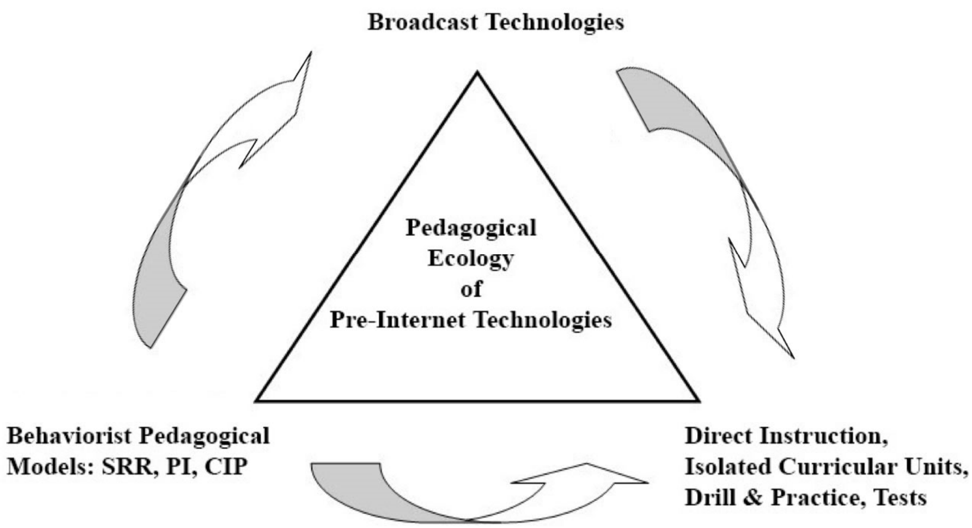
Keywords: Sociomateriality, sociomaterial entanglement, technosocial reality, pedagogical ecology, learning technologies, social media technologies, personal learning environments

Sociomaterial Entanglement Theory (SET): The New Technosocial Reality

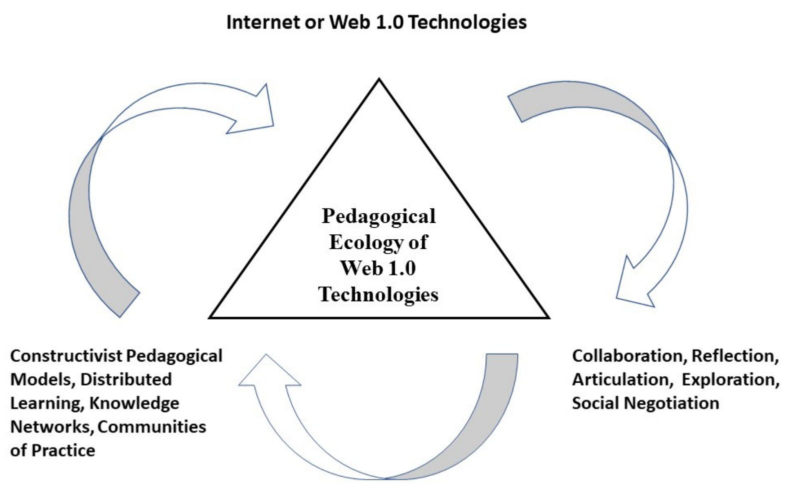
The cognitive sciences remain oblivious to the medium or material that shapes human interaction and agnostic of its affordances and how they influence the manner in which people act, perceive, or think. Sociomaterial Entanglement Theory (SET) is proposed as a theory that embodies the sociomaterial entanglement with which people learn and the technosocial reality we live in as well as an approach that enacts contemporary ideas about how people learn.

Several attempts have been made to battle the prevailing tendency to limit conceptions of the social to interactions between persons rather than between persons and things (Malafouris & Renfrew, 2010). Gibson's theory of affordances is one of those attempts. Gibson's theory of affordances is an ecological or environmental approach to psychology that emphasizes perception and action rather than memory and retrieval. Gibson (1979) proposed that objects or artifacts (e.g., technologies) have certain affordances (capabilities) that lead organisms (e.g., people) to act based on their perceptions of these affordances. In other words, people act when they perceive an opportunity to act. Therefore, action and perception are linked through the affordances present in a given situation. Affordances provide strong clues to the operation of things. For example, chairs 'afford' sitting, glass 'affords' seeing through or breaking, knobs 'afford' turning, balls 'afford' throwing or bouncing, etc. (Norman, 2013; Kaptelinin, 2014).

The theory of affordances has direct implications on how we may understand the evolution or ecology of online learning and the technology-based design of learning activities and interactions (Dabbagh, 2004; Dabbagh & Reo, 2011). For example, pre-Internet technologies such as broadcast technologies that focus on transmitting information or one-way provision of content 'afford' pedagogical practices that are primarily behaviorist or objectivist in nature. Examples include direct instruction, self-contained curricular units, and drill and practice activities.

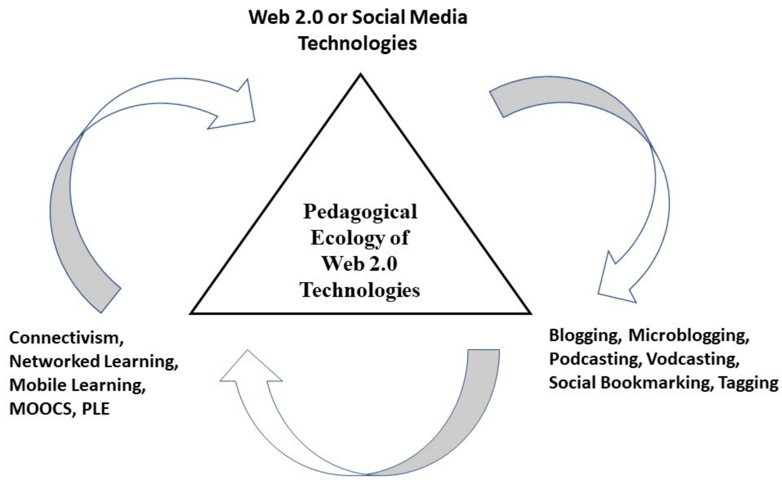


Web 1.0 technologies that characterized the first stage of the WWW, enabled more open and flexible learning spaces and afforded multiple forms of interaction such as learner-learner, learner-group, learner-content, learner-instructor, and group-group, allowing teaching and learning events to be distributed across time and place synchronously or asynchronously (Dabbagh & Bannan-Ritland, 2005; Dabbagh et al., 2019). The pedagogical ecology of Web 1.0 technologies resulted in pedagogical practices that are more constructivist in nature, such as collaboration, articulation, social negotiation, exploration, and reflection.



Web 2.0 technologies characterized the second stage of the WWW representing a qualitative shift in how information is created, delivered, and accessed on the Web (Dabbagh & Reo, 2011). Web 2.0 saw ICTs move away from simply transmitting and conveying static content to allowing users to generate their own content, and interact with what they were experiencing on the Web. Web 2.0 became a concept and not just a technology, embodying themes such as openness, personalization, customization, participation, social networking, social presence, user-generated content, the people's Web, read/write Web, and collective wisdom leading to its characterization as the 'Social Web' (Alexander, 2006; Davis, 2008; Jones, 2008; O'Reilly, 2005). The 2014 NMC (New Media Consortium) Horizon Report (Johnson et al., 2014) also emphasized the social side of Web 2.0 particularly as this relates to the ubiquitous use of social media technologies in the education sector and the way this use is changing how students and educators interact, present information, and judge the quality of content and contributions.

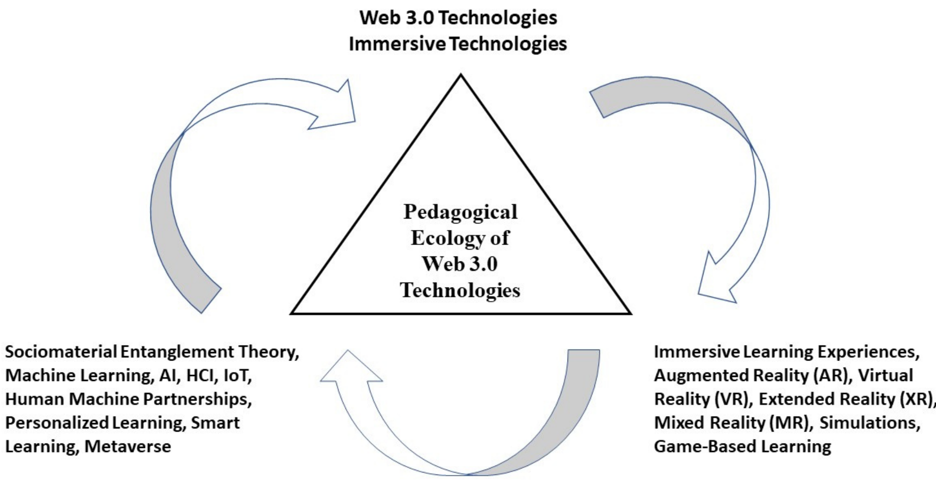
The new activities that grew out of Web 2.0 technologies (e.g. blogging, wikis, creating and posting videos) moved technology supported activities away from having to be teacher-centered to the possibility of being more learner-centered. First, Web 2.0 technologies made it possible for learners to engage in high levels of dialogue, interaction, and collaboration through social networks and provided learners with the ability to generate and share knowledge across learning networks. Second, Web 2.0 technologies deflected control of learning away from a single instructor or expert by distributing learning among all participants in the learning community, promoting agency in the learning process and an appreciation of diversity, multiple perspectives, and epistemic issues. And third, Web 2.0 technologies enabled learners to personalize their learning environment by selecting the technologies they wish to use (e.g., apps on mobile devices), accessing and organizing information sources, customizing the user interface of a technology, and building personalized learning and professional networks (Dabbagh et al., 2019).



Web 3.0 technologies are now surfacing as the next wave of ICTs and the next phase or iteration of the World Wide Web. Web 3.0 technologies can be characterized as the "semantic", "spacial", or "3D web" (Evans, 2021; Roy, 2022). As Evans describes, rather than seeking information by keyword, activities, or interests, users will be able to define their preferred means of information seeking. Enabled by blockchain technologies, the Web 3.0 movement has been characterized by embracing the principles of "open, decentralized, censorship-resistant, immutable, trustless, and permissionless" interactions (Eshita, 2021). These platforms cut out the middle man of the larger corporations so that the user can control their own data analytics, set their own rules, and obtain the full monetary gain from their efforts online. Web 3.0 also promises interoperability so that end users do not need to create multiple accounts for multiple services. Given the promised interoperability, Web 3.0 may enable personalization across platforms, yielding a cryptographically backed digital identity to be represented across the web and resources that better connect to the end users based on their interests and powered by machine learning (Evans, 2021). These extended capabilities, however, are very much in their nascent stages and beg questions about privacy, security, bias, and censorship.

Web 3.0 technologies can also be characterized as immersive technologies in that they allow participants to be totally "immersed" in the context that the environment represents. Immersive environments allow participants to be "in" the experience created by the tool (Pagano, 2013). They create virtual experiences that strive to look and feel like real settings. Immersive environments can be created as either a "classic" immersive reality where the participant may wear goggles, and interacts via a headset and a joy-stick or other controller, and experiences the environment through these devices. Immersive technologies allow the participant to create an avatar to represent themselves. Simulations, educational games, virtual reality environments are all examples of immersive environments. The immersive environment would include a 3-dimensional visual experience, audio and potentially olfactory stimuli.

Augmented reality (AR) experiences, extended reality (XR) experiences, mixed reality (MR) experiences, and virtual reality (VR) experiences are all examples of Web 3.0 technologies that are transforming the “learning with technology” landscape. Advances in artificial intelligence (AI), computational design, machine learning and smart technologies like the Internet of Things (IoT) are automating the design of human-centered environments and human-machine partnerships whether in real or virtual reality transforming the future of work, entertainment, healthcare, education, business and everyday life.



It is clear that online learning (or what used to be called distance learning) has significantly changed over the years from a social, pedagogical, and technological perspective. These changes seem to coincide with the changes and advances in learning technologies, making it difficult to separate the impact of technology on the teaching and learning process and supporting the argument that technology is not neutral, rather, it brings with it its own affordances and implications on learning designs premising a pedagogical ecology that emphasizes the non-neutrality of the learning space and consideration of the expectations and potentials that each learning medium brings forth to the teaching and learning process. Supporters of this view argue that each medium has a unique set of characteristics and that understanding the ways in which students use the capabilities of the medium is essential to understanding the influence of the medium on learning and on building media theory (Kozma, 1994).

Enter Sociomaterial Entanglement Theory (SET) (Decuypere & Simons 2016; Fenwick et al. 2011; Carvalho & Yoeman, 2019); the intersection of the technical (material) and the social (human) through thought and action, also known as multiagent socio-technical systems, which means that humans and “things” are ontologically inseparable from the start” and are observable through the intra-action (Frauenberger 2020, p. 21) and the relationships with the other elements of the learning environment in the context of their contribution to the learning activity.

Sociomateriality is another attempt at breaking the prevailing tendency to limit conceptions of the social to interactions between persons rather than between persons and things. It provides a post-humanist/sociomaterial perspective of how people learn and ensures that we have a deeper understanding of the learning activity. In other words, the components and the actors in the learning environment —including the learner—mutually condition and transform each other while they interact, continuously shaping the learning activity (Castañeda et al. 2017).

SET is not an explanatory theory, rather an approach or framework with a broad spectrum of applications that are able to integrate some of the most naturalistic ideas about how people learn in the digital environment. The most relevant of which are:

- learning anytime, anywhere, or what has come to be known as ubiquitous learning (Taraghi 2012);
- adult learning, specifically as this relates to self-directed learning or what is known as heutagogy (Blaschke 2012, 2013);
- learning with others as conceptualized by social constructivism (Rahimi et al. 2015; Torres-Kompen et al. 2019); and
- learning in connection or connected learning as embraced by connectivism (Siemens 2005; Downes 2007) and networked learning (Drexler 2010; Goodyear 2005; de Laat and Dohn 2019).

If something has exceptionally changed in education, it is the ecologies in which people learn that are now full of emerging resources and technologies that scatter learning experiences across institutional, geographic, societal, and economic boundaries resulting in the personalization and globalization of the learning experience (Dabbagh & Castaneda, 2020). Also, if something has exceptionally changed in educational research, it is the importance of the learning activity and how we understand the relationships among the actors towards this activity. In this context, Sociomaterial Entanglement Theory or SET recognizes the ecologies in which people learn, how the elements of those ecologies interact to transform the learning activity, what this means for the practice of teaching and learning, and how people take advantage of the possibilities to learn they already have (Dabbagh & Castaneda, 2020). SET can be conceptualized as a technosocial reality that embodies the sociomaterial entanglement with which people learn as well as an approach that enacts contemporary ideas about how people learn. Learning can no longer be understood by focusing solely on cognition, development, or the behavior of individual learners; neither can it be understood without reference to its situated, sociocultural and lifelong nature, the tools through which learners construct meaning, and the context in which these tools are used.

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EXPLORING SYSTEMS THINKING IN SCHOOL PRINCIPALS' EDUCATIONAL TECHNOLOGY LEADERSHIP IN YUNNAN PROVINCE, PRC

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Descriptors: Leadership, system thinking

Short Description: We review existing definitions of "educational technology leadership" in China and find definitions that respectively emphasize individual capability, the executive ability of leaders, or understanding of a technical process. Educational technology leadership is often studied separately from the complex environments in which it is embedded. We explore educational technology leadership of school principals in a single region of China as embedded within a wider system that includes the processes of mutual influence and interaction among various elements and requires system thinking by educational leaders.

Two key words: Leadership, system thinking

Under the guidance of national policies and economic demand, many universities and primary and secondary schools in China have accelerated their construction of digital campuses. Scholars have different definitions and names for educational technology leadership. Local Chinese scholars (i.e., those who study school environments) often call it "technological leadership" or "information(ization) leadership"(Lei et al., 2021), while international researchers often use terms such as "e-leadership", "ICT leadership" and "technological leadership".

Although educational technology leadership is a derived and sub-concept of leadership, it cannot simply be equated with overall leadership. It is a new type of leadership generated by integrating the content and attributes of information technology into modes and practices of traditional leadership. It is a two-dimensional fusion product of leaders' information technology literacy and leadership ability (Zhao, 2017). Scholars have observed and understood this fusion product from the perspective of leadership process (Avolio et al., 2000; Northouse, 2010), constituent elements (Jablokow et al., 2010; Preston & Karahanna, 2009), or affiliation (Avolio et al., 2000; Zhao, 2017). Although the focus is slightly different, the leadership process is the outward manifestation of the elements of leadership, so these different perspectives also reside within a holistic system.

In 2010, China's *Outline of the National Medium- and Long-Term Educational Reform and Development Plan* (2010-2020) explicitly proposed the construction of digital campuses. The *Ten-Year Development Plan for Educational Informatization* (2011-2020) issued by the Ministry of Education in 2012 clearly states that it will vigorously promote the construction of digital campuses in universities and vocational colleges and formulate basic standards for the construction of digital campuses in primary and secondary schools. This plan includes the principal's “informatization leadership” in the annual evaluation of the principal's work performance. It is planned to improve the principal's informatization planning, management and execution capabilities. The 2018 *Education Informatization 2.0 Action Plan* promulgated by the Chinese Ministry of Education marked the shift of informatization policy orientation from construction and application to integration and innovation. This new policy is driven by three factors: China's promotion of education informatization 1.0, the modernization of education requirements for 2035, and the response to "Wisdom Education" (Yan & Yang, 2020, p.410). In 2019, the Central Committee of the Communist Party of China and the State Council issued the vision of *China's Education Modernization 2035*, which is to further accelerate the reform of education in the information age; to further coordinate the construction of an integrated intelligent teaching, management and service platform; and to advance a modern education management and monitoring system to promote “precise management and scientific decision-making”.

Because principals are at the heart of school reform and change, research on principals' educational technology leadership has gradually become a new research hotspot. When reviewing the existing definitions of technology leadership in China, we find that there are different emphases: Some scholars believe that its essence is a kind of personal ability, which is mainly reflected in the individual quality and behavior of the principal (Huang & Hu, 2012; Zhao, 2017; San, 2018). Others think of it as the executive power of the leader, which is reflected in the completion of the school's information technology construction tasks, implementation of the requirements, and realization of the intended goals (Wang et at., 2007; Sun, 2010). For other scholars, it is a process that reflects the leading role of school leaders in using information technology to change (i.e., improve) school education (Xie et al., 2009; Huo et al., 2008; Zhao & Shen, 2019). Although the foci of these views are different, they all fully affirm that the principal's informatization leadership plays a great role in promoting the construction of school education informatization. From the fusion of these perspectives, the competencies of the principal's educational technology leadership are summarized as follows: In the context of educational informatization, principals can rely on their own information technology literacy to lead the majority of teaching staff to continue to carry out school informatization vision planning, implement informatization resource management, and promote informatization evaluation work on the basis of the school's existing informatization construction.

The premise of the principal's educational technology leadership is the educational informatization situation, which can be viewed in a broad or narrow sense. For example, it can refer to the large social information environment, which can specifically involve various factors such as political development, economic conditions, cultural patterns, and technical conditions. The narrow informatization situation refers to the informatization development status of people's organizations and the informatization environment within the organization. The research and discussion on the influencing factors of principals' educational technology leadership include but are not limited to education policy (Xiao, 2008; Li & Fei, 2020; Lu, 2021), economic factors (Li & Li, 2017; Lu, 2021), demographics learning (Wang et al., 2020; Bian et al., 2016), technology integration (Zhao, 2017), campus culture (Xie, 2015), and teacher support (Pan & Chen, 2020). The influencing factors of principals' educational technology leadership are complex and diverse, including macro factors, micro factors, subjective factors and objective factors. Our research needs a systematic perspective. This is where complex adaptive systems thinking can play a role.

As early as 2004, the China Educational Technology Association promulgated the "Standards of Educational Technology of China", which for the first time put forward five requirements for educational leaders in educational technology, translated verbatim here from Mandarin into American English:

1. Leaders and managers need to understand the national policies related to educational technology, formulate and implement the educational technology development vision for the school, and clarify the basic composition and operating environment of the relevant information technology system.

2. Education leaders need to make full use of educational technology to optimize the school education and teaching environment - including leading faculty and staff to use educational technology to improve work ability, tap potential, and cultivate innovative technical talents.

3. Educational leaders can use educational technology to support teaching and learning activities in schools - including formulating rules and regulations for the application of technology, promoting the rational application of educational technology in teaching, guiding teaching practice, and ensuring that students have access to high-quality digital learning resource.

4. Educational leaders can use educational technology to strengthen management and improve school management efficiency - including implementing relevant regulations, monitoring implementation to ensure the effective use of educational technology, using technology to communicate with students and teachers, and effectively improve school management.

5. Education leaders need to have information awareness and compliance with technology-related ethics, laws and regulations - including intellectual property and information resource laws and regulations.

From these five requirements, we can see that the construction of educational technology needs to reflect various educational concepts and specific requirements of the country and society in all aspects of school technology construction. There are not only development strategies and laws and regulations at the macro level, but also various entities involved in the practice of school technology at the micro level. Rupert et al. (2008) proposed that the internet is an unstructured, distributed and complex open network containing a large amount of multimedia data. This network is a source of great potential for acquiring knowledge and needs to be screened, organized and maintained for effective use. They argued that the network is similar to a complex adaptive system with self-organized adaptive behavior and proposed to use an adaptive multi-agent orientation to construct complex systems (Rupert et al., 2008). An educational technology system is an abstract expression of a social system. These entities are abstracted into nodes in the information system through the interaction of information among various entities and respective system components.

The concept of a *system* is fundamentally the grasp of one or more relationships (Jackson, 2019). System philosophy emphasizes that the *relationships* among elements is more important than the substantiality of the individual elements. Jiang and Yang (2022) searched the China National Knowledge Infrastructure (CNKI) database with the keyword "leadership” and obtained a total of 1,181 journal articles from 2000 to 2020. They used Cite Space software to analyze the knowledge map and found that only commencing in 2020, did scholars researching schools began to study the connotation of "technological leadership." Most of the research before 2020 includes the construction of a technological leadership model, the internal mechanism of action, the impact on teachers' information application behavior, and research on training paths. Jiang and Yang (2022) argue that the disadvantage of current research is that its range is too narrow and not broad enough to form a necessarily complex multidisciplinary research system blending insights from history, anthropology, and political science.

Chinese scholars studying schools have discussed individually or statically the technological leadership capabilities that individuals or groups should possess (Lu, 2021;Wang, 2020;Yang et al., 2018). There are also some scholars who put the principal in the environment of school education development to summarize the interaction between the principal's technological leadership and school digitalization construction (e.g., Zhou et al., 2021; You, 2021; Lei et al., 2022).

We argue that complex adaptive system thinking may provide school leaders with a framework for understanding major system change and ways to engage, manage, and drive change. In complexity theory, according to Ramage and Shipp (2020), a complex adaptive system refers to a system that is composed of many interconnected parts, and at the same time, these parts can continuously self-organize and adapt to the wider environment. Within the field of organizational management, Jackson (2019) emphasizes that the problems faced by managers are usually chaotic. Because complexity theory promises to find order to our understanding of chaos, it has an irresistible charm. Complexity system thinking can be understood as a theory of change and adaptation that details how change occurs within a system and the principles and mindsets needed to thrive in turbulent environments (Morrison, 2010) – a description apropos for school environments.

In February 2014, the Department of Teachers' Work of the Ministry of Education issued the "Educational Information Leadership Standards for Principals of Primary and Secondary Schools". This seems to be a further refinement of the specific application of 2004 "Standards of Educational Technology of China" in primary and secondary schools. There are a total of six leadership requirements - leading development, collaborative innovation, improving information literacy, planning and design, organization and implementation, and evaluation and promotion. The differences from the 2004 standard are summarized as follows:

1. The 2014 standard proposes that as the organizer of the school informatization construction work, the principal should understand the complexity and systemic nature of this work.

2. Principals should actively cooperate with universities, research institutes and business units to obtain support from various aspects and introduce the development achievements of the school to the society based on the network platform.

3. Principals should organize personnel to formulate vision plans for informatization development as part of the overall development plan.

4. Principals should study and formulate learning plans for teachers' information technology application ability and formulate specific methods for the application of information technology in different disciplines.

5. Principals should rely on the networked virtual training community and learning community to carry out professional improvement learning activities to promote the professional growth of teachers.

6. Principals should regularly evaluate the development and construction of information technology for teachers, students and schools and formulate targeted rectification measures based on the results.

7. Principals should use information technology to manage school personnel and finance, network security, and asset logistics more efficiently.

According to these standards, Principals’ Educational Technology Leadership can be viewed as a series of Complex Adaptive Systems (CAS) of continuous interaction among principals and teachers, students, other departments of the school, and different departments outside the school. Each principal is not only a planner of innovative development and a promoter of system transformation, but also a leader of teaching reform and a modeler of active learning. In a CAS, individual agents interact with each other by acting according to their own rules and principles, adjusting their behavior to achieve their goals (Anderson et al., 1999). Behavior in schools is the result of the interaction of many factors, thus schools are CAS because it is “an emergent phenomenon that is not easily or fully predictable” (Keshavarz et al., 2010, p. 1472). A scoping review of journal articles on schools and CAS by Koh and Askell-Williams (2020) highlights that a key to school improvement is the need to recognize the complexity and adaptability of school systems.

Yunnan Province in China is slightly smaller in size than the US state of California. In 2018, the Yunnan Provincial Party Committee and the Provincial Government began to implement the "Ten Thousand Principals Training Program", organized by the Yunnan Provincial Department of Education and undertaken by Yunnan Normal University. It is planned to complete the training of 10,000 principals, vice principals and key teachers of primary and secondary schools in the province (covering kindergartens, primary schools, junior high schools, regular high schools, and vocational high schools) within five years (2018-2022). According to Kong & Wang (2021), the training plan is divided into ten phases, and 1,000 trainees are selected for each phase to carry out one-semester full-time intensive training. The prefectures and cities in Yunnan are allocated the number of trainees for the program according to the number of their teaching and administrative staff. Trainees are selected with the proportion of full-time principals accounting for 10%, vice-principals accounting for 70%, and key teachers responsible for school education and teaching management accounting for the remaining 20%.

So far, there are only two articles on the Chinese database CNKI analyzing this 10,000 school staff members training program (Kong et al., 2021; Kong & Wang, 2021). According to the survey report of Kong & Wang (2021), the current training mainly adopts listening to lectures (about educational ideas, teaching methods and management experience, etc.), and conducting class discussions in small groups of 50 people after reading two designated books every week.

The training content does not appear to be clearly relevant to actually improving the educational technology leadership of principals or their staffs.

It is not difficult to understand that Yunnan is a province that integrates mountainous areas, frontiers, ethnic groups and poverty. Due to the low level of social development, disconnectedness of local life from wider horizons and interactions, remote geographical environment, and other factors, its educational modernization has been at a low level for a long time. Duan and Gan (2015) point out that a considerable number of schools, education authorities and local governments in Yunnan regard education informatization construction projects as "face projects" to realize political achievements and cope with inspections by higher authorities. In addition, the application of educational technology has technical difficulties for some minority teachers due to too few operational opportunities and insufficient operational training (Duan & Gan, 2015; Ma & Yu, 2020). Kong et al. (2021) analyzed the current situation and characteristics of the implementation of the Yunnan principal training program through questionnaires, group interviews, and field classroom observations. They suggest establishing a talent training data platform to create a community where principals and experts can communicate, learn and grow online (Kong et al., 2021). Such a proposal would be difficult to implement given system inertia already present and its core feasibility and effectiveness would remain to be examined as compared to present arrangements. What is clear is that systems thinking can be better leveraged within the current system constraints in both big and small ways that make it more likely that efficacious training can be enacted, and ongoing professional development achieved.

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Roles, Rules, and Uncertain Outcomes: Redefining Games for Learning

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Abstract

Existing definitions of games fail to differentiate between regular academic activities and games in any meaningful way. According to existing definitions either all graded academic activities are games, or serious games and game-based learning are not games. In this paper existing definitions of games are explored and expanded upon to create a new definition that can draw a necessary line between a math exam and learning games. A discussion of surrogate roles, participants as actors, and uncertainty explains how these terms can be added to existing components of games as being an activity that contains rules to more meaningfully differentiate between what is and is not a game, particularly in the context of learning games. This article does not attempt to define what makes a game good or fun, but rather it includes a new definition of games that includes core elements that can be utilized to adapt academic content into games.

Roles, Rules, and Uncertain Outcomes: Redefining Games

A math exam is definitely not a game, yet it contains many gamelike elements such as rules, goals, even a scoring system. Existing definitions of games either rule that games can not be used for purposes other than entertainment, or that they are unsuitable to effectively distinguish between traditional learning activities and serious games (Stenros, 2016). One of the core concepts concerning what is and is not a game is the idea of play (Koster, 2005). While a game can include serious outcomes such as winning a professional match or gambling for life changing sums of money, there is a differentiation between placing a bet on the roll of the dice and investing funds in a particular stock in hopes of a similar outcome of increased wealth. While Deterding (2013) includes the word "safe" when defining games, there are many forms of games that pose a significant physical risk such as boxing or professional football. To properly understand what separates serious games from traditional education, we must understand the underlying concept of what it is that makes a game. If we fail to do so, educators are free to claim that any graded classroom activity should be called a game or that no activity undertaken for the purposes of learning can be called a game. In either of these cases, the term game, in particular serious games and game-based learning, have no meaning. In this paper, I argue that previous definitions of games have been insufficient to meaningfully break down the concept of games into its core elements and they have not focused on exemplifying the components of a game in a way that would allow for separating learning games from any other academic activity.

Additionally, I will propose a new definition of games with added elements to further clarify the distinction between academic activities and serious games.

Definitions of games

It is generally accepted that games require a set of rules (Koster, 2005; Schaffer, 2007; Stenros, 2016). Schaffer (2007) proclaimed simply that what "makes a game a game is that it has a particular set of rules" (p. 12). Additionally, he applied this definition through an example and stated that two children playing *house* as playing a game. In using the improvisational acting game *house.* Schaeffer suggests that while a game needs a particular set of rules those rules do not need to be particularly well-defined. Furthermore, it implies that a game does not need to have a particular goal or winner to be considered a game. A game of my own experience was the endless game of football on the playground during my fifth and sixth grade years which resembled a professional touch football league in all ways except that the teams were constantly in flux and no one ever kept score. Early versions of the popular game *Minecraft* did not include a way to win the game, but it was still considered to be a game in every respect. This would suggest that while a game may need rules, it does not need clearly defined rules that determine a winner or loser.

The limits of Schaffer's (2007) definition exist in every classroom in which a teacher gives students a test with certain rules, goals, and even a scoring system. Yet no student should be forced to accept that their math test is a game. If the teacher were to inform their students that they would be playing a game and they would be given a score, only to be handed a typical academic test, a mutiny would likely ensue as students would likely not only feel tricked but also betrayed by the notion that a test is any form of a game. While this test may meet Schaffer's definition of a game, it clearly is insufficient to meet what society accepts as a game.

Others have tried to define games as voluntary, unproductive, and make-believe (Caillois, 2001) or as a free activity outside of ordinary life (Huizinga, 1949). Huizinga (1949) even went so far as to indicate that there could be no profit from a game. If there is to be any link made between games and learning as literature on learning games suggests (Stitzman, 2011; Wouters et al, 2013; Zhoggen, 2019) the notion that games are limited to profitless or free activity needs to be overcome. However, other definitions include important components of what is lacking in Schaffer's definition that helps to differentiate between a traditional learning activity and a game. Many definitions of games include the idea of the adoption of roles (Avedon 1971; Juul, 2005; Stenros, 2016; Suits, 1978). Avedon (1971) includes roles for participants as a required element of a game and Juul (2005) describes a game as a representation of an alternate system; these components are largely missing from a rules only approach to defining games. Suits's (1978) definition of a game requires an acceptance of the rules by participants, attempts to overcome obstacles must be voluntary, and that the rules and goal set must be unnecessary. Therefore, even the simplest games require that the participants adopt arbitrary roles and rules that are somehow outside of the necessities of ordinary life. This suggests that the primary reason that test-taking is not a game is because the student is really a student, the test is really a test, and the teacher is really a teacher. There is no make-believe and the situation is only arbitrary in that the teacher has assigned it to the student instead of some other activity. It is not an activity in any way outside of the ordinary life of any of the participants, nor is it particularly voluntary. By voluntarily accepting the rules in attempts to overcome obstacles, participants are adopting a surrogate role outside of their ordinary life. Seeing who can run one hundred yards the fastest is a game because the rules that determine the winner and the loser are voluntarily adopted by the participants. In a true life or death situation, an individual trying to outrun a hungry tiger has not adopted the surrogate role of lunch, but has in fact become it--involuntarily.

Definitions of games that address the gap between reality and games show that games must be separate from reality but connected to it (Stenros, 2016). The insufficiency of Schaffer's (2007) definition regarding reality and Caillois (2001) and Huizinga's (1949) definitions which eschew the very premise that games can serve a primary purpose other than entertainment, makes it is necessary to clarify what can be considered a game in a way that is inclusive of learning games, but not math tests. I propose that a game is defined as:

a voluntary activity involving participants who take on surrogate roles, with rules that define an artificial conflict in which the outcome is uncertain.

Participants and actors

The first piece of the definition that I will discuss is likely the easiest to gloss over, the inclusion of participants. The use of the plural word 'participants' is incredibly important in understanding what is taking place in a game. While an assumption may have been made that participants would require multiple conscious beings, this is not the case. The word participants is designed to be read as the term agent was used in Sicart's (2008) definition of game mechanics. Sicart used terminology from computer science's object oriented framework to define agents as actors in a game that are either human or artificial. So too should participants include both human and artificial participants in a game with one caveat: without at least one conscious participant, there can be no game. If two computers are set up to play *Chess*, it is the human that sets them up who is playing a game.

Having multiple participants would allow for a randomized deck to serve as one participant in a game of solitaire in much the same way that the computer is a participant by randomizing bomb locations in *Minesweeper.* The player has adopted the role as the player trying to order the cards or find the bombs, the deck or computer participates by providing a randomized challenge, and there are rules that must be followed in the process. It is even possible that the participants in a game could be a single individual taking on multiple roles or comparing previous scores making their past self into an opposing participant. Requiring multiple participants is not intended to rule out the gamification of self improvement. Comparing your own results is oftentimes considered a game where an individual is competing with their past self. In this case the two participants are the separate actions of an individual at two distinct points in time.

Game design theory allows for acceptance of a broad definition of the term participants to include automated actors which then should be extended to non-digital actors. Recent cooperative games such as *Pandemic* and *Forbidden Island* rely on a randomized deck to operate as the 'computer' providing various challenges for the player to overcome. Games from the 1980s, such as *Warhammer Quest,* include rules for automatic enemy movement as a form of early analog artificial intelligence. These games allow for single player play while the combination of randomization and automated enemy movement provide artificial participants as well as create a situation with unknown outcomes. Therefore, participants in a plural form must be involved in our definition of a game.

It is important that the human participant(s) be accepting of the rules and roles of the activity voluntarily. While some level of coercion may exist to encourage an individual to participate in the game, acceptance of the existing rules and roles are necessary to actually enter into the playing of a game. Individuals finding themselves in a desperate financial situation may see gambling as the only way out, they are still voluntarily accepting the rules of the game and their roles within it.

Adoption of surrogate roles

The adoption of surrogate roles is a necessary component of separating a game from everyday life. When playing *Chess* or *Go* one player adopts the surrogate role as the black pieces and the other adopts the surrogate role as the white pieces. There may be an additional surrogate role as the commander of an army or perhaps playing as the king. Meanwhile, in *Go* the surrogate simply addresses which pieces will belong to a particular player. Similarly, in a game of chance such as *Roulette*, a player adopts a role by placing their bet on a particular square thereby adopting the surrogate role as desiring that number. In more complicated games the player may take on a surrogate role as an army soldier or mythological hero while the computer system handles the roles of villagers, monsters, and oversees the game board. In all of these games the adoption of a role is a necessary component of playing the game as it provides additional meaning to the activity beyond the activity itself.

Surrogacy and reality

Surrogate roles must be distinctly different from an individual's real world roles, however, they can mirror them. Schaffer (2007) includes the example of his daughters playing house in which the older sister plays the role of the older sister and the younger sister plays the role of the younger sister. While his children are adopting roles equivalent to their actual roles, they are truly taking on a stereotype of their natural position in the family structure and in this way are acting as a surrogate for their own role in the family. If the younger sister were to stamp her feet and proclaim she doesn't want to eat her vegetables, she is doing so as a proxy for the action that she imagines is within the appropriate rules for her role. If she were actually being forced to eat her vegetables, she would no longer feel that this was a game and likely wouldn't want to play any more. However, the adoption of surrogate roles may be simpler than picking one color of marker or another.

In many basic rules systems, accepting the role of player or participant is all that is necessary to play a game. In a race, the game requires the participant(s) to adopt the role of racer and accept the rules that the first person to cross the finish line becomes the winner. An individual who does not accept the role of racer, is not playing a game. Surrogacy, in this form, is the attempt to overcome unnecessary obstacles (Suits, 1978) or create an artificial conflict (Salen & Zimmerman, 2004). If the conflict is necessary or not artificial (i.e. a math test or real military conflict) we can no longer define it as a game. Additionally, a game can be made of a common activity simply by setting unnecessary obstacles or artificial conflict. Attempting to stack more bricks in ten minutes than you previously did is an example of creating an artificial conflict. While stacking bricks may not be an activity outside of everyday life, the goal of stacking them faster than you previously did is turning your labor into a game--although, not a particularly fun one.

The added term of surrogate roles to the definition of games is vital to understanding how games operate as it clarifies the two primary sources of player interest in games. Imagine the simple game of throwing rocks into a paper cup on the side of the road. Clearly the objective, getting the rocks into the cup, is not particularly difficult without rules defining where one must throw from. In this way the rules define the challenge by defining the requirements to score. However, roles must be also defined such that I can only get points for rocks that I throw while my roadside companion only gets points for rocks that they throw. In this simple game, entertainment is generated on one side from the rules, and on the other by the roles adopted by the participants.

Very simple games, such as not stepping on sidewalk cracks, use the rules to provide entertainment primarily by nature of the challenge of meeting them. Other games, such as house, draw entertainment primarily from the roles adopted. Generally it is in the confluence of roles and rules that games use to provoke interest. While it is roles and rules that cause a game to exist, it is the interaction of roles and rules that determine the overall quality of a game. It is not the individual quality of roles and rules that create a great game, but the ways in which they support one another in the form of game mechanics (Hocking, 2007; Ke, 2016).

Puzzles and games

The nature of surrogacy is incredibly important to the nature of what is and is not a game but this definition seems to run contrary to the theory that games are puzzles (Koster, 2005). More accurately, we suggest that puzzles are not games, unless one wishes to consider even attempting to solve a puzzle to be a surrogate role. While puzzles do contain a clear set of rules, they fail to include the adoption of surrogate roles. In a puzzle, you play yourself trying to solve the puzzle. While a maze puzzle may suggest that you are a rat attempting to find the cheese, the reality is that you are just you, trying to solve a maze with a picture of a rat near the entrance and a picture of the cheese near the exit. The maze is no more or less a game than is attempting to solve a particular algebraic equation. In algebra, you have not adopted the role as 'x' simply because it is the variable for which you are attempting to solve. Lacking in surrogate role adoption, puzzles are not, in and of themselves, games.

However, most games include a number of puzzles within their rules structure. In a game such as tic-tac-toe, every turn represents a puzzle to be solved, followed by the unknown response of your opponent, which in turn presents another puzzle. But Koster's (2005) definition does not account for the game that is the bane of my parenting existence, *Candy Land*. While I often rant about *Candy Land* not meeting the requirements of being a game to my game design students, they firmly hold to the belief that it is, infact, a game. My argument with my students is intended to be thought provoking because any five year old familiar with it will insist that *Candy Land* is a game and that you should probably be playing it with them right now. However, *Candy Land* is not a puzzle; it is not even a solved game like *Tic-Tac-To*e in which every outcome is predictable. *Candy Land* is a scripted randomized adventure. There is no strategy, there is no decision tree, there is no puzzle. There is a deck, there are colors, and there are little gingerbread men who act as your surrogate on a bright and happy sugar-filled adventure. Much as I hate to admit it, *Candy Land* is a game.

Considering the necessary addition of surrogate roles we find it necessary to expand beyond a rules set in order to call something a game. The existence of surrogate roles is the delineation of something that is real and something that is a game, as rules sets can be found in all manners of human experiences we would not consider a game. But rules and the adoption of roles alone is insufficient to fully define what is or is not a game. In all games we must look to uncertainty in our outcome.

Uncertainty and unknown

The primary source of entertainment in *Candy Land*, if one is to be found at all, comes from the unknown order in which the deck will be revealed. Children delight at suddenly and inexplicably pulling ahead and bemoan falling upon a licorice square and losing turns because these outcomes are unknown. Meanwhile, adults are unimpressed as these successes and failures have little to do with their skill at flipping the top card of the deck. Uncertainty plays a vital role in our understanding of what is a game and what is not.

Most commonly uncertainty in games is provided through randomization. Game designer Mark Rosewater (2012) labels “surprise” as one of the 10 necessary components of games and Shelton and Scoresby (2011) note that learning game elements “includes motivation-inducing attributes of challenge, proclivity, and uncertainty, yet directs [students] toward the learning goals” (p. 119). Table games will commonly use dice, a randomized deck, or a spinner as a method to inject uncertainty into games while video games may randomize enemies, loot, or game maps. But many classic games do not need any form of randomization in order to contain uncertainty. Games without inherent randomness rely on another participant to provide uncertainty absent dice, cards, or a spinner. While a game of *Chess* between a grandmaster and novice will have a predictable result, the exact steps to reach that outcome is unknown to both players. While experts at fighting video games may have very similar matches against the AI, their ability to press the button at the exact right time still remains uncertain each time they play. Even in a game such as Tic-Tac-Toe where the result can be determined, the space in which an opponent will place their mark is unknown.

The uncertainty aspect of games is important because a theatrical play would generally not be considered a game. In this case the outcome of the play is predetermined by the actors and the audience would not be considered participants in the show. If actors were to go off script they could be playing a game with one another but when interacting with the audience, the audience members have generally not adopted a surrogate role and while the outcome may be unknown not everyone is in on the game. Improvisational acting is frequently made up of “improv games” and even an entirely improvisational show could be described as playing house with an audience. The unknown that audiences experience at the theater is a facade, especially considering that some of them may have seen the play before. Therefore, the game only exists when participants encounter uncertainty in their surrogate roles.

Exploring the definition

Stenros (2017) offers ten questions regarding any definition of games based on their literature review definitions of games. The questions serve to question the components of a definition of games as well as investigating the need for further definition. We provide answers to these questions based on our new definition in Figure 1.

Figure 1. Answers to Stenros’ Questions Regarding a Definition of Games.

Question (Stenros, 2017, p. 515)	Response
What are rules?	A rules set defines limits to behavior as acceptable or unacceptable within the context of the game.
Do games have a function?	Games do not require a specific function to be defined as a game.
Are games an artifact or an activity or a muddle of the two?	The word “game” is used to refer to an activity that meets the definition of a game, it also can exist as an artifact used for the playing of a game. Monopoly exists as a game both when it is played as well as while it is sitting on the shelf.
How games exist in relation to the quotidien?	The acceptance of surrogate roles and a rules set outside of the quotidian are necessary for an activity to be considered a game.

What are players?	Participants as actors in the game, both human and artificial, who take actions to affect the game state. At least one sentient participant is necessary.
What do games produce?	There is no requirement or restriction for production from a game however there should be a perceivable outcome. This outcome does not necessarily need to be defined as a goal or result.
What is the role of competition?	Competition is common in games but not necessary. Competition is but one way to produce an unknown outcome.
What about goals?	Goals are common but ultimately unnecessary to define a game. Many games have existed with no defined goals.
What sorts of phenomena are relevant for games?	A voluntary human participant, an unknown outcome, rules, and the adoption of a surrogate role.
What purpose do definitions serve?	This definition exists to define the core elements of games in such a way that includes serious games within the larger context of games while excluding traditional academic activities. It further offers specific contextual points for the altering of traditional learning activities into games.

Discussion

Seeking to build on Schaffer's (2007) definition of a game, this article covered the necessary addition of surrogate roles, uncertain outcomes, and the term 'participants' to his definition. While not discussed in depth here, rules are agreed upon as a vital part of games across disciplines. This new definition allows game designers, theorists, and evaluators to have a meaningful structure by which to analyze the necessary components of a game to examine its use of these components to create meaning. This definition also allows for serious games to meet the definition of actually being games. One notable component that this definition leaves out is the existence of fun, upon which volumes have been written. It turns out that fun does not require a game, and games do not require fun. However, fun is generally a necessary component of good games (Csikszentmihalyi, 1975, 1990; Prensky, 2001; Koster 2005). If researchers are to continue to examine what makes games great, they must further examine the relationship between participants, uncertain outcomes, rules, and surrogate roles.

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Servant Leadership and The Instructional Design Process

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Abstract

The COVID-19 pandemic highlighted the critical role instructional designers play in helping faculty transition their course delivery to an online platform (Aschaiek, 2021; Nworie, 2021; Xie, Gulinna, & Rice, 2021) and create inclusive learning experiences for students (Pilbeam, 2020). An essential aspect of the instructional designer's consultation practice with faculty involves building collaborative, productive, and trusting relationships while helping them develop the skills and competencies necessary to design or revise their courses (van Leusen, Ottenbreit-Lefwich, & Brush, 2016; Schwier & Wilson, 2010). When instructors understand their roles and responsibilities with instructional designers in the course development process, they are more likely to consider innovative teaching strategies that align with evidence-based practices and engage students (Halupa, 2019). We can use the lens of servant leadership to understand how the relationships between instructional designers and faculty develop and influence faculty adoption of new pedagogical strategies.

Introduction

Servant Leadership

In his seminal work, Andrew Greenleaf (1991) described servant leaders as those persons who take care to ensure that "other people's highest priority needs are being served" (p. 15). They model and practice leadership as a service. Drury (2004) shared an operational definition of servant leadership as

> An understanding and practice of leadership that promotes the good of those being led over the self-interest of the leader. Servant leadership promotes the valuing and development of people, the building of community, and the practice of authenticity, the providing of leadership for the good of those led, and the sharing of power and status for the common good of each individual, the total organization, and those served by the organization. (p. 7).

Researchers have found that the practice of servant leadership increases trust (Savage-Austin & Honeycutt, 2011), productivity (Grisaffe, VanMeter, & Chonko, 2016), and information exchange between leaders and organizational members (Sousa & Dierendonck, 2016). Spears (2010) identified ten essential attributes of servant leaders:

1. Listening.
2. Empathy.
3. Healing.
4. Awareness.
5. Persuasion.
6. Conceptualization.
7. Foresight.
8. Stewardship.
9. Commitment to the growth of people.

10. Building community.

Further, servant leaders also humble themselves and place the needs of others first (Wheeler, Ser2012). Russell and Stone (2002) noted that Spear's list of characteristics was not exhaustive and that other accompanying attributes supplement the servant leader behaviors in the workplace and their ability to connect with others on a personal level. These attributes include:

- Trust - "the assured reliance on the character, ability, strength, or truth of someone or something" (Merriam-Webster, n.d). Russell et al. (2002) noted people develop trust through direct interaction with one another and that followers are more likely to rely on and have confidence in the decision-making processes of trustworthy leaders. Russell (2000) stated that trust must be earned.
- Credibility - "the quality or power of inspiring belief" (Merriam-Webster, n.d). When people demonstrate relevant expertise in a given field, their legitimacy and leadership credibility is enhanced.
- Competence – Possessing the skills, knowledge, and abilities necessary to perform a job and demonstrate competence among their followers.
- Communication and Vision – Articulating the organization's mission, vision, and goals and the work to be completed now and in the future.
- Delegation – Giving followers the opportunity to take ownership in completing a task.
- Encouragement – Persuading others by intentionally seeking to build their self-esteem so they would not be hesitant to try new things.
- Persuasion – Collaborating with others to develop a shared understanding of the task at hand and develop a consensus on a recommended solution (presented by the leader) to move forward.
- Pioneering – Thinking "out of the box" by taking risks and having the courage to lead others in implementing new innovative strategies.
- Teaching – Identifying and developing the talents of others so that they can lead themselves and others. Russell et al. (2002) commented that servant leaders teach trust leading by example and through coaching.

However, personal characteristics of servant leaders are not enough to successfully lead others in their efforts to accomplish organizational goals. In a systematic review of servant leadership literature, Coetzer, Bussin, and Geldenhuys (2017) found that servant leaders should possess the competencies of empowerment, stewardship, building relationships, and articulating a compelling vision for their efforts in a systematic manner to achieve goals. (See Figure 1 Servant Leadership Attributes and Competencies). Empowering others includes creating an environment in which others can learn and grow on an individual and professional level, participate in collaborative decision-making and problem-solving experiences, build confidence, and work to their strengths. Stewardship encompasses being accountable as a leader to facilitate the successful completion of tasks or project goals. Building relationships involves bringing people and teams together and developing relationships based on trust and respect of others and their capabilities. Finally, the servant leader will articulate a clear, compelling vision, so that others can conceptualize, plan, execute, and understand the value and importance their work brings to the endeavor. They demonstrate the importance placed on others by listening actively and intently and incorporating their values and opinions into decision-making. Servant leaders work with integrity and use their interactions with others to continually improve their professional practice in their service to others.

Figure 1
Servant Leadership Attributes and Competencies

Instructional Design Work

Instructors often find the processes of designing a new course, redesigning an existing course, or transitioning a course from a face-to-face to an online or blended format to be complicated endeavors (Chiasson, Terras, & Smart, 2015). One strategy instructional designers use to address this challenge is through the use of an instructional design model. Branch and Dousay (2015) commented that these models could be used to "visualize, direct, and manage processes for creating high-quality instruction… and assist us in selecting or directing appropriate operational tools and techniques" (p. 24). An important aspect of the instructional designer's course design and development practice involves building collaborative, productive, and trusting relationships with instructors as they help them develop the skills and competencies necessary to design their hybrid/online courses (Schwier & Wilson, 2010).

When we consider the use of instructional design models through the lens of servant leadership, these models help instructional designers communicate and develop a compelling vision for the course design and development work with instructors. Also, these models help instructional designers organize their work with instructors by breaking down the course development cycle into component processes/strategies thereby aiding in the instructional designer's ability to mentor instructors as they develop their courses. Table 1 provides an example of how servant leader attributes and competencies could be applied to the ADDIE model of instructional design, which includes Analysis, Design, Development, Implementation, and Evaluation phases .

Table 1
Servant Leadership Attributes and Competencies

Phase & ID Activities	Servant Leader Attributes	Servant Leader Competencies
Analysis The instructional designer (ID) meets with instructor or subject matter expert to discuss instructional goals and objectives, learner characteristics, environmental constraints, possible pedagogical strategies, and implementation timeline.	• Listening • Communication • Competence • Trust • Vision	• Building relationships • Articulating a compelling vision
Design The ID collaborates with the instructor in planning the course structure. This process includes systematically creating and reviewing learning objectives, formative and summative assessments, storyboards, instructional content, and select instructional media to achieve project goals. Appropriate instructional pedagogical theories and instructional content are also applied.	• Listening • Communication • Competence • Delegation • Encouragement • Pioneering • Teaching • Vision	• Empowerment • Stewardship
Development During this phase, the ID and instructor continue their collaboration as they work together to create and organize content and activities; integrate instructional strategies and technologies; and test user interfaces. (The ID might train instructors on various teaching strategies).	• Listening • Communication • Competence • Delegation • Encouragement • Teaching • Pioneering	• Empowerment • Stewardship
Implementation	• Communicating	• Stewardship

Instructors teach their course. The ID is available to answer any question the instructor might have.	• Competence • Encouragement	
<u>Evaluation</u> Evaluation occurs throughout each phase of the ADDIE model. The formative evaluation process includes evaluating instructional strategies and materials and is designed to improve the process and delivery of instruction. The summative evaluation process is designed to assess the learning effectiveness and the extent to which learners achieve learning goals.	• Communication • Encouragement • Listening	• Stewardship • Articulating a compelling vision (for the next ADDIE cycle)

Inouye, Merrill, and Swan (2005) described the instructional design field design as a helping profession designed to improve learning and foster growth in instructors and learners. While there is an extensive body of literature describing the technical competencies necessary for successful instructional design work (Tracey & Boling, 2013; Larson & Lockee, 2009), the philosophy and practice of servant leadership can also inform our understanding of how collaborative relationships evolve between the instructional designer and instructor. Hunter et al. (2013) noted in their study of a sales organization that servant leadership can foster a service climate in organizations in which “the customer’s needs are highly valued and carefully addressed” (p. 321). In addition, these researchers argued that servant leadership promotes the value of helping behaviors among employees and fosters an environment in which employees want to stay and work. These outcomes can be translated into the work of the instructional design organization and the consultative practice of the instructional designer with an instructor.

Research Questions

This research will examine the influence of four servant leader competences on the professional practice of instructional designers and faculty by investigating the following research questions:

For instructional designers:

- How do you go about building relationships and trust with the faculty?
- How do how do you approach helping faculty members develop a vision for their course?
- What does stewardship mean to you?

For faculty:

- Based on your participation in this workshop and work with the instructional designers, what new pedagogical strategies will you try in your course?

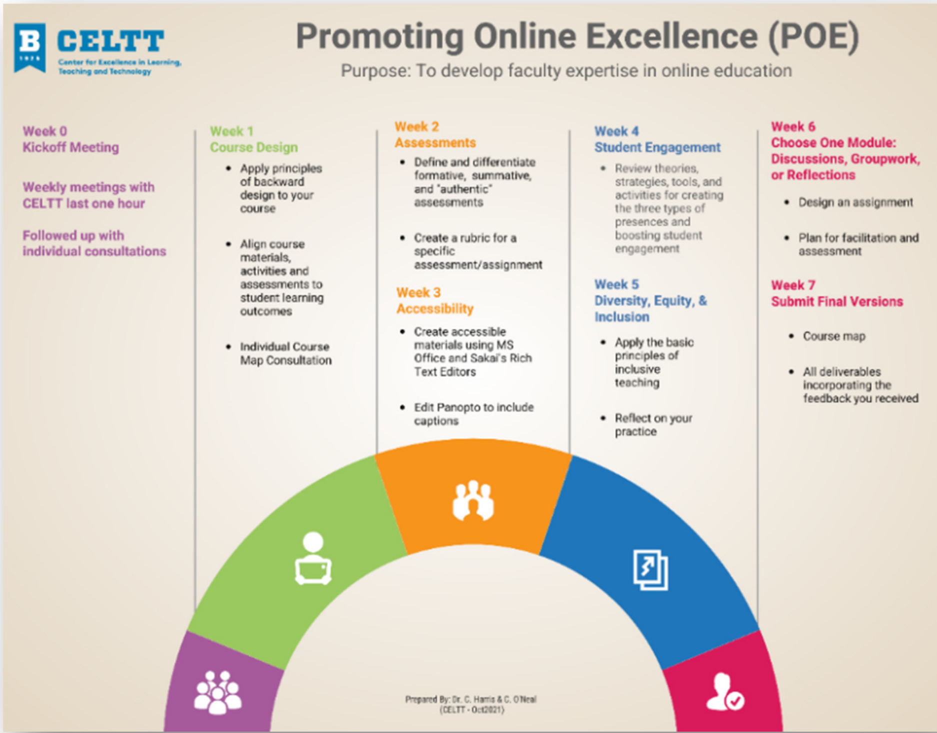
Many instructors must transition their pedagogical strategies from teaching traditional face-to-face courses to teaching online courses. To address this challenge, universities provide professional development opportunities (Leary, Dopp, Turley, Cheney, Simmons, Graham, et al., 2020). Researchers provide recommendations to help guide colleagues in their efforts to design and facilitate online experiences. Fiock (2020) commented, "while the Community of Inquiry (COI) presences are important, they are of no use to instructors or instructional designers without guidance on how to foster them in online environments" (p. 139). The COI framework is a process model outlining how the interdependence of core elements (social, cognitive, and teaching presences) can be structured to create a deep and meaningful online educational experience for students (Garrison, Anderson, & Archer, 2010).

Study Context (Setting)

Three instructional designers, Victoria, Angela, and Michelle, participated in this study. They had extensive experience in adult education, higher education, and corporate training. In addition, faculty participants in this research included two instructors from the College of Arts and Sciences, Professor Alexander and Professor Daniels, and one instructor from the College of Public Affairs, Professor Shaw. These faculty participated in the seven-week Promoting Online Excellence (POE) training program at a public university in Maryland. Victoria, Angela, and Michelle served as co-facilitators in the delivery of the POE program.

Promoting Online Excellence (POE) combines faculty self-paced work with cohort work and individual consultations with instructional designers. This seven-week training program aims to develop faculty expertise in online education. See Figure 2 for workshop components. See Figure 2 for workshop components.

Figure 2
Promoting Online Excellence (POE) Timeline



Methodology

This study employed a hermeneutic phenomenological approach to examine how instructional designers applied the servant leadership competencies of building relationships, empowerment, stewardship, and articulating a compelling vision in their consultative practice with faculty during a seven-week professional development workshop designed to help faculty develop expertise in online education and whether these servant leader competencies prompted faculty to consider implementing innovative teaching practices in their courses. Laverty (2003) stated the focus of the hermeneutic approach is to illuminate details within an experience to create meaning by understanding a person's culture, historical context, and how they are embedded in the world.

Data Collection

Data was gathered by conducting qualitative interviews. Patton (2002) stated " the purpose of qualitative interviewing to capture how those being interviewed view their world, to learn their terminology, and to capture their complexities of their perceptions and experiences" (p. 348). Three faculty and three instructional designers were interviewed following their facilitation and participation in the online teaching workshop, respectively.

Interviews

The instructional designers and faculty members participating in this research signed informed consent forms before they participated in this research. The researcher used a semi-structured interview protocol, anonymizing participant responses. In addition, the researcher used Microsoft Teams to record and transcribe interviews. The researcher asked the instructional designer participants about their professional background and consultation process, how they built relationships with faculty, how they helped faculty develop a vision for their course, and stewardship. In addition, faculty were asked questions about their professional experiences, a pedagogical challenge in a course they hoped to address by enrolling in the workshop, and whether they would implement any changes in their class.

Data Analysis

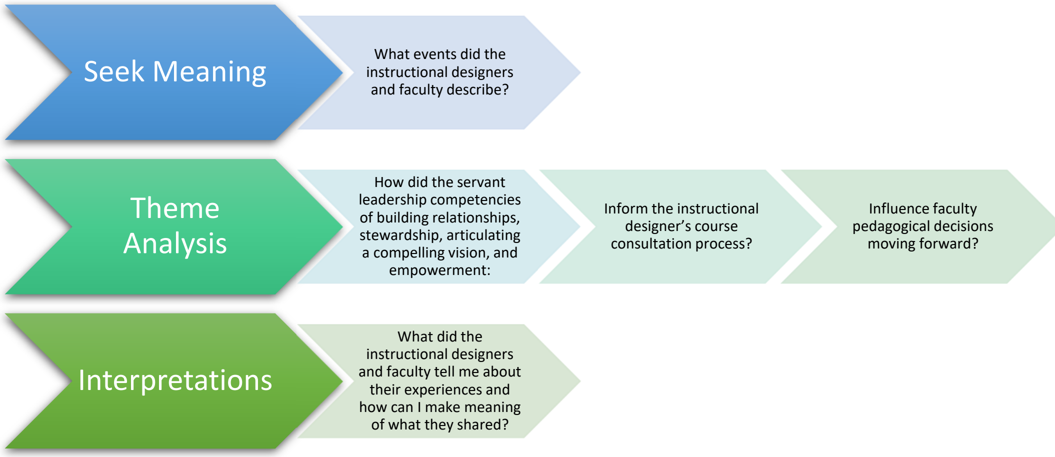
Data were analyzed using a hermeneutic phenomenological methodology to interpret the lived experience of instructional designers and faculty members during their participation in the POE program. Laverty (2003) identified distinctions between phenomenology and hermeneutic phenomenology and stated:

> Phenomenological research is descriptive and focuses on the structure of experience, the organizing principles that give form and meaning to the life world… Hermeneutic research is interpretive and concentrated on historical meanings of experience. This interpretive process includes explicit statements of …philosophies that are guiding interpretation as well as the presuppositions that motivate the individuals who make the interpretations. (p. 27)

Lauterbach (2018) noted that hermeneutic phenomenology allows for collaboration between the researcher and participants to develop a shared understanding of the phenomenon under study. Crowther, Ironside, Spence, and Smythe (2018) stated that this methodology highlights essential "but hidden" aspects of the lived experience. According to van Manen (1997), there are four ways in which people experience their lived experiences or "lifeworld:" existentials through the *lived body* (corporeality), our physical presence in everyday life; *lived human relations* (relationality), how we interact, communicate, maintain and develop relationships with others; *lived space* (spatiality), how we experience the spaces (environments) that we find ourselves in; and *lived time* (temporality), how we experience time and moments in our lives and the constraints placed on that time. Rich, Graham, Taket, and Shelley (2013) commented that the lifeworld existentials interact with one another and present a helpful framework in which to explore a phenomenon.

For this study, the data analysis process involved seeking meaning, theme analysis, and reflective interpretation (van Manen, 2007). The first step in the analysis process of seeking meaning encompassed reading the transcripts of the instructional designers and faculty members and placing answers to questions in an Excel spreadsheet, guided by the question: what events did the instructional designers and faculty describe? The second step was analysis and aggregation of subthemes encompassed in instructional designers' and faculty members' lived experiences. The overarching questions for this phase of the analysis were: How did the servant leadership competencies inform the course consultation process and influence faculty pedagogical decisions moving forward? The third step was the interpretation of the results and included my reflections about the consultation process as well. (See Figure 3).

Figure 3
Steps involved in Hermeneutic Phenomenological analysis



I used three existential (lifeworld) views, lived relations, lived space, and lived time, to explore how servant leadership competencies informed the instructional designers' consultative practice and influenced whether faculty adopted new pedagogical strategies because of their participation in the POE program (or due to their participation in the POE program). Below, I present an explanation with examples of each of these existential views.

Building Relationships (Lived Space). The lived space encompasses the environments in which we find ourselves daily. How we experience space is subjective based on whether we feel safe or uncomfortable. The instructional designers facilitated the POE workshop work with participants having varied online teaching experiences. Victoria commented:

> *With Poe we tried to establish our cohort as well, you know, and make Faculty feel comfortable sharing and establishing an environment where they could bring in ideas and drafts of things and bounce that off their colleagues for ideas. So I think that (strategy) worked well with establishing, you know, just building a community and establishing that Faculty are experts in this as well. So they can help each other. It's not just instructional designers telling them what to do. POE is a non-judgmental zone.*

As their time in POE progressed, faculty participants became more comfortable discussing pedagogical strategies and seeking information from one another. Michelle stated:

> *In breakout rooms you…. You let them know that their questions and contributions were important. [Faculty] were more open to providing answers to questions, sharing more information about what they (or their colleagues) were doing in their courses, and giving suggestions. We even had one faculty member soliciting other faculty members to critique what she submitted. They were all open to a kind of self-evaluation.*

Stewardship and Building Relations with Others (Lived Relations). The lived relations view encompasses how we communicate, interact, and develop relationships with one another. This view frames how instructional designers built relationships and trust with faculty. For example, Victoria commented, *"establishing trust with faculty means being flexible... because faculty are people first and the work comes second."* As a steward, Angela commented *that "it's serving in a community that I think I belong to and care about. And being a leader, being engaged member, doing my best to improve it."* These comments inform the philosophy of service members of the instructional design team bring to their work.

Building trust with faculty. Building trust with faculty begins with respectfully talking to faculty and listening to what they have to say. *Victoria stated, "I found it helpful to have one-on-one conversations with faculty… to provide a listening space for them... Communicating clearly, responding to faculty needs, and following through are essential when establishing trust. You do not want over promise and under-deliver; you want to reverse that. You want to exceed expectations as much as you can."*

> Professor Alexander has known Victoria for several years, including working with her on POE and commended her work ethic. *From the beginning, Victoria's just had the quickest and the fastest solutions. If she doesn't know the answer, she goes out of her way to find it for you. So, I'm excited about whatever project I will bring her. Whatever problem I'm trying to solve. I'm not asking just because I want to know, but because I'm going to, you know, follow through and use it. There's a lot of trust that goes both ways. If I'm in a room with other people who are questioning, how valid her strategies are, or whether something works like she knows she has an ally in me as well.*

It is also important to serve for instructional designers to serve as collaborative partners with faculty. For example, Victoria stated, "*the course map is important, a vital process, and a document to create. But even before that, faculty need to discuss it and think about what they want it look like before grounding it in alignment and learning outcomes*." Angela said "*I ask a lot of questions. So I listen a lot to what faculty are talking about their likes and worries, their questions, and what they ask in POE. Then I make sure that I listen to all of that and think about it. Making connections with people is done well when they think or they know that I am valuing their time, valuing their effort."*

Empowerment (Lived Time). This lifeview helps us to understand "how individuals experience their world on a temporal level" in each situation (Rich, Graham, Taket, & Shelley, 2013, p. 501). Individuals' feelings, constraints, and demands also influence how they experience time. POE linked the concept of time to group participation in cohort meetings, instructional designers' individual consultation meetings with faculty, and faculty preparation of POE deliverables. Michelle commented:

> *We asked the faculty to review the content in each module in Pressbooks and develop any questions they would want to bring to the meetings once we got in the meeting… So we'd have them ask questions, and it was just the back and forth of sharing information and what they had learned that really helped the faculty understand their role even further.*

Professor Shaw described his experience working with Victoria and Michelle to make his syllabus more accessible. He stated:

> *So, I had to spend some time correcting [my document for accessibility issues]. I'm just a private session with the two of them. And they helped me out. Michelle also took the time to go over the various student outcomes and how to revise them, so they are more active. So that was extremely helpful. I think it made it [the syllabus] much better. How they managed to do this, I don't know, but they [Victoria and Michelle] managed to interject at the proper times and places. And once I got that format, I applied it to all my courses.*

While POE aims to develop faculty expertise in online education, sometimes faculty face instructional and pedagogical challenges that may be barriers to adopting new strategies in their teaching practice. Victoria commented, *"It's going back to that idea of planting a seed; sometimes you work with people who are there and engaged [in POE], but they're kind of*

resistant to the ideas and might not want to devote the time to developing deliverables."
Professor Daniels stated:

> *In the POE meetings, we talk about best practices. If I find out that at least half the other instructors in my department are using true-false exams and I'm giving essay exams, I realize that I'm an outlier, and either I go with the pack or try to convince the pack (to change).*

Conclusion

The lifeworld existentials of Lived Space, Lived Relations, and Lived Time provide an opportunity for members of the instructional design community to consider how servant leadership competencies of building relationships, stewardship, and empowerment can inform their professional practice. The instructional designers in this research highlighted the importance of respecting faculty expertise. When building relationships with faculty, they made a conscious effort to create a community and environment (lived space) in which faculty felt comfortable sharing ideas, asking questions, and seeking feedback from colleagues. Further, regarding the importance of stewardship, building relationships, and empowerment, the instructional designers discussed the importance of establishing trust with the faculty (lived relations) by following through on commitments, being flexible with deliverables, and listening to faculty (empowerment), because "people come first, and the work comes second." This research suggests that faculty are more willing to adopt new pedagogical strategies in their courses when instructional designers integrate the competencies of building relationships, stewardship, and empowerment in their professional practice.

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Improving Online Learning Engagement Through a Kid-Teach-Kid Approach for High School Students During the Pandemic

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Abstract- Online learning sessions have become an indispensable complement to in-classroom learning sessions due to the emergence of Covid-19 and social distancing. However, online learning imposes significant challenges ranging from a lack of motivation to a lack of social interaction, which can hinder students from engaging effectively during the learning sessions. To resolve these problems, Project PWR, a non-profit organization founded by high school students, developed an online kid-teach-kid learning environment where student-teachers teach other students about their passions or interests. This research aimed to determine the effect of a kid-teach-kid learning model on the performance of online classes. We used a mixed-method design to address the three challenges we identified, including teacher surveys, student surveys, observer evaluations, classroom statistics, and one-on-one interviews. The results indicated that Project PWR's teaching model had positive support for boosting students' learning interests and improving students' engagement during online learning sessions.

Index Terms- Covid-19; Online Learning; Student-Centered Learning; Student Engagement

I. Introduction

With the upward trend of Coronavirus cases during the pandemic, high school students' in-classroom education has drastically transformed, shifting to more abundant and robust online learning methods. Studies show that since the coronavirus outbreak, 93% of U.S. parents with K-12 children said their child had had some form of online instruction [1]. Despite the prominence of online classes, tutoring, or seminars, they still lack interest or are unbeknownst to most students. Recent studies [3][4] highlight learning challenges that arise in an online environment: highlight learning challenges that arise in an online environment:

Challenge 1: Many students lack motivation and concentration during online sessions, leading to decreased engagement between the student and the teacher.

Challenge 2: Due to the one-way nature of the online learning process, it is challenging for students to consult with the instructor about content that they feel requires a more in-depth explanation or comprehension.

Challenge 3: Online environments lack student-centered learning, which focuses on the needs, abilities, interests, and learning styles of the students.

Many pre-pandemic online learning methods later used during the pandemic face one or more challenges. This is because they were designed to function in conjunction with in-person learning and not solely used alone.

A common form of distance learning, online tutoring, comprises an adult that helps a student review class content, offers help with problems, and goes through homework. However, common technological issues, such as low-quality audio and video, make it hard for a tutor and tutee to develop a personal connection. This relates to the matters stated in challenges one and two. Furthermore, online learning tools lack the interactivity of in-classroom tools. For example, in-classroom tools like labs are hard to replace in an online environment. This relates to issues stated in challenges one and three. Another form of distance learning, webinars, educates students on a subject in a structured manner. Much like online tutoring, webinars lack the interactivity and engagement of students. Learning environments of webinars are often one-directional, with instructors giving their lectures while students pay attention to the lesson.

Project PWR created an online kid-teach-kid learning environment to take advantage of virtual and student-centered learning to address the hurdles of online learning and enhance learning interests. By replacing a traditional teacher with a student-teacher and altering the learning environment, Project PWR hopes to address the previously stated challenges by solving the online education issues on how to match an online environment, which compares to a traditional in-person environment. Through Project PWR, we showed that the kid-teach-kid learning model effectively supplements the traditional teacher-centric model that Covid-19 has significantly impacted. Project PWR enables kids to share their interests and effectively bond with one another, making the learning environment effective and promoting healthy personal one-on-one interactions.

In this study, we measured the effectiveness of a kid-teach-kid learning model on the performance of the students and teachers in terms of the 5E Model of Instruction [2] and Affinity Space. We study the online learning performance of the students impacted by the presented three challenges. Challenge 1 was addressed since student-teachers and students attend courses based on their interests, therefore, are motivated intrinsically. Challenge 2 was addressed since student-teachers and students can develop an affinity space, making classes more open for discussion and collaboration. Challenge 3 was addressed with the intervention of Project PWR, where syllabus templates and advice were given to student-teachers to help them make their courses more student-centered and engaging.

In the rest of the paper, Section II presents the background of effective teaching strategies that Project PWR has incorporated to address the learning challenges previously stated; Section III demonstrates Project PWR's implementation of a kid-teach-kid model and its relation to the learning strategies mentioned in Section II; Section IV presents the Project PWR's l research hypothesis; Section V presents an kid-teach-kid class as an example to evaluate the effectiveness of kid-teach-kid education; and finally, we conclude this research in Section VI.

II. Background

A. 5E Model of Instruction

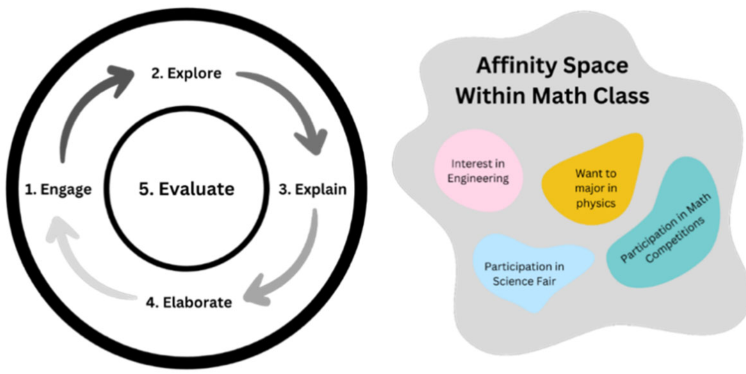
Some schools have leaned towards using the 5E Model of Instruction [2], highlighted in *Figure 1*, to improve student learning during the pandemic, which includes five phases: Engage, Explore, Explain, Elaborate, and Evaluate. By utilizing these concepts, teachers can create a student-centered learning environment; rather than teachers simply handing the information to them, students will explore topics mainly by themselves.

- **Engage**: "The first phase of the 5E Model engages students by having them mentally focus on a phenomenon, object, problem, situation, or event." Teachers should focus on identifying the current knowledge students have on the subject. Students may ask questions and express interest in a topic. Students may also have prior knowledge on the topic.
- **Explore**: "Explore activities are designed so all students have common, concrete experiences which can be used later when formally introducing and discussing scientific and technological concepts and explanations." Explore activities allow students to establish a common ground of

their knowledge by having them compare and discuss ideas with each other. Students can learn hands-on during the phase.

- **Explain**: This phase is mainly led by the teacher, as they help students gain new knowledge on the subject. "Students use these resources and information, as well as ideas of other students, to construct or revise their evidence-based models and explanations." Teachers can aid their teaching by using learning tools, such as physical devices or online tools. Students later use the knowledge they gain to explain their understanding of a topic to their peers.
- **Elaborate**: "Once students have constructed explanations of a phenomenon or design solutions for a problem, it is important to involve them in further experiences that apply, extend, or elaborate the concepts, processes, or skills they are learning." During the elaboration phase, students apply their knowledge to gain a deeper understanding of what they have previously learned. Teachers should also encourage students to conduct further research on the topic to reinforce their understanding.

Figure 1 Illustration of 5E Model of Instruction (left) and Affinity Space (right)



- **Evaluate**: Teachers should constantly observe students throughout this phase to see whether they fully understand the key ideas. Students can be assessed formally or informally. Example of assessments includes peer evaluation, exams, or final projects. "The Evaluate phase encourages students to assess their understanding and abilities and allows teachers to evaluate individual student progress toward achieving learning goals and outcomes."

B. *Affinity Space*

Another common method used by schools to engage students are affinity spaces, a place where students can common interests and activities. Affinity spaces encourage students to share their ideas and learn from each other's experiences. Members in an affinity space have common ground and incentives because they share an interest in the same practice, belief, or activity.

C. *Student-Centered Learning*

In student-centered learning, "students are the center of the educational enterprise, and their cognitive and affective learning experiences should guide all decisions as to what is done and how [5]." "Rather than the teacher carrying out the instructions and learning activities, they considered a "guide on the side", assisting and guiding students to meet the goals that have been made by the students and the teacher [6]."

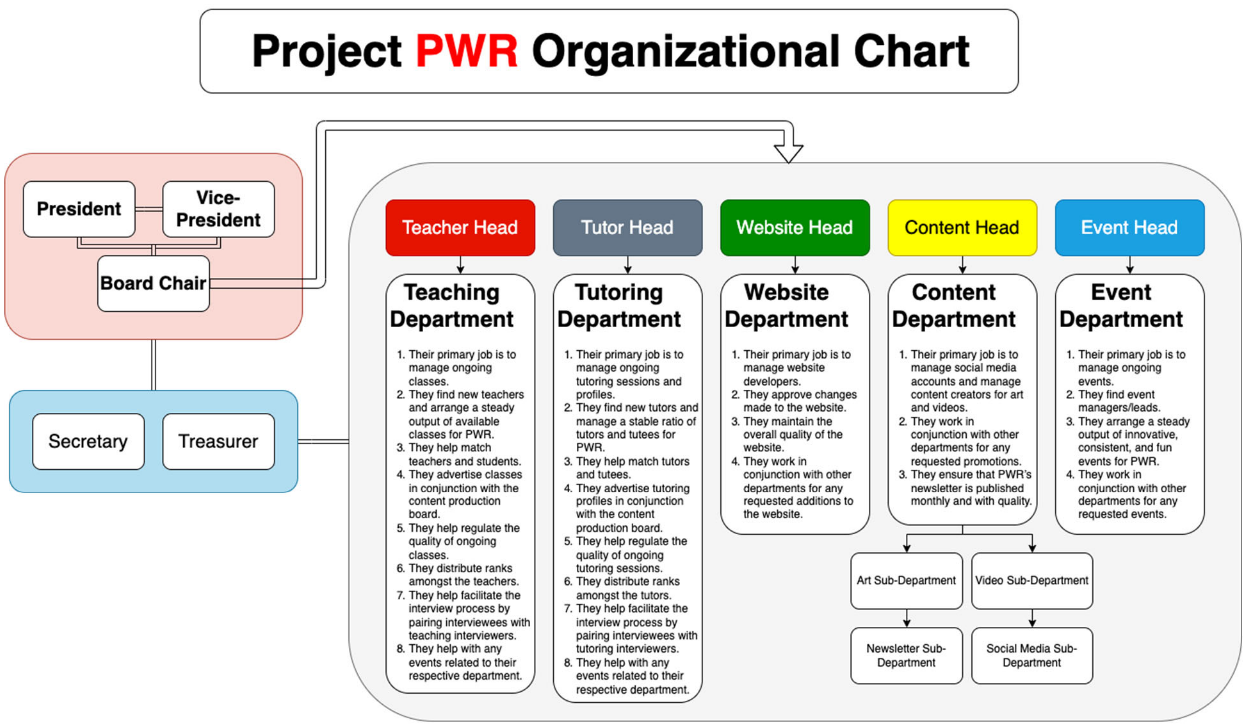
III. PROJECT PWR

In this section, we present Project PWR, which can serve as the platform to support kid-teach-kid activities.

A. *Overview of Project PWR*

High school students initially established project PWR during the pandemic to make up for the free time they had when schools were shut down. Originally, the only service provided was online teaching, where high school students taught other high school students any interests or passions they had. To better support kid-teach-kid education activities, Project PWR was formed as a non-profit organization established in 2020, and its organization chart is presented in *Figure 2.* Project PWR has over 20 students with leadership roles. Project PWR's organizational structure consists of a board and departments. The board consists of the president, vice-president, board chair, secretary, and treasurer, while the departments consist of the teaching, tutoring, website, content, and event department.

Figure 2 Project PWR Organization Chart.



Six courses were successfully conducted in only four months since the formation of Project PWR. On average, each course consists of eight sessions of an hour-long lesson, and each course has around five students. Seeing the value in a student-teach-student model, Project PWR added tutoring and webinar services that students also led, although these will not be evaluated for this research purpose. In the past two years, Project PWR has facilitated over 1,500 hours of student-to-student engagement and has also amassed over 80 student teachers and tutors combined. In addition, they have established connections to 8 high schools and formed two school clubs.

B. *Student-Teacher and Student Recruitment Process*

To become a student-teacher, there is an application process that high school students must go through. Kids are accepted as student teachers or tutors based on a written application, a teaching interview, and trial lectures. Written applications consist of past experiences, knowledge of the subject, or their class structure and schedule. When interviewed, student-teacher candidates are assessed according to a standardized rubric. To maintain a position as a student-teacher, they must pass occasional screenings conducted by Project PWR Officials. To evaluate student-teachers' performance, classes are occasionally screened. Students must also fill in the teacher's mid-term and final assessments. On the other hand, student-teachers are required to submit a final evaluation for their students at the end of the course.

Although student-teachers have near unlimited freedom with designing their course, they are encouraged to follow the "templates" that Project PWR creates. The template includes instructions on how to format classes, how to engage students, and how to evaluate students. In addition, the template includes suggestions on when to start the course, the number of students to cap the course at, the length of each class, and the time that class is taught.

Project PWR recruits new student-teachers and students through a cycle method. At the end of each course, Project PWR asks students to consider becoming a student-teacher. Participants are also asked to refer a couple of friends that would be interested in teaching or learning something new. Although Project PWR advertises all the courses, many of the students that join are the teacher's friends that he/she referred. In addition, Project PWR can promote the courses through its online webinars and school clubs.

IV. Research Hypothesis

In this section, we present how Project PWR address the presented challenges in the Introduction by applying the learning concepts of 5E, affinity, and student-centered learning, in which the model is presented in **Error! Not a valid bookmark self-reference.**.

Table 1 Kid-teach-kid model.

Challenge 1: Many students lack motivation and concentration during online sessions, leading to decreased engagement between the student and the teacher.	Engage phase of 5E	Project PWR addresses *challenge 1* because of the student-teacher and student's shared interests, achieving the engage phase of the 5E model of instruction. Because students are learning something new or topics they are passionate about, they are exploring new ideas and concepts they have not known before. Students can ask, "What can I find out about this?" when they see a course they are interested in. By signing up for one of Project PWR's courses, the student shows interest in the topic through curiosity and expression of wonderings rather than attending to an enforced learning environment driven by a teacher. This poses many benefits, including increased engagement, because student-teachers and students can relate with one another.
Challenge 2: It is challenging for students to consult with the instructor about content that they feel requires a	Engage phase of 5E Explore phase of 5E Explain phase of 5E	Project PWR addresses *challenge 2* because the courses are taught solely by high school students. Recruited students often have previous connections with the student-teachers and peers within a class, creating an open environment, as the participants are already comfortable with each other. An open environment aids in the phases since students are more open to sharing ideas and asking questions. Conversely, within webinars and

more in-depth explanation or comprehension.	Elaborate phase of 5E Affinity Space	traditional online class settings, students often have no prior connection with the teacher or other students, leading to a suppressed class environment where students act awkwardly or reserved towards others. Furthermore, Since the classes have an average of four students per teacher, teachers can explain and engage with students more effectively than in traditional classrooms. Being in the same age group as students, teachers can elaborate more clearly, considering their shared similar experiences with students. Students can also connect better to their teachers, given their minimal age gap, promoting discussing and comparing problems and ideas with others.
Challenge 3: Online environments lack student-centered learning, which focuses on the needs, abilities, interests, and learning styles of the students.	Explore phase of 5E Evaluate phase of 5E Affinity Space Student-Centered Learning	Project PWR addresses *challenge 3* due to the constant feedback loop between student-teachers and students, in addition to the guidance from Project PWR. Project PWR requires student-teachers to give their students a final assessment, fulfilling the evaluate phase. Furthermore, students fill out a survey each class to assess the teacher's performance, allowing them to improve upon their teaching. Due to the close learning relationship between the teacher and students, the learning model can be adjusted based on students' need, thus fulfill both affinity space and student-centered learning features.

V. RESEARCH DESIGN AND EVALUATIONS

In this section, we presented Project PWR's implementation of the kid-teach-kid model through a case study. Then, we present the evaluation of the kid-teach-kid model based on a set of education evaluation metrics.

A. *Project PWR Curricula Design*

To demonstrate how Project PWR works, we present a curriculum design example to show how to apply the proposed teaching models based on a "Fusion 360 for Beginners" course. A significant part of the teacher application is the course syllabus. A syllabus example of Fusion 360 for Beginners course is given in Table 2, which outlines the course agenda and topics that are learned.

Table 2 Curriculum Design Example (Fusion 360 for Beginners Course Syllabus).

Lesson 1	Introduction to the course	Students introduce themselves. About the course, downloading Fusion 360. Getting on the same page-changing units and grid settings
Lesson 2	Intro to UI, Navigating, Create a thingamabob	Students will design a Thingamabob- Create a line, create a 3d object, key binds, saving files, shortcuts

Lesson 3	First design, Modeling, Basics of sketching	Warm up: Students will attempt to recreate a design shown to them Learn how to use tools: circle, rectangle, points, arcs, offset, extend, trimming, dimensions, constraints, extrude, creating sketch on existing 3d model, project, fillet in sketch
Lesson 4	More complex designing	Warm up: Students will attempt to recreate a design shown to them Learn how to use tools: more on sketch palette, more on dimensions, right click functions, using guidelines and marks on grid, using mirror tool, more on extrude, using timeline, fillet in 3d model Applying your knowledge: student will be given a challenge to do on his/her own
Lesson 5	Reviewing your knowledge	Review, applying current knowledge (“toolbelt”), and learn how to use shell command
Lesson 6	Creating Organic Shapes	Warm up: Students will attempt to recreate a design shown to them Learn how to use tools: creating a sphere, using revolve tool, properties tool, text tool, even more on extrude function, combine tool, bodies, even more on constraints
Lesson 7	More Organic designing	Warm up: Teacher will discuss with students about their final project Learn how to use tools: hold and drag, spline, more on planes, move tool, more on mirror Applying your knowledge: student will be given a challenge to do on his/her own
Lesson 8	End of the course	More on patterns, chamfer, split body, loft SHOWCASE: students will show off their final project and there will be a winner!

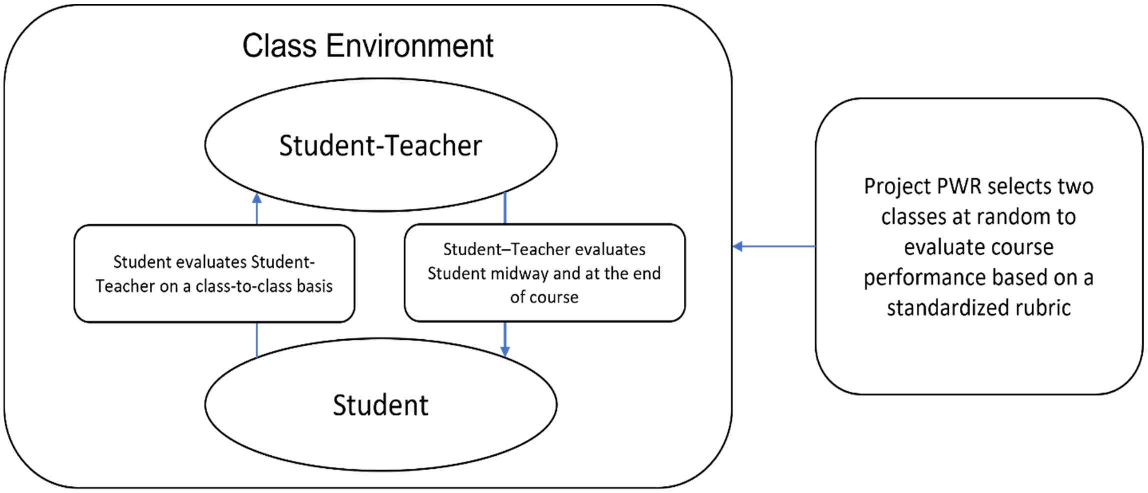
B. Learning Outcomes and Evaluations

This research was a mixed method research, in which the learning environment is highlighted in *Figure 3*. With respect to our qualitative analysis, we investigated the efficacy of a student-teach-student model through four cases. We investigated the interaction between the student-teachers and students, how teachers designed their courses, and the difference in returning teachers’ teaching abilities, and collected student-teacher and student surveys. With respect to our quantitative analysis, we analyzed course statistics, including student attendance rate, student-teacher ratio, and student retention rate.

C. Participants

For this research, we used data from 20 courses. Each course is instructed by one or occasionally two student-teachers and comprises of an average of six students per course. This totals 17 unique student-teachers and 91 unique students. In addition, some teachers instructed a course more than one time. Participants were primarily high school freshmen, sophomores, juniors, and seniors from local schools around Phoenix, Arizona. These courses can be categorized into two groups: courses instructed by first-time teachers and courses led by teachers who taught more than once.

Figure 3 Project PWR’s Learning Environment Setup.



D. Data Collection and Analysis

Table 3 presents the statistics about Project PWR's learning environment.

Table 3 Classroom Statistics.

[redacted]	
Average number of students per course	5.8
Average student attendance rate (excused)	96%
Average number of students that drop at beginning of course	0.4

Table 4 Students' After-class Survey Results-Part I.

[redacted]		
I am satisfied with the classes.	4.2	4.4
I gain new knowledge from the classes.	3.9	4.3
The teacher is prepared for our classes.	4.5	4.8
I am constantly engaged during the classes.	4.0	4.1
The class environment was welcoming.	4.0	4.0
My classmates were encouraging and motivated.	4.1	4.0

Figure 4 Students' After-class Survey Results-Part II.

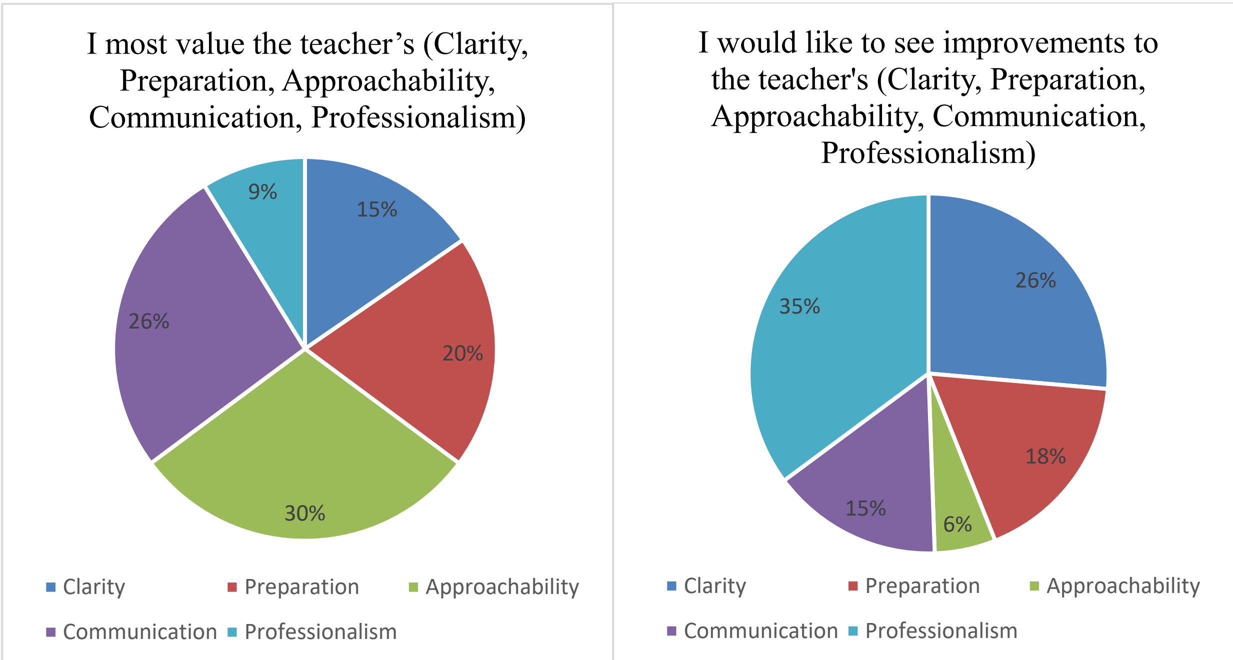


Table 5 Students' After-class Survey Results-Part III.

What did you enjoy about the course?	The teachers were very responsive and answered any questions that the students had. Students also enjoyed that they were friends with many of the participants in the class. Students also appreciated the fact that the classes were free.
What improvements would you make to the course?	Many students wished that the teacher had given out assignments after class. Some students also wanted the lessons to be taught at a faster pace.
What would you say if you had to write a 1-2 sentence honest review of the course right now? (Optional)	Students thought the course was interesting and learned much about the subject. Many students mentioned that the teacher was very dedicated and taught the subject very well. The course was tailored to their own needs.
Additional comments? (Optional)	Students asked for more advanced courses and mentioned how they enjoyed the course.

The student results show that overall, students had a positive experience with the courses they participated in. Based on *Figure 4*, most students valued the approachability and communication of the student-teachers, which can support the responses from *Table 4* and *Table 5*. Survey questions from *Table 4*, which relate to the engagement of the students, motivation of the students, and effectiveness of the classes, had responses with a 4.0 or above. In addition, survey questions from *Table 5* were generally enthusiastic and positive. We can conclude that factors such as the approachability of the student-teacher, dedication of the student-teacher, past connection with classmates/student-teacher, and the personalization of the class have enhanced the engagement and openness within the classroom, which made the courses more enjoyable for the students. The significance of this data is that it proves an online kid-teach-kid model has a positive impact on the engagement and motivation of students and can thoroughly educate them on the course subject. Therefore, Challenge 1 and Challenge 2 can be addressed with Project PWR's online kid-teach-kid model.

Table 6 The Average Score of the Mid-course and End-of-Course Teachers' Survey.

Students were motivated during class.	4.2
Students constantly participated during class.	4.3
Students collaborated with their peers.	4.1
Students demonstrated knowledge learned in class during the final assessments.	4.7

Table 7 Teacher Interview Questions.

What did you enjoy about teaching for Project PWR?	Most teachers mentioned how teaching the course was a great learning experience and how they learned more about the subject themselves. Teachers also liked the benefit of gaining volunteer hours and meeting new people. Some teachers enjoy the fact that they get to teach something they are passionate about.
What was the biggest factor that played in the effectiveness of your course?	Many teachers dedicated a lot of time to their course since it was their first time, and they did not want to mess it up. Teachers also mentioned that the course syllabus template was useful for effectively planning their course and making it more engaging. Teachers also thought the teaching process was made easier since they already knew their students or that the students were excited to learn the topic.
What part of Project PWR would you like to see improvement in?	Teachers requested for Project PWR to give more guidance, as the whole process is somewhat confusing. Some teachers wanted Project PWR to help advertise their course more, so it would be easier to find students.

Table 8 Project PWR Evaluation on Teachers.

Teacher was teaching effectively during the class.	4.1
Teacher is prepared for the class.	4.3
Teacher engages with students during the class.	4.5
Class environment is engaging and encouraging	4.6
Teacher answers student's questions	4.9

Observer Notes of Courses (Summarized Version of Key Ideas)

There is a constant feedback loop, where students in the class often ask questions that the teachers would promptly answer. Student-teachers and students also seem to know each other well. Some student-teachers utilized interactive online learning tools to help them in their lesson. Overall, all the courses went smoothly, and students were learning the subjects passionately. There were also some cases where students were distracted during class, but these occurrences were rare.

The student-teacher results show that they were motivated and enjoyed teaching their course. Based on *Table 6* and *Table 8*, student-teachers and Project PWR officials also observed the classroom environment to be collaborative and engaging. A central theme within the results is the prominent amount of interaction between the student-teacher and student; this is mentioned within the *observer notes* and shown in *Table 8*, where the question: "Teacher engages with students during the class.", had a positive response of 4.5. The prominent amount of interaction can be explained in *Table 7*, where student-teachers mentioned that since they and the students knew each other beforehand, they felt more comfortable interacting with each other. One motivation for the student-teachers to continue teaching was them noticing that the students were also motivated to attend the classes. This proves that Project PWR's kid-teach-kid model can create an affinity space, where both student-teachers and students are not obligated to participate in a course. In *Table 7*, teachers mentioned how the course syllabus template helped them make their course more effective at engaging the students. The *observer notes* also imply that the courses are individualized and cater to each student's needs. Therefore, Challenge 3 can be addressed with Project PWR's online kid-teach-kid model.

VI. Conclusion

In this paper, we investigate a new kid-teach-kid learning model to address the online learning issues due to the impacts of social distancing due to Covid-19. We designed and established Project PWR, a non-profit organization formed by high school students, to develop an online kid-teach-kid learning environment where student-teachers teach other students about their passions or interests. Project PWR applied a mixed method design to the engagement learning challenge, including teacher surveys, student surveys, observer evaluations, classroom statistics, and one-on-one interviews. The positive feedback from both student-teachers and students indicated that Project PWR's teaching model had positive support for boosting students' learning interests and improving students' engagement during online learning. To further enhance the kid-teach-kid model, we will study other learning approaches, such as personal tutors and mentors, as our future work.

Acknowledgment

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Creating a Multimedia Book for Korean Learners: Using Emerging Technologies to Foster English as a Second Language

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Introduction

This study explores the question of how to create a multimedia book to foster English learning as a second language for Korean learners. Multimedia principle suggests students learn better when they learn with multimedia learning materials comprising text, audio, and visual images combined together (Clark & Mayer, 2011; Mayer 2002). Several components of the multimedia principle were used in a multimedia book designed and printed to support students in learning the English Language better. Currently, this book is titled Thanksliving (Dean et al., 2022), and in its first edition is being used in online classes where young Korean students learn the English language with international teachers. The teachers help students read aloud the contents in the book as students use the book to practice their speaking, listening, reading, writing and vocabulary skills in online class sessions. Inside this multimedia book, emerging technologies including QR codes, Word-Wall, and Padlet were embedded to assist students with diverse practices such as a vocabulary game in learning English. In this manuscript, multimedia components with examples from the book will be introduced. In addition, the implications and suggestions for future application of the book will be discussed.

Multimedia Principle

According to Clark and Mayer (2011), students learn better with multimedia materials than text alone. Multimedia resources contain the forms of text, sound, video, and visual images, which can facilitate interaction between learning content and students. Mayer (2002) explained that learning happens when a student "builds a mental representation from words and pictures that have been presented (p. 85)." For example, when students learn about an apple in English as a second language, presenting a text of an apple, and image of an apple together can help students learn better. In addition, the English passages selected for the multimedia book feature the signaling effect. Signaling refers to highlighting key terms or specific content which does not add any extra content or materials to the original learning material. In the experiment of Mayer's study (2002), two groups of students received the same content, and one had signaled content and the other had non-signaled content. The results showed that students who received the signaled materials performed better than the non-signaled group of the students.

Problem Statement and Research Questions

Because of the complexity of designing and developing educational content (Jung et al., 2019), more research is needed to explore creative ways to utilize emerging technologies in simple ways with practical examples. Thus, this study explores the question of how to create a multimedia book with educational technologies to foster English learning as a second language for Korean learners.

Method

QR codes were actively used in designing and developing a multimedia book in this study. The following will describe specific examples that this multimedia book used QR codes. First, when students scan the QR codes, they connect to multimedia resources including the videos on Youtube (Figure 1). With these videos, students can listen to the passages in the book in both English and Korean as much as they want at any time through their personal device such as a smartphone (Figure 2). In addition, the QR codes connect students to play games and to communicate with their peers via online bulletin boards, which will be described more in one of the subsequent sections, Emerging Technologies as Educational Tools.

Figure 1. Online Contents on Youtube

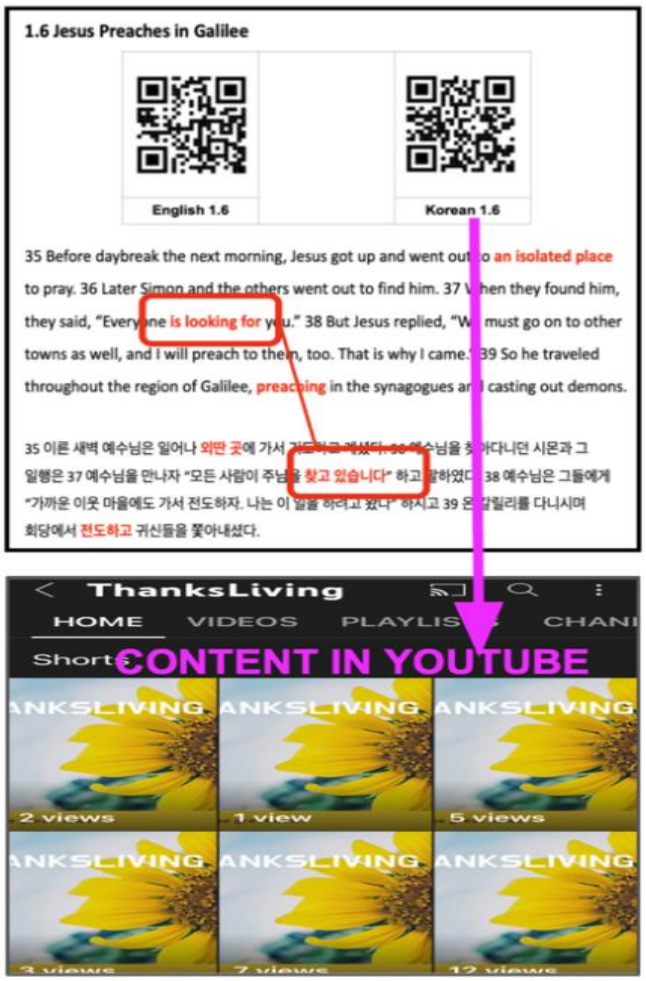


Figure 2. QR Codes for Reading English and Korean Texts

1.6 Jesus Preaches in Galilee

English 1.6	Korean 1.6

35 Before daybreak the next morning, Jesus got up and went out to **an isolated place**
to pray. 36 Later Simon and the others went out to find him. 37 When they found him,
they said, "Everyone **is looking for** you." 38 But Jesus replied, "We must go on to other
towns as well, and I will preach to them, too. That is why I came." 39 So he traveled
throughout the region of Galilee, **preaching** in the synagogues and casting out demons.

35 이른 새벽 예수님은 일어나 **외딴 곳**에 가서 기도하고 계셨다. 36 예수님을 찾아다니던 시몬과 그
일행은 37 예수님을 만나자 "모든 사람이 주님을 **찾고 있습니다**" 하고 말하였다. 38 예수님은 그들에게
"가까운 이웃 마을에도 가서 전도하자. 나는 이 일을 하려고 왔다" 하시고 39 온 갈릴리를 다니시며
회당에서 **전도하고** 귀신들을 쫓아내셨다.

In each section of the book, the Korean and English texts were added together on the same page, and three to five words on each passage were highlighted in red according to signaling strategies (Mayer, 2002). This is intended for students to recognize specific vocabulary words to focus on, so they can remember after reading the corresponding passage. For example, in Figure 3, *John's disciples* were highlighted in red in the English passage, and *요한의 제자들* were also highlighted in red in the Korean passage, and they indicates the same word in both English and Korean. This was supposed to be helpful, especially, when students do not know most of the English words in the English passage. It can be daunting for students to read an English passage containing a big chunk of unknown words. On the other hand, highlighting three to five words per English passage could put less pressure on students to learn the new vocabulary by preventing students from closing the textbook, and by encouraging them to continue to move on to the next page.

Figure 3. Highlighted Words

18 Once when John's disciples and the Pharisees were fasting, some people came to Jesus and
asked, "Why don't your disciples fast like John's disciples and the Pharisees do?" 19 Jesus replied,
"Do wedding guests fast while celebrating with the groom? Of course not. They can't fast while the
groom is with them. 20 But someday the groom will be taken away from them, and then they will
fast.

18 요한의 제자들과 바리새파 사람들이 금식하고 있던 어느 날, 사람들이 예수님께 와서 "요한의 제자들과
바리새파 사람들의 제자들은 금식하는데 선생님의 제자들은 왜 금식하지 않습니까?" 하고 물었다. 19
그래서 예수님이 그들에게 대답하셨다. "신랑의 친구들이 신랑과 함께 있는 동안에 금식할 수 있겠느냐?
그들은 신랑과 함께 있는 한 금식할 수가 없다. 20 그러나 신랑을 빼앗길 날이 올 것이다. 그 때에는 그들이
금식할 것이다

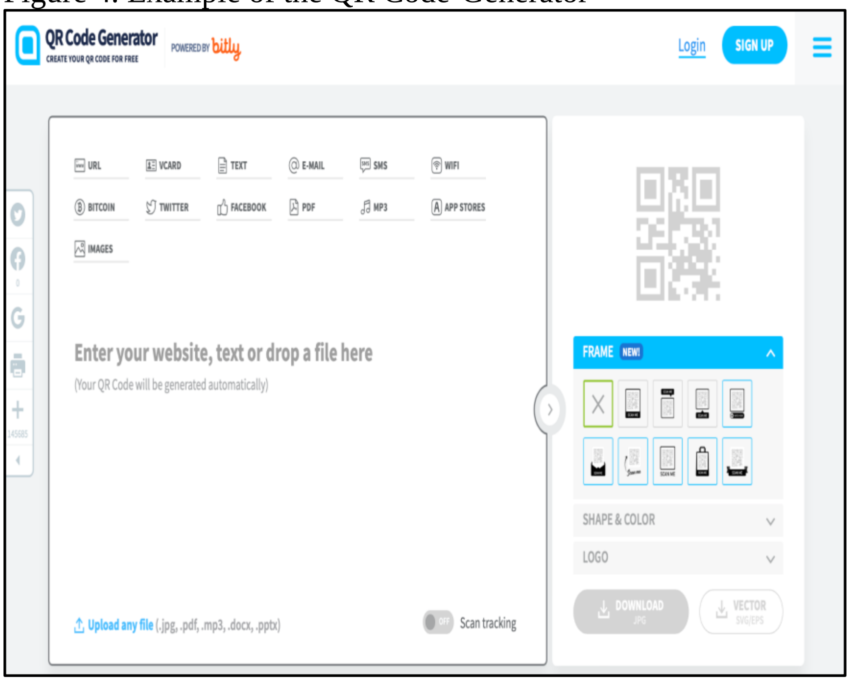
Emerging Technologies as Educational Tools

In the multimedia book, educational technologies were used to facilitate students' learning English as a second language of instruction. This section introduces QR codes, Word-Wall, and Padlet along with the examples of how they were used in the multimedia book.

QR Codes

A QR code is a type of barcode which connects to different forms of online environments. In this book, QR codes were used to connect students to multimedia resources on Youtube, a virtual bulletin board called Padlet, and vocabulary games. QR codes can be generated for free on websites. The website, *https://www.qr-code-generator.com* (Figure 4), is one of the examples where any user can generate free QR codes. Once a URL, image, sound, or video on the website is typed, a QR code that connects to each resource is generated within a minute.

Figure 4. Example of the QR Code-Generator



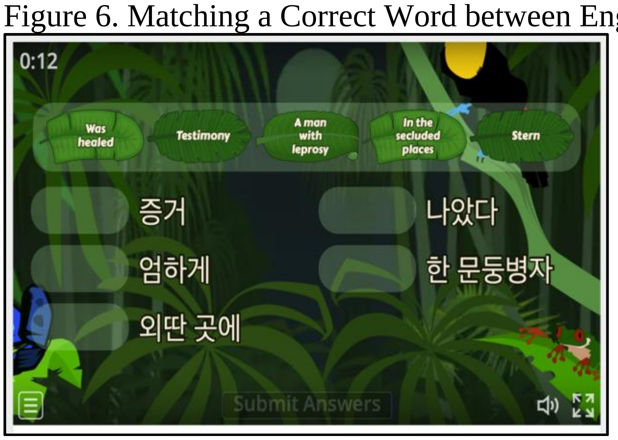
Word-Wall

Word-Wall is an online literacy tool where teachers can create teaching resources, such as quizzes and word games. In the last section in the multimedia book, several QR codes were added to guide students to engage in further activities (Figure 5). When students scan the QR codes, they can play vocabulary games an unlimited number of times. This was intended for students to review the vocabulary that was highlighted in red in each section of the passages on the previous pages of the book. Once students scan one code with a phone, different vocabulary games pop up. One form of the game is to select a correct English word among different words based on a given Korean vocabulary (Figure 5).

Figure 5. Further Activities

Another part of the vocabulary game is to match the correct words between English and Korean (figure 6). When students play this game, fun music plays in the background depending on the themes of the game. The theme of the Figure 6 is a jungle, so the background scene and the music match with a jungle theme. In addition, students are able to leave their nickname on the leaderboard if they finish within the top five, which can generate positive competition among students to complete the game fast. Once this game is set up, students can play the game at their convenient times, more than one student can access the same games at the same time, and students can have repeated access to the games if they want.

Figure 6. Matching a Correct Word between English and Korean



Padlet

Padlet is an online post-it-note or a virtual bulletin board. On the last page in the book, Padlet was added with a QR code as an extra activity (Figure 7). With this tool, students are encouraged to connect with each other asynchronously or synchronously to communicate in English. While a paper bulletin board has only an option with a paper based-note, a virtual bulletin board can have diverse forms including website-links, videos, images, texts, and documents. Additionally, students are allowed to communicate with each other by leaving comments on each other's notes in English. One activity used in this book was that students choose and type their favorite sentence from the book in the English language (Figure 7).

Figure 7. Virtual Bulletin Board

Implementation

So far, the multimedia book has been introduced to 3rd and up to 8th graders for the purpose of learning the English language under the supervision of six different teachers including American and Korean teachers through online classes. Students and teachers meet on Zoom to learn and teach English with the book respectively. In addition, shadowing techniques are used where students read and write about the content of the book. Since the book contains mostly Korean texts with the corresponding English translations, it seems to be very beneficial to low-performing English reading students as they can understand the English passages through the aid of the Korean texts. Kim & Curry (2020) claimed that using new technology through hands-on activities is helpful to build self-efficacy especially "when working with novice learners" (p.218). Offering diverse hands-on experiences through QR codes to students such as playing a vocabulary game seemed to be helpful as students could access through their phones, with the ability to play games either in class or out of class. In addition, using QR codes seemed to facilitate accessibility as students can access learning content easily and quickly. After using this textbook for more than six months, it seemed that the students' vocabulary, speaking, and listening skills improved tremendously.

Implications and Suggestions

The multimedia book was designed by using simple educational technologies such as QR codes, Word-Wall, Padlet, and media contents on Youtube which are available for educators to use for free. So far, around 20 young Korean students have used the book with six different teachers. Future study will be to implement this project with different languages, so that users can learn English as a Second Language of instruction. For example, the content of this book is from the Bible which has the same content with different languages. The book can be designed for students who use Japanese, Chinese, or Spanish as their first languages to learn English in the similar format of the book and educational tools from the multimedia book.

In this paper, multimedia resources including educational tools, and its examples were introduced. While developing online content can be complicated (Jung et al., 2019), through using these resources, teachers can easily create multimedia books in a simple way; students can have fun interacting with educational tools. Additionally, using educational tools introduced in this book can be beneficial to potential authors who are interested in creating a book with a small budget because different free and open educational tools are available.

The purpose of creating this book was to assist English learning, especially for Korean students. Learning English has been a hot topic as educational issues in South Korea have been a problem for a long time. Scholars have been concerned with a social phenomenon called the *English Divide*, referring to the English gap between advantaged students and disadvantaged students (Jeon, 2012; Lee & Lee, 2016; Martinez-Garcia, 2020; Shin & Lee, 2019). Some students receive quality English education while other students do not (Jeon, 2012; Lee & Lee, 2016; Martinez-Garcia, 2020; Shin & Lee, 2019). This multimedia book was made to offer good quality English education to any students with easy access. Target students of the book can be any English language learners, and they can have repeated access to educational resources only through a smartphone.

Language skills can be built along with learning a new vocabulary, listening, reading, writing, and speaking. With games and highlighted words on the book, students may learn new terms while reading this book. As students have access to audio files for the whole passages in English and native language (here Korean), students may increase their listening skills along with understanding the content of the book with a story. Reading skills may be facilitated with texts in English and Korean along with audio versions of the text. A virtual bulletin board may facilitate writing and speaking skills as it allows students to upload diverse forms of the files including sound and typed text.

According to Self-determination theory by Ryan and Deci (2017), when students have autonomy, competence, and relatedness in learning, students can be motivated to gain knowledge. In this book, students can choose diverse activities based on the same contents - listening, reading, or writing. With different activities, students can read the English passages. Moreover, the book contains not artificial English passages, but original English passages by using the English Bible. This is important as using natural English passage could be beneficial to learn English as a second language. One of the authors of this book was an English as a second language teacher for several years in South Korea, she observed lots of unclear or awkward sentences used in the textbooks at public and private schools. In this multimedia book, the English Bible was used as an English passage. Some of the primary reasons for using this are because the Bible is considered one of the steady sellers and the Bible contains natural or clear English sentences. Besides, self-determination theory explains when students feel they belong to a learning group or community, they can be encouraged to learn better. Through a virtual bulletin board and vocabulary game-platform, in this multimedia book, students are given access to be connected together with classmates and teachers. In order to explore the impact of using this book, future study will be necessary. Thus, inviting students to use this multimedia book would be the next step by using the following questions.

1. What are the pros of this multimedia book, if any?
2. What are potential challenges of using the book, if any?

3. What features or tools would you like to use if you intend to create your own multimedia book?

In order to use this book effectively, using a smartphone is necessary as a smartphone connects students to access all the learning materials. In some districts and schools, using a phone in class is a controversial topic as it can be helpful or hinder students' learning. An author of this book thinks a smartphone is considered the same as a knife. A knife can be used for cooking beautiful and delicious food at fancy restaurants. At the same time, a knife can be considered as a weapon to be used to hurt people. Phones can be the same way. In this multimedia book, using a smartphone is highly encouraged to students and teachers to facilitate students' learning English. At the 2022 AECT International Convention, this project will be presented in order to listen to diverse opinions from students, teachers, instructional designers, and professors from around the world. Their creative and critical opinions will be tremendously beneficial to numerous stakeholders in the education sector.

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Hello! My Name Is …

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Keywords: introduction discussion forum, social presence

Community of Inquiry Framework

The CoI framework is a social constructivist model of learning processes utilized in online and blended environments. Garrison and Archer (2000) shared that learning can be greatly enhanced in online learning environments when CoI can be established and developed. The CoI theoretical framework guides ways to offer deep and collaborative online learning experiences through the lens of three interdependent elements – social presence, cognitive presence, and teaching presence. As the focus of this presentation was about social presence, the other two CoI elements (cognitive presence and teaching presence) will not be addressed.

Social Presence

Students engage in learning when they feel connected with others and when they play an active role in their learning process. Therefore, social presence is an important component of effective learning in both face-face and online learning environments. How social presence has been defined hasn't deviated greatly from the original description offered by Garrison, Anderson, and Archer in 1999; "the ability of participants in a CoI to project their personal characteristics into the community, thereby presenting themselves to other participants as real people through the medium of communication being used" (1999, pp. 89). In the CoI model, social presence becomes more than the salience of individuals and their interactions in a mediated environment, or the 'being real' and 'being there' component. Social presence provides information about group cohesion and cognitive affect as well as the capacity of participants to identify with the community, communicate with purpose in an atmosphere of trust, and grow relationships with one another by projecting their own individual personalities (Garrison, 2009). Kreijns et al. (2014) contend that the term social presence has been used to describe two different concepts: the extent of interpersonal relationships within the community and how real the other individual seems. Furthermore, as defined by Tasir and Al-Dheleai (2019), social presence is the individual's perception that their presence within a group of people is recognized, valued and respected which boosts the feeling of being connected to other group members. For this presentation, social presence is being referenced as the ability of students to identify with others within the course, to perceive others in an online environment as 'real', and to project their own self as a real person when engaging in open communication, affective expression, and group cohesion.

Cognizing that the online learning environment is predominantly dependent upon asynchronous instruction, the use of computer-mediated communication channels for developing social presence is important to consider when designing a course. In the online learning environment, computer-mediated communication can be understood as a feeling of social presence. According to Sung and Mayer (2012), social presence refers to “the subjective feeling of being connected and together with others during computer-mediated communication” (p. 1740). Additionally, Oztok and Kehrwald (2017) defined social presence as “the subjective feeling of being with other salient social actors in a technologically mediated space. It is the sense of ‘being there, together’ when ‘being there’ does not involve a physical presence” (p. 9).

Social Presence in the Online Learning Environment. Social presence, or the ‘being there’ and ‘being real’ in the presence of others in an online learning environment, is widely considered to have a positive impact on student motivation and participation, student engagement, actual and perceived learning, course and instructor satisfaction, and retention in online courses (Bowers & Kumar, 2015; Cui et al., 2013; Moallem, 2015; Oh et al., 2018; Richardson et al., 2017; Rogers & Price, 2008; Whiteside, 2015). Beyond the ‘being there’ and ‘being real’ social presence components, to include the ability of participants to project themselves socially and affectively into a community of learners can also serve to further personal and purposeful relationships. Referencing how students relate to one another, it is their personal stamp that indicates their willingness to engage, connect, and communicate effectively with other learners in their online community. Additionally, sharing information among their community of learners leads students to engage with the course content more meaningfully (Carlsmith & Cooper, 2002).

Creating an online class environment where the learner is engaged, relaxed, and comfortable when communicating with their classmates should be a primary objective for online pedagogy. In their study involving online higher education students, Don et al. (2022) found as students’ participation in e-Learning class activities increased, their levels of social presence also increased. Noting the students felt more acknowledged by their classmates. Additionally, social presence has been shown to lead to higher levels of cognitive presence in online classes (Garrison et al., 2010; Kozan & Richardson, 2014). Therefore, when there are higher levels of social presence, learners are more likely to engage in higher-order mental processes.

Building a Community of Learners. Humans are inherently social creatures. Socialization and connections among students are a natural yet central aspect of the learning process within any learning environment (Jones-Robert, 2018; Laffey et al., 2006). In the online learning environment, it takes intentional course design to incorporate activities that allow for student-to-student interactions and to avoid feeling a lack of social presence. Evidence suggests that a focus on developing a community of learners in online instruction is considered optimal by experts in the field (Baldwin & Trespalacios, 2017; Martin et al., 2019). Having interviewed eight award-winning online faculty about their perspectives of online instruction, Martin et al. (2019) found all of the participants interviewed noted interaction or community as an important component in designing educational activities.

Though building community may seem separate from teaching, the research of Elliott et al. (2016) and Shadiow and Weimer (2015) conclude building a community of learners provides a sense of belonging that promotes class contribution, student engagement, learning, and motivation for learners. A community where students feel valued and heard. A community that fosters a climate of openness, acceptance, and a place to share common interests (Elliott et al., 2016). This type of community of learners will encourage students to share diverse perspectives, recognize and affirm differences, and ultimately help them connected with course content for greater learning outcomes (Oh et al., 2018; Richardson et al., 2017). In online learning environments, the more interaction taking place between students, the stronger the development of social presence and the greater the levels of knowledge development (Costley, 2019).

A feeling of belonging to a community creates comfort and trust and encourages students to participate by sharing their knowledge, asking questions, and supporting peers (Haythornthwaite et al., 2000; Picciano, 2002). In their study of 71 graduate students from Malaysian public universities, Tasir and Al-Dheleai (2019) found a high sense of safety and trust toward the instructor and other students deepened the relationship among the community of learners. When the students felt a sense of safety and trust in their learning community, they tended to disclose their personal life stories with each other. For students to feel the sense of safety and trust, they need to perceive a social connection to the course as well as with the learners (Dixon et al., 2006). In other words, they need to feel as though they are part of a community of learners who share a common goal.

As students move from the periphery to becoming a central player they begin to build social presence and, in turn, enter into dialogue with others and enhance the community of learners. Learning environments that optimize opportunities for students to interact with their peers, the instructor and the content, such as introduction discussion forums, provide excellent platforms for student engagement (Stephens, 2015). Dixon et al. (2006) conducted research on the effectiveness of introduction discussion forums, identified as an icebreaker activity. They found that “members of a learning community need to work together to produce ideas and share responsibility for advancing the community’s learning, develop relationships that support collaborative work, and specifically take on course assignments and work together on them” (p. 2). A response from a university undergraduate student was “I think that icebreakers in conjunction with other learning community-building tools helps develop the integrity of the learning community” (Dixon et al., 2006, p. 8). Or as shared by another student,

> This exercise can certainly introduce people to each other in a more fun way–instead of reading a paragraph or two about someone. … [it] helps people to get a bit closer which could break the barriers to taking risks online faster, thereby enabling participants to start connecting earlier in the course. (p. 9)

Research also suggests that size of the learning community in online instruction plays a role in social presence (Akcaoglu & Lee, 2016; Poquet et al., 2018). As well, educators and researchers have experimented with various methods to create and sustain social presence in the online learning environment, including the use of audio and video technology (Aragon, 2003; Bartlett, 2018; Dunlap & Lowenthal, 2018; Jones-Roberts, 2018; Martin et al., 2022).

Instructor Presence

Although a teacher is not physically sharing the learning space in an online learning environment, it is important for students to feel that they are interacting with a real human being to develop a teacher-student relationship. Putting a face and voice to the instructor helps students feel there is a human teaching their course, which can positively impact students' willingness to reach out for help and may impact students' course satisfaction perceptions during instructor and/or course evaluation (Song et al., 2019). Developing a teaching persona is also an authentic means of contributing (Shadiow & Weimer, 2015).

In an online learning environment, instructor self-disclosure is important for building relationships with students. Self-disclosure being broadly defined as an interactive process through which one reveals personal information to others (Green et al., 2006). It is a sharing behavior by which individuals "voluntarily and intentionally reveal about themselves to others, including their thoughts, feelings, and experiences" (Posey et al., 2010, p. 183). In an educational context, instructor self-disclosure is understood as "conscious and deliberate disclosures about oneself, aspects of one's professional practice, world or personal views, personal history, and responses to ongoing classroom events" (Rasmussen & Mishna, 2008, p. 192). In computer-mediated communications, the role of instructor self-disclosure in relationship building is more powerful than in non-mediated contexts. The reason why self-disclosure affects relationship satisfaction is that students feel a strong social presence of their teacher (Song et al., 2019). In an online learning environment, Song et al. (2016) found that instructor self-disclosure was positively associated with instructor–student relationship satisfaction; where this association appeared to be stronger in an online class than in a face-to-face class. In another study with 262 undergraduate students who had taken at least one online course, Song et al. (2019) found "the association between teacher self-disclosure and teacher–student relationship satisfaction was mediated by social presence" (p. 450). Given that the future and success of online education are dependent upon student satisfaction, instructors in online classes are strongly encouraged to interact actively with their students by disclosing their personal information (Song et al., 2019).

Conducted a crowdsourcing methodology to determine online educators' recommendations for teaching online, Dunlap and Lowenthal (2018) found the highest number of recommendations shared centered around the instructor presence theme. Including the importance of connecting with students, helping students connect with each other, and helping students feel they are members of a supportive learning community. Their recommendations in support of instructor presence included putting a face to a name; being accessible and kind; showing your character and personality; having a sense of humor; using video to introduce yourself and to model what you want from students; making connections early in the course to ensure all students feel comfortable communicating with you and each other; and creating opportunities for students to build community (pp. 83-85).

Introduction Forums

There is a strong need for investigating how to promote relationship building in online courses. Understanding that relationship building starts from knowing each other, utilizing introduction forums is a way to offer instructors and students a platform for coming to know each other. Being mindful that when starting a class, the students are all strangers. Using a non-risky introduction prompt allows students to creatively find avenues for sharing common interests or experiences. By offering students creative outlets for expressing themselves, instructors are also empowering students to share with their classmates. Introduction forums help students create connections and build a sense of camaraderie in the class (*Ice-Breaker Activities*, n.d.). Almodiel (2021) showed that there is also a high level of access to self-introduction forums, suggesting that students are interested in discovering information about their co-learners. Introduction forums can also help educators get to know their students and build better relationships with them (Fernandes et al., 2020).

Introduction strategies used to welcome students to the online course environment can also influence students' levels of engagement in the class. Having a dedicated discussion for student introductions helps build a sense of community, where learners begin to identify with the group, build trust and develop personal relationships (Peacock & Cowan, 2016). When including divergent questions that may require them to review the course syllabus, students begin to share their expectations about course outcomes, assess students' prior content knowledge, develop an awareness of their own learning styles and those of their classmates, and ensure that diversity and privacy perimeters are protected (Stephens, 2015). Developing introduction forums topics that respect the importance of student autonomy and support the anytime, anyplace aspect of online participation "serve to move learners towards an authentic learning community with a clear understanding of the interests, needs, and work habits of their virtual colleagues" (Dixon et al., 2006, p. 3). Ultimately, there should be a fun aspect to the introduction discussions.

While an introduction discussion assignment has been regarded as a best practice in online courses (Plante & Asselin, 2014), for many learners, the very nature of posting to an online space of their thoughts to be read by unknown peers is threatening, and impersonal (Peacock & Cowan, 2016). Despite the familiarity of this classic assignment, some students may feel participation anxiety (Bond, 2017), an uncomfortableness or uncertainty introducing themselves for the first time. Others may not be engaged due to monotony. The key is to get students interacting with each other, having conversations and making connections in a safe and effective way. The best introduction activities help students create connections and build a sense of camaraderie in the online learning environment while also allowing instructors to get to know their students and build better relationships. The student's responses to the introduction forum prompt can also provide the instructor with specific learner characteristics that may later be used in the formation of online learning communities; determine the composition of small groups, sub-groups or peer teams within the course; or to differentiate learning activities in upcoming course activities and assignments.

Designing Introduction Forums

Crafting the introduction forum is as much a course design effort as it is providing a tool for sustained communication with each other throughout the course. If social presence and a feeling of community are important for learning to advance, course designers and educators must develop ways to create a community of learners early and help to nurture it throughout a course. Research supports the use of introduction forums and community building exercises help to build social presence and minimize the sense of transactional distance (i.e., the space felt between learners and instructors; Dixon et al., 2006; Fiock, 2020; Richardson et al., 2009). Introduction activities would allow learners working at a distance to make connections, learn about each other, and encourage the development of trusting relationships. These relationships would then support collaborative learning and constructivist, supportive, learning environments (Dixon et al., 2016). In creating introduction forums, it is important that they are fun, simple, not time consuming, are inclusive and sensitive to cultural differences, do not require advanced technology skills, maintains the asynchronous anywhere anytime participation, and are mindful of online learners right to maintain their anonymity (Dixon et al., 2016). Students having previous online course experience and some degree of technology proficiency are important to consider as is the design of the introduction activity (Bond, 2017).

This author has found having a specific introduction activity prompt and writing clear instructions for how the student is to respond to be effective in helping students structure their self-introduction. In addition to the written instructions, including an instructor created video where the instructor models the expectation or converses about what the students are to do removes uncertainty what is expected in the student's self-introduction. Instructor engagement in the introduction discussion forum not only conveys a message of care and concern for their students, but avails themselves to being the conduit for connecting learners with each other, with ourselves, and with the content being discussed. Thus, the instructor is instrumental in the introduction forums to both model response expectations as well as showing students that their contributions, thoughts, and opinions are valued. I, as the instructor, typically post my own self-introduction first where I share something personal. It's my 'here's what I want you to know about me' response, similar to the fashion that I ask the students to share something about themselves.

Video Introduction Discussions

While text-based discussion boards are standard in online learning, video discussion boards offer a new and exciting opportunity for students to engage with one another and to discuss their interests and backgrounds. Online students often work asynchronously and feel they are alone in the course. Video discussion forums show participants they are not alone and that there are others moving through the course with them. When compared directly with text-based discussions, asynchronous student-to-student video discussions have been shown to have significantly higher self-reported perceptions of social presence (Clark et al., 2015). Social cues in videos like humor, self-disclosure, emotions, and interjecting allusions of physical presence are noticed and preferred by students (Paquette, 2016). Using the video style discussion forum helps students get to know each other as well as increases communication efficiency by showing body language, facial expressions, and tone of voice. In her study using Flipgrid to increase students' connectedness in an online university course, Bartlett (2018) found 92% of the students reported the use of Flipgrid increased their connectedness to the course, peers, instructor, program, and overall sense of community while 8% reported being unsure. One student shared after one week of engagement in an introduction Flipgrid forum that they felt more connected to their peers in the class, including when working on group projects. Borup et al. (2012) found when instructors offered their own video introductions that it helped students to develop an emotional connection with their instructor and to perceive them as a real person. Additionally, by utilizing video introduction activities, social presence is developed among students by providing an example of how students can communicate and use social cues in an online course.

Implementing asynchronous introduction video discussions can be done in several ways, including using FlipGrid, Google+ Group, Google Hangouts, Voicethread, or embedded LMS audio/video recording tools. YouTube videos could also be created as well as use of video authoring tools, such as Kaltura or Brightcove, and then upload the recordings within a LMS's discussion board interface. When using video or audio recorded introductions, instructors will want to provide students with clear instructions on how to use the technology suggested, how to access the video forum suggested, and communicate clearly what the student is expected to cover during their video or audio introduction. Instructors should be mindful of video length limitations that either they establish or is a part of the recording technology chosen to be used. The shorter the video limit, the more the students will have to prepare in order to ensure their content fits within the time allowed (Bartlett, 2018). However, if an instructor gives more time, the overall time students spend watching their peers' initial posts and peers' response posts will exponentially increase. Instructors may also use introduction posts as a graded assignment to encourage students to meet each other. The grading of discussion posts has been seen as a motivator on whether students participate in them or not (Dodson, 2021). If possible, instructors should also provide learners with a brief reasoning behind the video or audio introduction activities including some references to literature discussing the importance of community building and collaboration.

Examples of Introduction Forums

What follows are examples of introduction forums used by this author and/or founded in research to be effective means of building a community of learners, developing social presence within the online learning environment, and offering an enjoyable start to the online course of any discipline. An assortment of introduction forums helps to "meet a variety of needs and contribute to improved student participation, increased student persistence, and ultimately enhanced student learning" (Chlup & Collins, 2010, p. 35). The introduction forum prompts are included and may be adapted to each instructor or course content. Developed with instructor flexibility in mind, it is important each instructor participates in these introduction activities to showcase their own unique style(s) for getting to know their class.

Going the Distance

For this introduction activity (also referred to as *World Series* or *Map Quest*), students choose a part of the world that holds significance for them. Postings may highlight cities that students have visited in their travels, a part of the world they currently reside in, or maybe a country their families might have emigrated from. Identifying the parts of the world that are of significance to participants can aid in expressing any cultural differences present throughout the class. A benefit of this strategy is that students share information about past, present, and/or future experiences to create connections. It provides students with an opportunity to discuss their geographic background which lends to a more humanizing educational experience (Dixon et al., 2006). It can also provide a way for students to learn who is near them which is especially nice for international students or students providing military service. In this author's own experience, when asking students to share where they currently reside, I have created a virtual map, tagged with the geographic locations that students provided.

Hollywood Stars/A Picture Says It All

Dixon et al. (2016) ask students to describe themselves by posting the name of an actor and/or a character in a movie that they identify with and/or perhaps look like. Classmates then try to guess why the individual relates to the movie character. Responding to classmates whose character/movie is not familiar generates communication between participants. A benefit of this approach is that students who do not wish to share a genuine picture of themself likely would not object to providing the name of an actor that they identify with; therefore, a sense of anonymity will be maintained. In a similar manner, this author has used the *A Picture Says It All* introduction forum. This is simple, quick and safe topic that asks the students to upload a picture or an image that they feel represents themselves and to share how they feel the image best represents them at this point in their life journey.

Good Things Come in Three's

Students are asked to share their three favorite ____. This author has filled in the blank with their three favorite websites, or their three favorite hobbies or interests, or their three favorite television or Netflix shows. The flexibility of this topic offers the instructor easy variety in its use. This is also a non-risky introduction forum that builds create comradery among the class in their responses, both in agreement as well as other websites or shows to watch of a similar genre. When asked to share hobbies or interests, students again find commonality or their own interest is sparked in the classmate replies.

My Slogan

An equally non-risky introduction forum is My Slogan. For this topic, students are asked to develop a personal slogan. This author includes they are welcome to use a company's existing slogan and to share how that relates to themselves. I provide the examples of "I'm Lovin' it" based on the McDonald's slogan or "Just Do It" based on the Nike slogan.

CSI: Class Session Introductions

Stephens (2015) used this introduction assignment to establish a foundation for student success in other course activities. By incorporating the CSI activity among the initial assignments, the online students were better prepared for future course activities that required interaction between them and their peers, the instructor and the content. Student are asked to respond to four prompt questions:

1. Which of the course's learning outcomes are of most interest to you and why?
2. What preparation have you had as a foundation for this course?
3. What influence do you believe this course will have on your future?
4. Complete and reflect upon a web-based assessment (links provided to free, online assessments) regarding their dominate learning modality and/or intelligence.

8 Nouns

For their initial response, students are asked to only write 8 nouns that best describe them. For the classmate responses, students are told to share why their 8 nouns are representative of their personalities or backgrounds. What this author finds intriguing in using this introduction forum is to see how many students follow the direction of including only 8 nouns, as well, the student's creativity in how to list just 8 nouns.

When I Grow Up

The description of this introduction discussion is to share what the student envisioned themselves being when they grew up and whether that is the career they are in or are pursuing now. This author has used this topic with multiple introductory course introduction forums. As students are just entering their higher education journey, many are also still contemplating what discipline or career they are pursuing. Likewise, Dixon et al. (2016) has used the *What Do You Do?* introduction discussion forum as a means for students to become acquainted with each other. For this activity, students are asked post three hyperlinks that provide clues regarding their profession or area of personal interest. Students are encouraged to be as creative and imaginative as they would like in providing their clues for their profession or interest. Student responses are to pose questions to each other in an effort to identify the professions or interests of their virtual classmates. Ultimately this activity provides insight into each other's backgrounds and interests and gives a context to the group's experiences and expertise.

This or That

The introduction prompt simply offers opposing responses to a statement and students are asked to choose one of the positions and share why they chose that perspective. Some neutral, safe, examples are:

- Which breakfast food is better: Pancakes or Waffles?
- Would you rather read a book or watch a movie?
- Would you rather live in the country or live in the city?
- Would you rather be indoors or outdoors?
- Would you rather travel every single day or never leave home?

Gonzalez (2015) found this introduction forum builds student confidence, it helps students quickly find kindred spirits, and it's also just a lot of fun.

3 P's

This author has found the 3 P's introduction topic most useful with the learners have previously been together. For this introduction forum, the students are asked to share three facts about themselves. One fact is something **P**ersonal, one fact is something **P**rofessional, and one fact is something **P**eculiar, such as a hobby or habit. An additional statement about respect for each person's privacy is included in the topic description as the sharing of something personal or peculiar could seem risky to some students.

3 Truths and A Lie

The hunt for truth is a good way to generate a lot of discussion and community building amongst contributors (Dixon et al., 2006). This exercise (also referred to as *Liar Liar*) gives everyone the opportunity to take part in some creative story telling. For their initial introduction response, students are asked to provide four statements about themselves. Three of the statements are true and one statement is false or made up. Classmates then respond to each other with a guess and an explanation to why their guess of what is false was chosen. In a larger cohort that has worked together previously, this introduction exercise can offer continued team building (Fiock, 2022).

Conclusion

Ultimately, there is no singular strategy to increase social presence in the online learning environment. The use of creative, purposefully designed introduction discussion forums has been found to foster student-to-student and instructor-to-student connectivity in a personal yet safe manner. The author has provided both research-based and personal experiences with multiple introduction discussion prompts that align with the CoI and social presence concepts discussed. Regardless of how it is achieved, successful acquisition of social presence can lead to more motivated students, successful student engagement, and effective online instruction.

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Using Video Conferencing and Media Management Tools in Support of Synchronous and Asynchronous Teaching and Learning

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Abstract

The use of multimedia content in education today takes various forms in the learning environment. Technology integration should be seamless, accessible, and usable to ensure a safe and convenient user experience. When learning content is only available on one device or system, it may generate another challenge. It is important for users to be able to easily share multimedia content between e-learning tools, media storage, and learning management systems to facilitate creative educational video usage. The media integration helps make seamless media adoption and usage possibilities. This emerging technology showcase demonstrates how video content is enhanced for online teaching and learning experiences based on synchronous and asynchronous conditions, allowing users to access their video content across systems. The technology-integrated environment, educational media management, and how teachers and students can utilize them to teach and learn content from evidence-based practices were further discussed.

Keywords: video conferencing, media management, technology integration, synchronous, asynchronous

Background

We are embracing and experiencing numerous new emerging technologies. These technologies make our lives more convenient and beneficial in various ways. However, it should not be overlooked that technology needs to be adopted with caution at times (Higgins et al., 2012; Williams, 2011). New technologies must meet standards for safe and suitable environments. The priority should be given to building a system that protects users (Amo et al., 2020; Huang et al., 2019; Pardo & Siemens, 2014; Romiszowski, 2004). When unforeseen errors occur in places such as security, safety, and accessibility, they could infringe on human rights (Klang & Murray, 2016; Sieber, 2019). One representative example is the use of technology in education. The use of new technologies in a safe, educational environment may present another challenge (Bricken 1991; Liu & Huang, 2005; Tsai & Chai, 2012; Wu et al., 2013). Building a secure, balancing, and integrated technology environment is essential to support the ease of use for teaching and learning, especially as the video content in education increases. The purpose of the showcase is to present one solution to this challenge.

Purpose of the Showcase

Technology integration must be seamless, accessible, and usable to ensure a secure and convenient user experience. To use video content effectively, users must be able to easily share multimedia content between e-learning tools, media storage, and learning management systems. An integrated multimedia ecosystem helps create seamless media adoption and usability (Kidanu, 2015 et al.). The emerging technology showcase demonstrates how video content can be enhanced for online teaching and learning experiences based on real-time conditions, allowing users to access video content across systems.

Evidence-Based Practices

Multimedia Principle

According to Multimedia Principles (Mayer, 2001), presenting words and pictures are more preferable to learning than words only. This principle has been supported by various empirical studies that learners perform better when information is presented in both, rather than one method. This principle provides a foundation for using multimedia and it is necessary to properly use multimedia for deeper learning.

Technology Integration Model

Technology integration is a theoretical model designed to help students think about technology integration in ways in educational settings. The SAMR model can help educators think about the role of technology in supporting learning. The SAMR model includes substitution, augmentation, modification, and redefinition. When using technology, we often focus on the first two levels (i.e., substitution and augmentation); however, technology integration has moved to the last two levels (i.e., modification and redefinition). With those targeted levels, learning can be supported, enabling activities that were previously impossible in the classroom. Through technology integration, learning can be enhanced.

Emerging Multimedia Technology

This emerging technology showcases how media content is optimized for online teaching and learning based on real-time conditions, using video conferencing and media management tools. The demonstration allows teachers and students to transfer a synchronous or asynchronous video across media content and learning management systems. Practical implications were further discussed for educators who are interested in using video in their classrooms.

Video Conferencing

Video conferencing tools give students, faculty, and staff the opportunity to host, and record meetings as well as store them in the cloud. Zoom has been commonly used as a video conferencing tool. Users can also use it with additional features such as small groups, whiteboards, screencasts, and sharing. Zoom is used for creating synchronous and asynchronous videos so that users can create and access videos in real-time or at any time.

Media Management

Media management tools support all video experiences for online teaching and learning. Users can add, edit, and manage their video content. Kaltura is one of the popular cloud-based media management tools. My Media is a personal media repository where users can create and store video content. Also, in the cloud, they can edit, manage, and publish videos. It is easily shareable with others and publishable to either a media portal, online course, or external website. The tool supports enrichment functions such as screencast, auto-captioning, interaction, learner control, assessment, analytics, and collaboration.

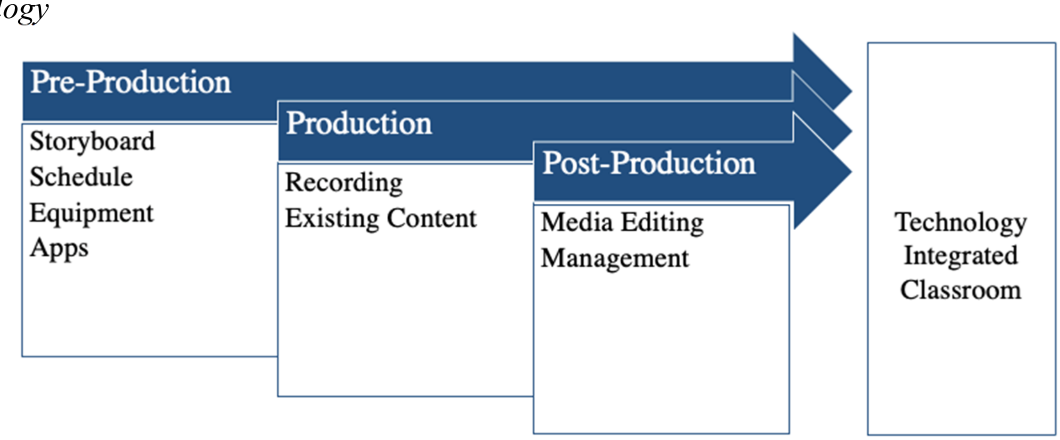
Integration of video conferencing and media management

The integration of video conferencing and media management allows students, faculty, and staff to create and manage their video content efficiently. For example, after a meeting ends a video recording is added to the Zoom cloud, and then automatically transferred to the Kaltura media cloud. The cloud recordings are available across the Zoom cloud, Kaltura cloud, and learning management system, enabling users to easily access, manage, and share with other users. In addition to the recordings, its transcription files and chat transcripts are sent to the Kaltura cloud and attached to their recordings.

In particular, the integration can be utilized in hybrid classrooms beyond the usage scope of online courses. In a hybrid classroom, instructors can use Zoom to record real-time sessions and utilize recorded content afterwards in video management and learning management systems. Figure 1 illustrates the flow in a technology-integrated multimedia environment where the three phases (i.e., pre-production, production, and post-production) are not separated and can operate as connected elements. Various types of hybrid courses can be made feasible by this integrated environment.

Figure 1

Integrated flow in a hybrid classroom with video conferencing and media management technology



Discussion and Implications

This emerging technology showcase demonstrates how video content may be enhanced for creating a safe, engaging, and flexible learning experience based on synchronous and asynchronous conditions.

Students, faculty, and staff can minimize edit and upload times and technical errors. The integration makes it easier and quicker to create and access video content. Virtual meetings can be recorded directly to a media cloud hosting service. This not only allows users to secure their video content but also avoid using their own storage capacity and internet bandwidth. Zoom-Kaltura integration allows all users to easily access Cloud recordings across the web portal (e.g., MediaSpace) and learning management system. Sharing and reusing video recordings is significantly more convenient and faster in this unified environment. Kaltura video management tool provides easy editing, captioning, and adding quizzes, as well as monitoring and analyzing video usage. With easy video creation and editing, users can also produce and publish their final video product in a variety of ways. They can present it to classes within the learning management system, and extend access to both internal and external audiences. It enables users to share and control their videos from anywhere via the embed code.

In short, the integration has the following practical benefits: (a) extended storage availability and data footprint, (b) enhanced accessibility, (c) robust media management capability, and (d) easier video editing and sharing. When integrating technologies, some considerations may be useful: (a) technological and pedagogical approach, (b) faculty professional development, (c) showcase at multiple formats, (d) partnering with various stakeholders, (e) actionable timelines, and (f) one-on-one support and scaffolded resources

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Faculty Competency-Based Micro-Credentials and Quality Assurance in Distance Education

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Abstract

Given the rise in the number of distance education courses being offered, it is increasingly important for educators to be prepared to teach online. In this session, we share best practices to enhance the quality of distance education based on the rules and procedures of competency-based micro-credentials and quality assurance for online teaching and learning. Faculty interested in teaching online or developing classes in the online environment are expected to be both credentialed and have their courses go through an approval process. Evidence-based teaching and learning practices were evaluated and prioritized to positively improve student learning in online environments. This session will be valuable for educators who support online teaching, learning experience designers who support professional development for online teaching, and administrators who support online teaching in higher education.

Keywords: faculty development, micro-credentials, quality assurance, quality matters

Background

In distance education, learners and teachers are physically separated in time and space. Distance learning is a preferred choice for individuals who are either employed or unable to be physically present to attend courses. The forms of distance education have been evolving in various ways, and the number of distance learners has also been increasing (Keegan, 1980; Johnston. 2020; & Saykili, 2018). Many efforts have been made to provide quality distance education. In the aftermath of COVID-19, discussions about the quantity and quality of distance education have become more crucial (Lassoued et al., 2020; Selvaraj et al., 2021; Teele et al., 2021). Many distance learning institutions have established or adopted standards as part of these efforts (Bolliger & Martin, 2021; Castro & Tumibay, 2021; Naim, 2021; Timbi-Sisalima et al., 2022).

Specifically, distance education guidelines, suggested by the Higher Learning Council (HLC, 2021) along with The National Council for State Authorization Reciprocity Agreements (NC-SARA, 2021) and the Council of Regional Accrediting Agencies (CRAC, 2021), have articulated our distance education program. The guidelines were created in collaboration with accreditors, other organizations, and subject matter experts in the education field and are consistent with the standards adopted by other institutions for assuring the quality of distance education and planning continuous improvement. In order to improve the quality of distance education, faculty and other academic support staff need to continue their professional development.

The professional development should be ongoing and include attention to "educational technology, instructional design, learning science, pedagogy, assessment, and methods of using data for improvement." Their institution ensures that "learning resources used for instruction and tools used for access to services are sufficiently supported and ensure accessibility and privacy for students" (HLC, 2021, p.4). Higher education institutions should provide clear rules and procedures regarding their distance education. The guidelines for evaluating distance education state that faculty who teach online courses and evaluate students' achievement in online learning should be appropriately qualified to perform their duties.

Based on these guidelines, our institution established and developed its standards, rules, and procedures for ensuring the quality of distance education. To fulfill the requirements for quality and to achieve the goal, educators who deliver online courses and assess student success must demonstrate evidence that they are qualified to teach distance education courses. Faculty may present either (a) evidence of their online pedagogy training or (b) teaching online experience that conforms to best practice standards. To provide training opportunities institutionally, faculty development programs for online teaching were reformed, incorporating best practices in online learning pedagogy, and ensuring competencies in the variety of educational technologies employed by the institution.

Purpose of the Impact Practice Session

As the demand for distance education opportunities grows, it has become increasingly critical for faculty to be prepared to teach online. As a practitioner-oriented session, we shared best practices on their preparedness to teach online based on the rules and procedures of micro-credentials and quality assurance in online courses. Faculty interested in teaching online or developing classes in the online environment are expected to be both credentialed and have their courses go through an approval process. This session introduced evidence-based teaching and learning practices to positively impact online student learning. Finally, the session has practical implications for faculty who teach online teaching, professionals who support faculty development for online teaching, and administrators who support online teaching in higher education institutions.

Evidence-Based Practices

Micro-credential is "a short, competency-based recognition that allows an educator to demonstrate mastery in a particular area" (National Education Association (NEA), 2020). The micro-credentials are based on research and best practice. Using micro-credentials, complex professional development is divided into smaller tasks and flexible along with a list of competencies where learners can choose to learn on their own and submit evidence for evaluation of competencies (Meyer, Clifford, & García-Arena, 2021). Additionally, micro-credentials provide a way to tailor and recognize professional learning based on performance and flexibility (Hunt et al., 2020; Rossiter & Tynan, 2019) and enables institutions to provide competency-based learning, regardless of time, cost, and place (Acree, 2016; Selvaratnam & Sankey, 2021). The micro-credential system makes it easy for all faculty members to access professional learning opportunities throughout their teaching careers. Remarkably, given the rapid advancements in educational technology, continuous professional development is needed to perform new strategies (Hunt et al., 2020; Selvaratnam & Sankey, 202; Tooley & Hood, 2021)

According to the American National Standard (ANS), quality assurance comprises "all the planned and systematic activities implemented within the quality system and demonstrated as needed, to provide adequate confidence that the entity, product or service will fulfill the requirements for quality." (ANS, 1994). Quality assurance for distance education is one of the significant concerns of institutions and stakeholders in distance education (Scull et al., 2011; Stella & Gnanam, 2004). With growing national interest in ensuring the quality of distance learning, the HLC and associated accreditation agencies set their standards to include distance education in their evaluation system (Bolliger & Martin, 2021; Castro & Tumibay, 2021; Naim, 2021; Timbi-Sisalima et al., 2022; Scull et al., 2011). These standards help coordinate new and existing resources into educational practices and to enhance innovative ways of improving distance education without chaos. Our institution has established or adopted standards as part of these efforts to provide high-quality distance education.

To ensure this quality, our institution participates in the NC-SARA, a nationwide organization to improve distance education quality and provide oversights on higher education programs. Also, we adopted Quality Matters™ (QM, 2018) to provide peer-reviewed assessments of online course design and recommendations for quality assurance and improvement (Legon, 2006; Naim, 2021; Sadaf et al., 2019).

Rules and Procedures

The rules and procedures regarding distance education have been tailored and established to implement evidence-based practices. By these rules and procedures to ensure students achieve online learning goals, faculty members should be appropriately qualified and trained. The following section explains the details of the rules and procedures regarding faculty credentialing and quality assurance for distance education.

Faculty Credentialing

The rules and procedures align with NC-SARA (2021) and the CRAC (2021) guidelines in conjunction with the HLC (2021) guidelines for distance education. The general rules and procedures are as follows: (a) Faculty should review detailed expectations for credentialing and approval processes, (b) Apply to get credentialed to teach online, and (c) Submit either evidence of training in online pedagogy, such as transcripts, certificates, etc., or evidence of experience teaching online that conforms to best practice standards (QM). Faculty credentials are reviewed and approved by the department of distance education.

The competency-based micro-credential program is designed for faculty and educational professionals who want to build on their knowledge and practice in online/hybrid teaching and learning. The program is intended to institutionally provide professional development opportunities that engage faculty and staff in educational practices and resources to support their move to online teaching directly. The in-house program consists of three competency-based micro-credential courses, which will satisfy the requirement for faculty online teaching credentialing: (a) PD101: Online Teaching Foundations (Introductory topics with six modules; Fully online), (b) PD102: Online Teaching Academy I (Basic topics with six modules; Hybrid), and (c) PD103: Online Teaching Academy II (Advanced topics with six modules; Hybrid). Multiple facilitators deliver these courses through online modules and synchronous sessions. The courses will also include a follow-up in-person training to help participants solidify their new skills. The other elements designed for competency-based micro-credentials include: (a) Spiral curriculum design, (b) Measurable competencies, (c) Flexible learning pathways, (d) Teacher as a coach/facilitator, (e) Experiential learning, and (f) Gamification.

Quality Assurance

Faculty are required to submit their online course for approval to the online review committee. Fully online courses must meet 85% of the QM standards. The general rules and procedures are as follows: (a) Obtain permission from the department to develop an online course, (b) Upon approval, develop a course utilizing the master template and resources. (c) Complete a self-evaluation using the QM rubrics, (d) Submit a formal application for the course and self-evaluation. It will be approved if the course meets 85% or more QM standards. If the course fails to meet 85% of the standards, the review committee will recommend revisions with suggestions, and they need to resubmit for consideration within two weeks. Faculty may schedule a meeting with the learning experience designer if assistance is required in course development.

To comply with the U.S. Department of Education (2020), faculty teaching online/hybrid courses should demonstrate evidence of Regular and Substantive Interaction (RSI) in various ways. For instance, distance education courses include at least two types of substantive interaction that should be scheduled and predictable between students and instructors either synchronously or asynchronously. The importance of RSI is reaffirmed as a critical factor for high-quality distance education and facilitates more regular and effective instructor-student interaction than a traditional online delivery format (Federal Register, 2021).

Discussion and Implications

The roles of faculty competency-based micro-credentials and quality assurance for online teaching and learning are critical in high-quality distance education. These efforts should be supported through continuous investment in various ways. The crucial elements in improving distance education require (a) Strong educational leadership and support, (b) Diverse collaboration for professional development, (c) Periodical improvement via quality assurance discussion, (d) Multi-faceted learning design support, (e) Pedagogical technology integration, and (f) Agile project management. It is also important for educators to continuously upskill their pedagogical and technological knowledge and skills as a part of their professional development. A potential challenge from the lesson learned is securing experienced coaches and reviewers internally. It is key to securing a stable pool of highly experienced coaches to meet a long-term goal with every facet of the program. In order to review a large volume of courses and provide high-quality feedback, securing certified course reviewers remains a challenge.

All online courses should be reviewed and approved periodically for continuous improvement. Thus, all faculty members are encouraged to participate in continuous professional development and quality assurance process to learn best practices for teaching in online learning environments. The lesson learned from the evidence-based practices would enable distance education to continue to develop best practices in online teaching and learning to help faculty start strong and succeed in their courses. We hope that participants create innovative ways to effectively implement evidence-based micro-credentialing and quality assurance to build an engaging online learning environment.

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Best Practices Using Digital Text in Distance Learning: Suggestions from Current Research

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Short description (75 words): Multimedia has been widely used in today's distance learning, yet a significant amount of the online content is still in the digital text format. While traditional writing style guides offer a certain level of reference, more guidance is needed for the effective design of digital text in distance learning. This study examined current research on the topic and drew suggestions for best practices using digital text in distance learning.

Keywords: Instructional Design, Visual Literacy

Abstract:

Introduction

Presenting content with multimedia is an effective and widespread practice in distance education (Mayer, 2001), but online learning still necessitates a significant amount of text information. Traditional writing style guides are not always effective or appropriate for maintaining focus and retention in the context of online learning (Escamilla, 2021). A comprehensive, peer-reviewed Digital Style Writing Guide does not exist for instructional designers to reference. This presentation hopes to open a dialogue about best practices in using digital text in distance education, draw suggestions from current research, and advocate for a Digital Style Writing Guide that maintains the integrity of the Americans with Disabilities Act (ADA) standards of accessibility.

Method

A query for "best practices text distance learning" through the authors' university library homepage resulted in three peer-reviewed articles. A Google search using the same keywords produced academic support materials from the University of Leicester, the National Council of Teachers of English, the University of South Carolina, the Purdue Writing Lab, and Edutopia. The highest number of search results came from the websites shiftelearning.com and eLearningindustry.com. An additional Google search for "ADA website compliance" produced a guide from Digital Authority Partners. A total of eighteen references are included in this review.

Results

Due to the word limit, the findings are presented in bulleted format. We will expand the findings and provide examples at the presentation.

Headings

- Use descriptive headings to clarify what the learner will need to know and do on each page or section to group information or tasks (Burns, 2021; Cagiltay, 2014; Escamilla, 2021; Gutierrez, 2021; University of Leicester, 2016).
- Use different colors or font styles but not necessarily different font sizes (Burns, 2021; Cagiltay, 2014; Escamilla, 2021; Gutierrez, 2021; University of Leicester, 2016).
- Number headings and use enough white space around them to make them meaningful (Burns, 2021; Cagiltay, 2014; Escamilla, 2021; Gutierrez, 2021; University of Leicester, 2016).

Fonts

- Different font styles are acceptable to draw attention to specific information but avoid too much variability in font size (Burns, 2021).
- Be consistent in the use of different fonts (Cagiltay, 2014).
- Boldface or slightly larger fonts increase attention to the content, but better to bold only individual words or phrases in the body (Escamilla, 2021; Jones, 2021).
- Body text should be in one size font (11 or 12), 14 for subheadings, 18 for headings - do not vary font size in the body of a text (Gutierrez, 2021).

Titles

- Add a title to each subheading (Escamilla, 2021).
- Number titles if possible (Escamilla, 2021).
- Create a relevant title that helps learners remember what they need to know (Escamilla, 2021).
- Use words like “what, when, why, how” to trigger curiosity (Escamilla, 2021).
- Use a colon and put the most critical words on the left to avoid wordiness and draw attention to the title's second half (Escamilla, 2021).
- Avoid filler words like “a, and, it” and never begin a title with filler words (Escamilla, 2021).
- “Headlines should be 4-7 words and summarize the screen. Bolding text makes it stand out and easier to find.” (Escamilla, 2021)
- Write titles that grab the attention of a learner, such as: “Titles That Make A Promise, Titles That Are Intriguing, Titles That Identify A Need, Titles That State The Content” (Jones, 2021).
- Use left alignment (Gutierrez, 2021).

Tone, Form, and Word Choice

- Use a conversational tone (Mayer, 2001; Mayer &Moreno, 1998; Swan, 2004, all cited in Grandzol, 2020).
- Use personalization with “you,” such as “What should you do?” Instead of “What should be done?” (Jones, 2021).
- As in a conversation, write like one speaks (Escamilla, 2021).
- Avoid unnecessary descriptions, phrases, or clauses (Escamilla, 2021).
- Use words like “Remember” to reference bullet point items (Escamilla, 2021).
- Use connecting words like “first, second, therefore, however, on the contrary” at the beginning of sentences (Escamilla, 2021).
- Avoid compound or overly complex sentences. Simple is best, nouns and verbs, and provide simple directions (Escamilla, 2021).

- Provide a brief introduction with the most critical points in 14-20 words. Simply explain unique vocabulary (Escamilla, 2021).
- Avoid "weak" words such as: "For the most part, absolutely, each and every, figure out, ask the question, very and basically - if it doesn't convey meaning, don't use it." (Gutierrez, n.d.; Jones, 2021)
- Be concise using words like "now" instead of "at the present time."
- Active voice is less wordy than passive voice (Gutierrez, n.d.; Jones, 2021).
- Avoid repetitions, overly complex words, or excessive use of adverbs (Gutierrez, n.d.; Jones, 2021).
- Use short paragraphs, 3-6 lines long, and break up any paragraph longer than six lines (Gutierrez, n.d.; Jones, 2021).
- Use bullet points to add visual white space (Gutierrez, n.d.; Jones, 2021).
- Avoid using verbs ending with "-ing" because they interrupt the flow of a text (Gutierrez, n.d.; Jones, 2021).
- Use "chunking" to break down topics from simple to more complex. Use a title label to help students skim for what they need (Burns, 2021).
- Use hyperlinks within a document to help avoid unnecessary scrolling (Cagiltay, 2014), to help define unfamiliar terms, or direct to other online texts (University of Leicester, 2016).
- "Note that we take in 25% less when we read online, and so a good rule is to write only 50% online of what you might write in print." (University of Leicester, 2016)
- Check written text with a free online "readability tool" (https://www.webfx.com/tools/read-able/) (Cousins, 2013).
- Allow for white space between lines of text on a page to allow the eye to rest and to draw attention to the most critical information (Gutierrez, 2021; Gutierrez, 2014).

Discussion

While multimedia has proven valuable to distance education, instructional designers will still need best practices for using digital text. Screen reader software accessibility is a requirement for ADA compliance, yet screen readers do not recognize some of the above suggestions, such as bold or colorful text. A Digital Style Guide would help software developers to address this problem. Further research and collaboration are needed on this topic.

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Strategies for Designing Inclusive Online Learning Environment

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Abstract

There are various aspects of the course that an instructional designer, online educator, and teaching assistant can improve in order to make an online course more inclusive. This article provides recommended strategies for creating inclusive online learning environments. We focus on three aspects of an online course, namely, the classroom climate, assessment strategies, and pedagogical approaches. Our findings indicate that incorporating various strategies could help break down barriers to learning in online learning environments.

Keywords: Diversity, Equity & Access, Instructional Design

Introduction

There are many benefits of designing inclusive online courses. One of the most important benefits is that inclusive courses reduce barriers and create learning opportunities for all students. According to Florian (2015), "inclusive pedagogy is an alternative pedagogical approach that has the potential to reduce educational inequality by enhancing learning opportunities for everyone" (p.6). It is also of added value to consider inclusive design as a requirement by law for the protection of the rights and privileges of learners with disability (IAAP, 2022). Upholding the civil rights of people (learners) with a disability as provided in laws affords learners with a disability and nonnative learners alike the opportunity to engage in an equitable learning environment. Laws like the Americans with Disability Act (ADA) adopted in 1990, the Equality Act of 2010 of the United Kingdom, Ontarians with Disabilities Act of 2001 ensure that the rights and privileges of the disabled are protected to discourage discrimination among learners in higher education. Instructional designers and online educators, including teaching assistants need to consider practical ways that they are able to not only design and develop the online content and courses feasibly and accessible but also understand how they are able to apply inclusive pedagogy approach, online course design principles, and inclusive online teaching tactics to design and develop inclusive online learning environments for all learners (Lowenthal et al., 2020). We present various recommendations for designing inclusive online learning environments under three categories namely strategies for creating an inclusive classroom climate, strategies for assessing learners, and inclusive pedagogical strategies.

Inclusive Learning

According to Milani and Rostami (2014), there are two types of definitions of inclusive learning: the narrow approach and the broader approach. In the narrow approach, inclusive learning means that learners with developmental problems are in the regular education system (Milani & Rostami, 2014). Inclusive education is when all learners including students with special needs participate in an equal learning environment or classes for educational purposes (Peranginangin & Husein, 2021). Inclusive learning was adopted from the importance of the Universal Declaration of Human Rights (United Nations, 1948) and The Convention on the Rights of the Child (United Nations, 1989) which emphasized that all people regardless of disabilities have the human right to have the same educational opportunities (Peranginangin & Husein, 2021).

In the broader approach, inclusive learning is a kind of educational philosophy adapted to the needs of people who learn regardless of their age, culture, gender, language, ethnicity, disability, and so on (Milani & Rostami, 2014). The purpose of inclusive education is that all people can participate in learning activities without any restrictions, make contributions through numerous methods, and be esteemed and appreciated as equal participants in educational institutions (Milani & Rostami, 2014). Therefore, inclusive learning reflects all possible human experiences as well as concentrates on the learners' needs to provide better learning opportunities for all people who want to learn (Phillips & Colton, 2021).

As the definition of inclusive learning has changed from the narrow view to the broader view, the education system needs to adopt this change. For example, instructors or trainers in classes need to provide all learners with significant engagement that the learning environment is helpful for all students regardless of their backgrounds or disabilities (Peranginangin & Husein, 2021). In particular, in an online learning environment, instructors or instructional designers should acknowledge inclusive learning design principles that reflect the crucial factors of accessibility and investigate ways in advance to deliver user-friendly learning opportunities for all learners so that learners engage in a class and actively participate in learning activities (Phillips & Colton, 2021).

Review of Inclusive Online Learning Strategies

Trapp et al. (2022) suggested essential nine principles for designing an inclusive online learning curriculum: (1) building on learners' talents and skills, (2) investigating, confirming, and accepting learners' diverse identities and voices, (3) respecting each learner's own experience, (4) allowing positive agents of social change, (5) confirming various ways of expression, (6) suggest valuable feedback for learners' development, (7) investigating course ideas based on historically marginalized learners or groups, (8) confirming online course designs are not systemically prejudiced, (9) allowing suitable replies or feedback to recognize inequities. They also suggested strategies that support this principle to provide guidance for designing inclusive online learning.

Frechette, Gunawardena, and Layne (2016) presented the instructional design model for designing culturally inclusive online courses that elucidate all learners' various cultural experiences. This model included six steps: (1) identify a problem, related case study, or inquiry, (2) investigate the problem and suggest individual understandings, (3) search for related information or materials to contrast, question, and conclude contending viewpoints, (4) consider how the explored topic has reorganized thoughts, both independently and cooperatively, (5) conclude the consequences of previous steps to suggest united resolutions in a group, (6) save new perceptions learners created for other learners. This model particularly focused on designing group activities with diverse peers in an online learning environment.

Lowenthal et al. (2020) also suggested several strategies for online educators and trainers to assist all learners. The aims of these strategies are to create a usable, accessible, and inclusive online learning environment for all learners. They argued that for inclusive online learning experiences, three areas should be considered: "accessible and usable course and content, accessible and inclusive pedagogy and course design, and accessible and inclusive teaching (Lowenthal et al., 2020, p. 7-8)". Considering accessibility and usability, web spaces for learning need to be made accessible. Web accessibility, according to IAAP (2020), is "the ability of a website or application to be easily navigated and understood by a wide range of people, including those who have disabilities" (p. 64). This implies that web resources and environments like websites and all technologies that support learning need to be designed to allow user privileges for all learners including learners with disabilities (IAAP, 2020).

For online content or courses, audio materials including sight, and visual materials including sound and clicking are needed. For course design, there were various strategies such as (1) various ways of engagement, illustration, and evaluation, (2) unambiguous assignments, (3) reliable and user-friendly course design, and so on. Accessible and inclusive online teaching could be provided through consistent and impartial communications, appropriate feedback, knowing learners, observing learner growth, synchronous feedback, and so on.

Rao (2021) also presented an outline for inclusive online learning based on Universal Design for Learning (UDL). According to Rao (2021) and Meyer, Rose, and Gordon, (2014), UDL is a framework to proactively incorporate inclusive learning tactics that can facilitate learning activities for all learners in an online learning environment. The UDL design process for inclusive online learning consists of six steps: (1) reflect learner variableness, (2) find obvious learning objectives, (3) develop evaluations, (4) design flexible learning methods and related resources, (5) provide UDL-based learning, (6) review and modify. Through this design process, instructors can overcome hardships to design inclusive online courses and proactively provide learners with appropriate assistance.

These existing strategies are useful to design inclusive online learning. However, these strategies usually focused on accessible online learning or culturally inclusive online learning. In addition, other principles do not contain design principles for the whole learning process (e.g. learning objectives and assessments). Therefore, more comprehensive strategies are needed to design inclusive online learning for all learners regardless of their backgrounds. In the following section, we propose various strategies for designing inclusive learning environments.

Proposed Strategies for Designing Inclusive Online Learning Environments

Inclusive Classroom Climate

According to Freeman et al (2007), a welcoming and positive online classroom climate is an important factor in an effective and inclusive online learning setting. This online classroom climate helps students feel comfortable, respected, and esteemed and encourages them to establish a social presence which impacts their self-efficacy, sense of competence, and worth for the learning activities (Zumbrunn et al., 2014; Dewsbury & Brame, 2019). Therefore, an important step in aiming for an inclusive online classroom climate is to create a positive and welcoming learning environment and establish a social presence by ensuring that the classroom environment is welcoming and committed to equality (Smith, 2020). The course designer/instructor could make an effort to ensure that injustices that students may feel are addressed and that students perceive a sense of fairness.

To foster an inclusive classroom climate, it is essential to let students know that they matter. This could be accomplished through attention (a sense that you notice a student's presence or absence) and an appreciation of their efforts (Smith, 2020). An appreciation of their effort could be shown in the feedback provided to them at various stages of the learning process. We recommend that course designers and instructors should strive to create an online learning environment where all students feel welcome. For asynchronous online courses, we recommend creating a warm welcome video that can be located on the course welcome/ landing page. The course welcome or landing page is essential as it is the first item students will see and this will impact their impression of the course. Text used in the course landing or welcome page should also be welcoming to all learners which should set the tone for the rest of the course.

Similarly, the syllabus is another important document that should be reviewed to ensure that it presents accurate information on how the course is designed to be inclusive. Student impressions of a course may be formed from reading the syllabus. The following are tips on how you could use your syllabus to create an inclusive and welcoming learning environment. The tone in your syllabus should be both welcoming and supportive. It should also 'encourage growth, cultivate hope, establish expectations for success, and recognize the array of experiences and knowledge students bring to the class as a value that enriches learning' (Pacansky-Brock et al., 2019, p. 11-12). Use inclusive language in the syllabus and include a diversity statement. We recommend including land and territory acknowledgment in your syllabus. Include a statement encouraging students to respect diversity. We also recommend clearly explaining what students can do to succeed in the course and providing information about how students can get help. If possible, avoid using jargon in the syllabus.

We recommend having a pre-survey or a short meeting with questions on students' backgrounds, strengths as well as difficulties to establish their social presence and assist online educators to understand the various types of students in their online courses (Lowenthal et al., 2020). Online courses should have opportunities for students to share about themselves. To accomplish this, we recommend cultivating a sense of belonging by creating opportunities for meaningful interactions (student-student and instructor-student). These may include discussions, group projects, and other collaborative activities.

Inclusive Assessment Strategies

There are various strategies for designing inclusive assessments. According to Kaur et al, (2017), "Assessment in diverse settings requires careful examination of practices to ensure provision of equal and fair opportunity for all individuals, irrespective of their backgrounds" (p,157). It is essential to design inclusive assessment methods because a one size fits all approach may disadvantage some students. The following are recommendations for designing inclusive and equitable assessments. When designing assessments for your online courses, consider providing clear, step-by-step instructions. Avoid assuming all your learners comprehend the assignment/task/instructions. One good practice is to request colleagues or a few students to review your assignments/tasks/instructions and provide feedback on the clarity. Another good practice is to provide examples and non-examples for your assessments. For example, if you want your students to write an essay, provide examples from previous classes (with permission from the authors) showing what a good essay will look like. You could also come up with a non-example to show students how they should not respond to the prompt. We also recommend including rubrics for all assessments. Rubrics should, however, be clearly explained to the students to maximize their usefulness (De Silva, 2014). Rubrics are beneficial to learners because they help clarify expectations, assist students in understanding the goals of the assessment and also assist instructors to provide more informative feedback to the students (Andrade, 2005).

We recommend using more formative assessment methods as they allow for adjustments to the teaching and assessment methods based on the data collected. Providing students with opportunities to revise their work could help facilitate the learning process as well. When assessing students, there is a possibility that our biases could influence how we grade them. As a result, we recommend that instructors/course graders could use blind grading if possible. Course graders/instructors could also request colleagues/ other members of their team to review assessments to look for evidence of bias. It is a good practice to provide students with multiple options to demonstrate their skills or knowledge. We recommend using alternative assessment methods to assess the students instead of using high-stakes assessment methods. This is because conventional assessment methods may not be equitable in certain situations considering the diversity of the student population.

Inclusive Pedagogical Approaches

Inclusive pedagogy is "a pedagogical approach that responds to learner diversity in ways that avoid the marginalization of some learners in the community of the classroom" (Spratt, & Florian, 2015, p. 89). Thus, inclusive pedagogy approaches should be considered in an online learning environment because it focuses on students and instructors creating an engaging learning environment for all the students with varied backgrounds, learning preferences, and physical and cognitive abilities in the classroom. We encourage course developers/instructors to conduct a deep cultural analysis of the content and accompanying learning materials in order to make improvements.

When curating content, be sure to include content from a diverse perspective. This could be accomplished through the use of guest speakers or articles from experts with diverse backgrounds. Within the class, strive to create a class environment where students from diverse backgrounds can share their perspectives. However, avoid tokenizing students or representations as this may have unintended consequences and may hinder learning instead of supporting it.

Recognizing the diverse situations under which your learners maybe it can help you plan and use strategies that will benefit your learners. For example, incorporate strategies that will assist learners to acquire the knowledge and skills needed. This could include using captions or transcripts for your audio/video content so that learners with disabilities or learners whose language is not the first language used in the video/audio can understand.

Incorporating various strategies for engaging learners can have a positive impact on their learning. For example, instead of using a discussion board, consider using audio/video discussion tools such as Voicethread. We also recommend using affordable tools and resources as using expensive tools or resources may present barriers to students who may not have the financial means to access the tools or resources. Instead of using expensive textbooks, consider adopting Open Educational Resources (OER) in your course. Instruction/lessons should be designed to accommodate a wide range of abilities and physical or online learning environment design should accommodate differences in the learner's physical, communication, and intellectual needs (Zaloudek et al., 2018). To promote equitable use, all students should be provided with the same means of use (identical when possible and equivalent when not). Variate assessment methods. Present various/multiple opportunities for students to demonstrate their understanding. Ensure that there are various pathways for students’ achievement

Inclusive pedagogy also entails making the learning process more meaningful to the learner. This can include using pedagogical approaches that recognize the agency of learners, meaning that the responsibility of learning is shared between the teacher and the learner (Florian, 2010). Recognition of learner agency further enhances learning outcomes and increases confidence and interest in the learner, and their willingness to learn. This can be achieved through the involvement of the learner in designing activities, and or choosing materials for learning (Luo et al., 2019). Welcoming student voices in the classroom can begin even before the start of the course through the use of pre-assessment/pre-survey strategies, as discussed above, that seeks to understand who your students are, the purpose of the course, and what the level of interest is in that particular course. We recommend, when possible, using surveys before the start of the course that asks basic, demographic questions like who the students are, and why they may be enrolled in your course. This helps you as the teacher to prepare material that is both relevant and meaningful to the student. In this way, student agency can be seen as a means of including student voices in the preparation of course materials, and assessment methods.

Conclusion

There is more than one strategy to provide students with inclusive online learning. This paper focuses on three types of strategies which are Inclusive Pedagogical Approaches, Inclusive Assessment Strategies, and Inclusive Classroom Climates that could provide students with a more inclusive online learning environment so that they could feel a sense of belonging regardless of their background. In addition, these strategies provide helpful guidance for online educators and instructional designers to understand how to create an inclusive online learning environment. With instruction moving towards online learning, the strategies recommended in this paper can help foster a rich and meaningful learning environment. This makes it even more important to establish a social presence and an inclusive learning environment that is cognizant of students' diverse backgrounds.

What strategies we will use, how they will work and why they should work are important questions that we must focus on as a way to ensure the students' engagement in online learning. Also, instructors can rely on principles of inclusive teaching to design inclusive learning, recognize diversity, and ensure that students can access courses, and feel a sense of belonging. In future research, we will design and develop an online class based on these strategies and investigate the effects on learners' motivation, social presence, and learning outcomes.

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Assessing the Effectiveness of Instructional Design/Online Course Development Teams

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Introduction

U.S. Higher education has faced an unprecedented decade, with overall enrollment declines coupled with calls for greater accountability and evidence of effectiveness and return on investment. Accrediting agencies, such as the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) have been shifting from an emphasis on inputs—e.g., number of books in the library--to outputs including assessment of student learning and graduation rates. One of the critical institutional measures for accreditation is "institutional effectiveness." In language reminiscent of an instructional design model, SACSCOC defines institutional effectiveness in its Standard 8.2c: "The institution identifies expected outcomes, assesses the extent to which it achieves these outcomes, and provides evidence of seeking improvement based on analysis of the results" (SACSCOC, 2018, p. 73). Interestingly, institutional effectiveness is one of the most often-cited areas of weakness identified during accreditation visits (SACSCOC, 2020).

The COVID-19 pandemic has been another unexpected and unprecedented event that continues to have a profound effect upon higher education. The threat of closure caused colleges and universities—many of which had largely downplayed or rejected online/distance learning in the past—to take it more seriously and began to institutionalize it (Garrett, et al., 2020). A recent study by NC-SARA indicated that during the past two years, the percentage of students learning online rose from 30% to 93% (NC-SARA, 2021). As a result, the job market for instructional/learning designers has risen significantly. Just one month after the COVID-19 crisis started shutting down campuses, Inside Higher Ed ran an article titled "The Hottest Job in Higher Education: Instructional Designer" (Decherney & Levander, 2020).

As colleges and universities instigate campus-wide digital learning initiatives, the model of a single instructional designer for an entire institution is increasingly being replaced by a team, (group, unit, center or department) of instructional design, learning design or online development (Intentional Futures, 2016). How will calls for accountability and institutional effectiveness affect these teams? When “COVID panic” dies down and colleges and universities return to a “new normal” of on-campus and online instruction, will decreasing funding mean that instructional design teams will need to justify their existence or effectiveness to stay intact? Which metrics will or can be used to measure the effectiveness of instructional design teams? How can systematic instructional design, which includes identifying outcomes, assessing the outcomes and making improvements based on outcomes assessment, be applied to instructional design/course development teams?

Metrics for Assessing Course Development Teams

Multiple standards and rubrics exist for assessment of instructional design and instructional designers. These, include the Association for Educational Communications and Technology’s (AECT) Instructional Design Standards for Online Courses (Piña, 2017), Blackboard’s Exemplary Course (Blackboard, 2022), California State University-Chico’s ROI (California State University-Chico, 2022), Quality Matters (Quality Matters, 2022), and OLC/Open SUNY’s Course Quality Review (OSCQR) (Online Learning Consortium, 2022). These standards and rubrics provide useful metrics for assessing the quality of individual courses but are not designed to assess the teams that develop the courses. The OLC Quality Scorecard for the Administration of Online Programs (Shelton, 2010) is a helpful tool for formative evaluation of institution-wide resources and processes; however, its guidelines and metrics also focus upon courses, not course development teams. The International Board of Standards for Training, Performance and Instruction (ibstpi®) has identified 22 competencies for instructional designers (Kozalka, et al., 2013). These competencies provide beneficial guidance for training and assessing individual instructional designers, yet they also were not formulated to assess a team of instructional designers.

Although Slaughter & Murtaugh (2018) recommend administering surveys to faculty subject matter experts to identify strengths and weaknesses in the course development process, a comprehensive search of literature failed to find comprehensive guidance on how to evaluate instructional design/online course development teams. A search was then conducted to identify assessment reports and assessments guides for academic support units at higher education institutions, some of which included course development. The reports and guides from the 15 institutions listed below were consulted:

- Arkansas Tech University
- Caldwell Community College and Technical Institute
- California University of Pennsylvania
- Eastern Kentucky University
- Florida State University
- Jackson State University
- LaGuardia Community College
- Miami University of Ohio
- New Mexico State University
- Northern Illinois University
- Savannah State University
- Sullivan University

- Texas A & M University
- University of Louisville
- University of North Carolina at Chapel Hill

Analysis of the assessment reports and guides identified four primary assessment categories for academic support units: 1) key constituent satisfaction; 2) activities undertaken by the unit; 3) scholarship undertaken and recognition received by the unit and 4) operations. Table 1 below identifies the most common data type for each category (survey data, numerical data, text description) and possible metrics for assessing online course development teams.

Table 1: Possible metrics for assessing online course development teams

Category	Data type	Assessment Metric
Key Constituent Satisfaction	Survey	Faculty satisfaction with courses Student satisfaction with courses Academic leadership satisfaction with courses Advisory council satisfaction with courses Faculty/SME satisfaction with course development process Faculty satisfaction with consultancy/support/training
Activities	Numerical	Courses developed/modified by the team Courses evaluated by the team Training events provided by the team Consultancy sessions provided by the team Faculty support sessions provided by the team
Scholarship and Recognition	Text description	Awards received Conference presentations Publications
Operations	Text description	Improvement actions taken

Discussion

The metrics listed above provide various options for assessment of instructional design/course development teams, units, centers or departments. The institutional effectiveness process requires that a team identifies outcomes, determines how to assess the outcomes, collects and analyzes assessment data, and determines improvement actions or strategies based on the data analysis (SACSCOC, 2018). In order to successfully implement an improvement strategy, the team in question must be "in control" of the assessment metric. In other words, if the data from a metric is primarily controlled or influenced by an entity outside of the unit being assessed, then improvement strategies or action may have no effect. For example, the metric "number of courses developed/modified by the team" would not be very useful if the number is completely dependent upon development requests received from academic units and there is little that the team could do to influence the demand for more courses. In order to successfully implement improvements, the team must be able to implement actions that could affect the data. In the same manner that instructional design models are designed to promote continuously improving instruction, the similarly-structured institutional effectiveness model is designed to promote continuously improving teams.

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Managing the Online Instructional Development Process: An Institutional View

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Introduction

The COVID-19 pandemic has resulted in online education becoming a larger and more central part of the mission of many colleges and universities. A growing number of institutions are formalizing their digital learning initiatives, including how online courses are developed and implemented (Garrett, et al., 2020).

Managing the instructional development process of online courses at the institutional level is significantly different than individual faculty members developing their own courses. Managing the process of online course development allows institutions to scale the development of online courses, better align individual courses to program-level learning outcomes, contain development costs, eliminate redundancies in the curriculum, and create a more consistent experience for online learners.

Decision-Making Framework

Each institution has its own unique culture. What works well for one school, college, university, organization or company may be less effective for another. Therefore, the decision-making framework illustrated in Table 1 below (adapted from Piña, 2021) provides guidance and ideas for the online/distance learning leader to consider in determining what to adopt and what to adapt.

Table 1: Decision Making Framework (Piña, 2021, p. 144)

Component	Decision Item
Environment	• Internal or external development • Centralized or decentralized development
Roles and Responsibilities	• Faculty roles • Scope of work, compensation and intellectual property • Instructional designer roles
Quality	• Standards for Development and Evaluation
Operations	• Independent or Guided Design

Environment - Internal or External Development

The growth of online learning enrollments, coupled with overall college and university enrollment declines during the past decade (National Center for Education Statistics, 2021;

National Student Clearinghouse, 2020, Seaman et al., 2018), and the reaction to the COVID-19 pandemic, has served as a catalyst for institutions to adopt online learning as a part of their mission and normal operations (Garrett, et al., 2020).

The Online Program Management (OPM) market was established to provide two basic types of services to institutions wishing to offer fully online programs: 1) A full-service model, where the OPM agreement includes all of the services for developing, supporting and promoting the online program or 2) an a la carte model, where the institution contracts only for specific services provided by the OPM, such as instructional design, marketing, promotion, analytics, or user support (Pelletier, 2018). While the OPM market has increased markedly during the past several years, many institutions find that the desire to control their own programs is more compelling than an OPMs potential to rapidly offer programs and provide up-front funding, marketing and analytics (Busta, 2019, Springer, 2018).

Environment - Centralized or Decentralized Development

Centralization or decentralization of course development is highly influenced by institutional culture. It can be considered as a continuum: At one end, resources and personnel for online course development are centralized in a department or group that is available to the entire institution. At the other is one in which academic departments, schools or colleges are run autonomously from each other, with course development personnel and resources dispersed throughout the institution (Bergeron & Fornero, 2018).

Roles and Responsibilities - Faculty Roles

Institutional culture, employment and bargaining agreements, interpretations of accreditation guidelines, and the ability or willingness or an institution to provide personnel and resources to the online course development process, will largely determine the role of faculty play in course development. Three common roles played by faculty are autonomous, partnership and team (Piña, 2021).

In an ***autonomous*** model, the responsibility for developing the online course rests completely upon an individual faculty member, who is usually not obligated to work with anyone else at the institution (Hawkes & Coldeway, 2002). In an autonomous model, the faculty require more extensive training, as they will be assuming the roles of all members in the partnership and team-based models described below (Slaughter & Murtaugh, 2018).

In a ***partnership*** development model, the faculty member partners with an additional person—most often an instructional designer—to develop the online course. While the faculty member serves as the subject matter expert, the instructional designer can provide faculty with ideas for structure, format and strategies to make their courses more successful. The instructional designer can help assure that student learning outcomes are well aligned with the assignments, activities, test, etc. that assess those outcomes (Xu & Morris, 2007).

In a ***team-based*** development model, the faculty member works as part of a design and development team of three or more individuals (Hawkes & Coldeway, 2002). The faculty member serves as the subject matter expert, while technical development tasks may be done by instructional designers, content editors, multimedia developers, graphic designers, psychometricians, copyright specialists or instructional or information technologists (Hixon, 2008).

Scope of Work, Compensation and Intellectual Property

Determining the role of faculty is also related to three other decision items (Piña, 2021):

- The ***scope of work***, (i.e., what needs to be done for the work to be deemed complete) should be explicit and written down.
- The ***compensation*** or incentivization for online course development (e.g., whether it is seen as expected part of the faculty member's basic responsibilities with no extra remuneration or whether the faculty member receives release-time or a stipend/compensation for course development
- The ***intellectual property*** (i.e., whether the online course is "owned" by the faculty member or the institution and whether the compensation given to the faculty member constitutes a work-for-hire agreement.

Instructional Designer Roles

The role played by the institutional designer is directly related to the faculty role described above (Piña, 2021).
In an ***autonomous*** model, IDs are often viewed as optional or expendable. Faculty may view the instructional designer as a non-peer who is "trying to tell me what and how to teach," not knowing or recognizing the distinct expertise and experience that the ID brings to the course development process (Dimeo, 2017).

In a ***partnership*** or a ***teams-based*** model, the instructional designer is assigned either voluntarily or by mandate. The success of this model is also determined largely by the relationship between the faculty member and the instructional designer (i.e., whether the faculty member considers the instructional designer as a mere subordinate or assistant or accepts the instructional designer as a true partner and collaborator for the course (Xu & Morris, 2007).

Quality - Standards for Development and Evaluation

While there is no common agreement regarding what constitutes online course quality, several resources are available to assist online/distance learning leaders (Martin & Kumar, 2018). These include Quality Matters (Quality Matters, 2022); Blackboard's Exemplary Course (Blackboard, 2022); OLC/Open SUNY Course Quality Review (OSCQR) (Online Learning Consortium, 2022); and the Association for Educational Communications and Technology (AECT) Instructional Design Standards for Online Courses (Piña, 2017). Some colleges and universities prefer a "best of all worlds" situation by creating their own institutional standards based on one or more of these standards and rubrics.

Whether an institution adopts one or more of the standards and rubrics mentioned above or creates its own, a decision needs to be made regarding how to use the standards, rubrics, etc. to evaluate/certify/approve online courses (Piña, 2021). Some may choose to have individual faculty members, instructional designers, academic leaders or committees perform evaluations, while others may opt for a more formal route, such as Quality Matters certification.

Operations - Independent or Guided Design

In a traditional ***independent*** setting, it is assumed that the faculty member who develops a course is the same one who will always teach the course (Piña & Bohn, 2016). The course reflects the personal style and preferences of the individual faculty member. The differences between different instructors' courses could reflect instructor variety and personality or could provide difficulty and confusion due to inconsistent interfaces, navigation, layout and use of course tools and procedures (Slaughter & Murtaugh, p. 261). Adjunct faculty could find it difficult to teach courses customized to a different faculty member.

"Providing a ***template*** for instructional designers and subject matter experts to compile the necessary content for the online courses they are developing allows for consistency across the design and development cycle. Using a design template also allows for the organization of the course information in a streamlined manner" (Slaughter & Murtaugh, p. 261). Templates can vary but tend to be organized to maximize intuitive navigation for students. Courses featuring templates tend to be easier for adjunct faculty, but some faculty may feel that templates stifle their creativity (Piña, 2021).

Master Course: A master course will typically add all basic course content to a template, making a course "ready to teach"—advantageous for new or adjunct faculty. An online master course can take different forms but is often understood to mean that all sections of a given course start out being identical (Piña, 2021). Faculty with editor access to their courses can then customize them as they desire.

Conclusion

The process of course development at the institutional level should be systematic—carried out in a planned and deliberate manner--taking into account the various decisions and tasks involved (Carr-Chellman, 1996). Failure to consider the components and decision items described herein early on will likely result in having to resolve more serious issues related to these areas at a later date.

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Using Rubrics to Improve Online Class Communications

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Abstract: Effective instructor-learner communications, especially communications on assessment, help to improve online learning. This article analyzes the challenges faculty encountered in online course assessment at Purdue University. It introduces how instructional designers helped to improve online instructor-learner communications by enhancing assignment instructions and creating/adopting assignment rubrics.

Keywords: online courses, communication, assessment, rubrics

Background

Communication has a foundational influence on teaching and learning (Smith & Ragan, 2005). Educators claimed that effective instructor-learner and learner-learner communication help to improve learning (Simonson, Smaldino, Albright, & Zvacek, 2012). Several learning activities and teaching strategies have been used to enhance communication and interaction in online classes, such as using discussion boards, assigning online group assignments, and hosting online synchronous class meetings. Researchers pointed out that using rubrics can be another way to help with creating better communications in online courses. (Haught, Ahern, & Ruberg, 2017). Steven, Levi, and Walvoord (2012) claimed effective rubrics can provide timely feedback, encourage critical thinking, facilitate communications on the goals and expectations, and help instructors to refine their teaching skills.

Meanwhile, literature shows that the quality of rubrics impacts learning performance (Chan & Ho, 2019). Researchers discussed ways to improve rubric design, such as inviting students to participate in the design process (Bauer, 2002; Steven, et. al, 2012), and using online rubric bank (Simonson, et. al, 2012). Jonassen, Howland, Marra, and Crismond (2008) identified five main characteristics of well-designed rubrics, which are:

- Includes all the items that are important enough to assess
- Create clear criteria categories instead of combining multiple criteria into one category
- Rating scales should cover the range of expectations
- Communicate clearly with both instructor and learner
- Provide rich information about the multiple aspects of the performance (pp.229)

From an instructional designer's perspective, this article analyzes the challenges faculty at Purdue University met in online assessment. It also introduces the strategies instructional designers investigated to assist faculty in designing and developing rubrics, and how rubrics improved communications and interactions in online courses.

Problems and Challenges

Assignment rubric is also called scoring schemes or rating scales. The benefits of using rubrics have been discussed by many educators. Jonassen et al. (2008) claimed applying rubrics can promote intentional learning by identifying important aspects of the assessment and learning goals. Simonson et al. (2012) pointed out that assignment rubrics should be provided in online classes to assist students with assessment because using rubrics helps to improve consistency and fairness of scoring.

However, rubrics have not been popularly used in online courses. In the online courses that do not have assignment rubrics, instructors experienced similar challenges. For example, students kept asking about the requirements of the assignments even though the instructions were provided on the course site, the time teaching assistants spent on grading assignments was longer than expected, or instructors spent extra time explaining the grades to students after grades were posted. When instructional designers reviewed the assignments instructions of these courses, we discovered some typical issues:

- The assignments do not clearly state the intended learning objectives they are to assess
- The expectations of the assignment are not clearly stated
- The assignment instructions are too brief, and the requirements are not clear
- The assignment instructions are too long and not easy to understand
- The assignment instructions are not clear on grading criteria

On the other hand, in the courses that adopted assignment rubrics, some faculty were struggling with using them. Instructional designers also noticed some common problems:

- The rubrics were designed for other courses or other assignments. They do not match the learning objectives or fit the assignment requirements of the current course
- The rubrics are downloaded from the online rubric template and were not adapted to the current course assignment
- The rubric criteria statements are somewhat ambiguous. The expectations of each point scale are not clearly explained
- The rubric criteria statements and point scale descriptions have conflictions
- The rubric criteria statements and point scale descriptions include words with weak or several meanings, single terms instead of full sentences, or Grammatical errors.

Furthermore, faculty have different opinions on using rubrics. Some faculty embraced the idea of using rubrics in online courses and believe it is one of the best ways to improve the effectiveness and efficiency of online assessments. In some online courses, instructors created rubrics for each assignment, including online discussion assignments. However, many faculty do not have enough time to create rubrics. Some claimed that rubrics are not helpful in grading assignments. Other faculty complained students never read the instructions and rubrics. These pushbacks from faculty are one of the biggest challenges for instructional designers in online course design.

Investigating Solutions

As mentioned before, poorly designed assignment instructions and rubrics can cause issues in online course communications between instructors, learners, and teaching assistants. In addition to this situation, faculty are not willing to apply rubrics in their courses because designing and developing assignment rubrics is a time-consuming task. It requires instructors to spend time reviewing the learning activities and aligning the assessment with the learning objectives before writing the criteria and point scales. Furthermore, there are also some new faculty do not have experience in designing rubrics and need assistance. To solve these problems and improve instructor-learner communication, the instructional designers created the following strategies:

First, instructional designers hosted workshops to introduce the benefits of using rubrics in online assessments and provided hands-on activities to walk faculty through the process of creating rubrics. In the workshop, participants were asked to list some specific requirements of their dream house in an imaginary house hunting scenario. The requirements can be size, location, and price of the house. Then the workshop facilitator helped to group these requirements to different categories and created criteria of a house hunting rubric. The participants tried to group different criteria to categories. The facilitator discussed the point scale with the participants and completed the rubrics. Participants provided positive feedback on this workshop. They claimed it helped them understand the basics of rubrics and how to use them in their courses. They also expect to attend in depth workshops on creating and using rubrics in different contexts. The following figure shows one of the PPT slides we used in the workshop.

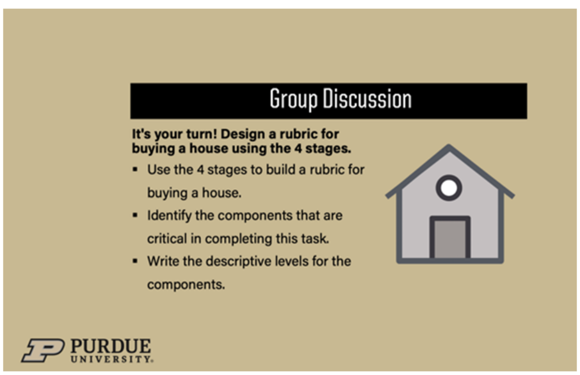


Figure 1: Workshop Activity

Second, instructional designers created a resources page to help faculty develop rubrics. The resource page includes the following items:

- Template and examples of holistic rubrics and analytics rubrics
- Good examples of rubrics designed by Purdue faculty,
- Links of online rubric creator, such as Rubistar and iRubric, and an OER resource, VALIE Rubrics
- Job aids and tutorials videos about how to use the rubric creation tool on LMS

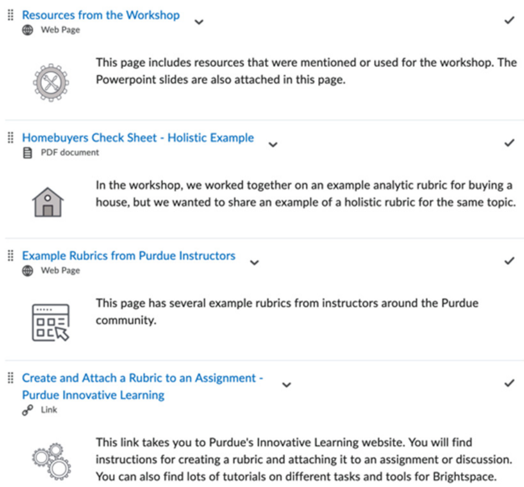


Figure 2: Resource Page

Third, instructional designers developed rubric templates for three types of commonly used online assignments, which include online discussions, online presentations, and online group projects. These templates and best practice examples of each type of rubric are shared with faculty in the regular course design meetings. Before designing or revising a rubrics, designers encourage faculty to review learning objectives and the existing assignment instructions. Faculty are asked to align learning objectives with rubric criteria. Instructional designers created the following checklists to help faculty review their rubrics:

Creating a Well-designed Rubric

Checklist

- ☐ Criteria align with the learning objectives
- ☐ Criteria categories are clear and cannot be separated or combined with other categories
- ☐ Point scales clearly show the expectations of performance
- ☐ The rubric criteria statements and point scale descriptions have **No** conflictions
- ☐ The rubric criteria statements and point scale descriptions **Do Not** include words with weak or several meanings, single terms instead of full-sentences, or Grammatical errors.

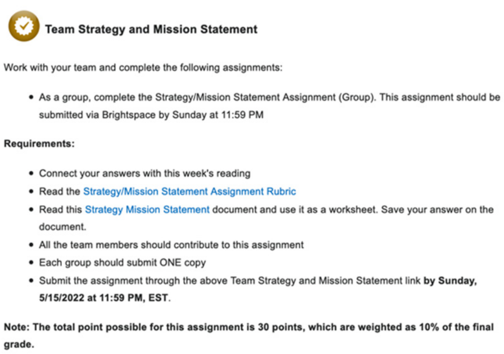
Figure 3: Rubric Design Checklist

Fourth, except for helping faculty create rubrics, instructional designers helped to review and redesign the assignment instructions because rubrics are considered as one part of the instructions. The redesigned instructions improved the clarity of the assignment requirement, learning goals, the expectation of the assignments, points possible, and due dates. The instructional designers also suggested faculty include a communication plan if students have questions about the instructions. The most used method is asking students to post questions in an online Q&A forum or ask questions in course synchronous sessions.

Fifth, As mentioned before, instructor found that many students would not read the rubrics before working on the assignment. Given this complaint, the designers adopted the following strategies to gain students' attention:

- Create rubrics using the rubrics tools in the Learning Management System and attach them to the assignments. Remind students that they can download the PDF version of the document or print it out.
- Added the quick links to the rubrics in the assignment instructions.
- Encourage faculty to explain the assignment requirements and the rubrics in their pre-recorded instructional videos or virtual synchronous sessions.
- Remind faculty to send out an announcement about the assignment requirement and the rubrics

The following figure shows a course site screenshot of a re-designed assignment instructions with a quick link of the rubrics.



Team Strategy and Mission Statement

Work with your team and complete the following assignments:

- As a group, complete the Strategy/Mission Statement Assignment (Group). This assignment should be submitted via Brightspace by Sunday at 11:59 PM

Requirements:

- Connect your answers with this week's reading
- Read the Strategy/Mission Statement Assignment Rubric
- Read this Strategy Mission Statement document and use it as a worksheet. Save your answer on the document.
- All the team members should contribute to this assignment
- Each group should submit ONE copy
- Submit the assignment through the above Team Strategy and Mission Statement link **by Sunday, 5/15/2022 at 11:59 PM, EST.**

Note: The total point possible for this assignment is 30 points, which are weighted as 10% of the final grade.

Figure 4: Assignment Instructions with Quick Link of the Rubrics

Case Review

Rubrics are used in different ways at Purdue University, such as helping students with self-assessment, peer evaluation, and non-graded assignments. In online courses, they are most often used to evaluate paper assignments, projects, online presentations, and online discussions. This session reviews two cases and discusses how rubrics help to improve online teaching and communications. This session reviews two cases and discusses how rubrics help to improve online teaching and communications.

Case 1: A fully online course

This course was taught in a traditional classroom in the previous semesters. Learning activities include project progress reports, final presentations, and related coding assignments. The instructor created detailed instructions for these activities and assignments. In the 2021 fall semester, the course was re-designed for online sessions. The online session keeps most of the activities from the face-to-face class.

The instructor re-designed the bi-weekly project progress presentations and the final presentations to fit online settings. He spent four weeks creating rubrics for each presentation and assignment. In a pre-recorded introduction video, he shared his computer screen and showed students the locations of assignment requirements and rubrics in the course site.

After the course launched in the 2022 spring semester, the instructor reported the online presentations went very well. He received fewer questions about homework and presentations compared to the previous semester. In addition, his teaching assistants claimed that they spent less time grading assignments using the rubrics that the instructor created.

Case 2: A hybrid course:
In a graduate-level management course, students meet in the classroom every other week and are required to complete activities and assignments online in the week they don't meet. There were no rubrics designed for the course in the previous semesters. The assessments includes weekly paper and final paper.

In the 2021 fall semester, the learning activities and assignments were redesigned to improve class engagement. Re-designed activities include online discussions, case studies, and reflection papers. The instructional designer and the instructor worked together to design rubrics and instructions for each assignment. The instructor reviewed the rubrics using the checklist created by the instructional designer before publishing them to the course site.

After the course launched in the 2022 summer semester, the instructor explained each assignment requirement and reviewed the rubrics with her student in face-to-face sessions. She reported that using rubrics greatly improved efficiency when grading assignments, especially in evaluating online discussions. She mentioned the online discussion rubrics helped students focus on the topic when creating their discussion posts. In addition, students provided positive feedback on the assignment rubrics. They claimed the rubrics helped them complete the paper assignment.

Conclusion

Designing rubrics could be time-consuming, however, well-designed rubrics can help with grading and save time in the long run. They also work as valuable pedagogical tools to help instructors be aware of their course outcomes, intentions, and expectations, which can help to improve communications between instructors, learners, and teaching assistants. The instructional designers noticed that one of the reasons faculty don't use rubrics is because they are not aware of them or have misunderstandings about them. The strategies we investigated helped to increase awareness of rubrics as a tool for the online class. We also noticed that faculty need help with course design basics, such as setting clear expectations and aligning learning objectives with assessments. We are planning to address these needs in our faculty development sessions. For future studies, we would like to see evidence-based studies on the effectiveness of using rubrics in online courses.

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Dashboarding Research Experiences for Undergraduates

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Abstract

Research Experiences for Undergraduates (REU) programs at universities, and industry mentoring programs, often have difficulties evaluating and assuring quality student experiences. Results from evaluations for two universities conducted in 2021 indicate that weekly reflection surveys and dashboards can raise the visibility of issues, and have the potential to improve mentoring and outcomes. This strategy has provided insights for instruction and program evaluation, suggesting both can benefit from collecting ongoing feedback on program challenges, accomplishments and interactions.

Program Overview

The Center for Discrete Mathematics & Theoretical Computer Science (DIMACS) was founded as a National Science Foundation Science and Technology Center. It has a long-running Research Experiences for Undergraduates (REU) program, attracting and nurturing strong students with bright futures in graduate school, research careers, and CS and math-related fields. Topics of investigation include research in algorithms, foundations and applications of theoretical computer science. University of Minnesota REU program is more recent, and has an innovative focus on computing for social good. Due to safety concerns related to COVID-19 the programs ran online in 2021. Goals are to nurture interests in research and programming careers.

Evaluation Overview

This paper focuses on how evaluation monitoring of student experiences can improve learning outcomes. The evaluation work began at Rutgers in 2020 and continued in 2021, while University of Minnesota evaluation began in 2021. While providing evidence of outcomes, these evaluations also explored ways to improve students' experiences. Weekly reflections, shared via an interactive R-Shiny dashboard, generated insights for both Research Experiences for Undergraduates (REU) programs during Summer 2021. Because the programs ran online-only, the evaluation prioritized the need for tools to increase visibility and communication.

Data collection coincided with official program launch and conclusion events, coordinated with the program to get near 100% participation. Pre- and post-surveys, asked about student objectives and prior experience, and attitudes at the conclusion of the program, among other topics. These pre-post findings framed analyses of the weekly reflections with the goal of understanding their relevance to eventual outcomes. The number of participants were as follows

- Rutgers DIMACS
  - 12 pre (100%)
  - 11 post (92%)
  - 13 reflections from 3 participants (25% participation)
    - Max N = 8; mean N = 4.3, median N = 3
- Rutgers Other
  - 19 pre (100%)
  - 17 post (89%)
  - 15 reflections from 6 participants (31% participation)
    - Max N = 6, mean N = 2.5, median N = 2
- Minnesota
  - 11 pre (100%)
  - 10 post (91%)
  - 53 reflections from 11 participants (100% participation)
    - Max N = 6, mean N = 4.8, median N = 5

Our analysis focuses on qualitative "case studies" using the weekly reflections, framed by the pre-post surveys to help us gain insights into each participant's experience.

Analysis of Weekly Reflections

Each week, students had the opportunity to reflect on challenges and accomplishments, and rate these from 1 to 10. They also rated interactions with mentors and peers, and whether the work was fun, interesting, successful, looked promising going forward, and was encouraged by someone. These weekly reflections were used by several participants at Rutgers, including additional voluntary use outside the originally-funded REU, and in Minnesota by all participants. Analyses raised questions and stimulated ideas for improving the programs – related to peer and mentor interactions, sense of accomplishment, and project completion**.**

Key theoretical questions concern finding the balance of self-reported learner challenges and accomplishments (the third scatterplot above (student challenges vs. accomplishments), as "flow theory" from Csikszentmihalyi (1990) suggests learning occurs when there is an appropriate balance. Another issue these data allow us to explore is the importance of a sense of competition ("finishing" their work), compared to promoting a "growth-mindset" (Yeager & Dweck, 2020). Many students had positive experiences without necessarily a sense of completion, while not all who were able to finish reported positive results.

The role of social encouragement **(**Wang, Hong, Ravitz & Ivory, 2016) is also highlighted. Findings confirm the importance of consistent supportive relationships in REUs (Fang, Lawanto, Goodridge & Villanueva, 2016) and of"strong relationships with their faculty mentor and graduate student mentors through consistent and professional interactions."

Dashboard View

The figure below shows the availability of data filters and the ability to "brush" on the experience of individuals or ranges of students (in the top chart) to explore the outcomes shown on the right. The data include scatterplots showing the evolution and rating of challenges and accomplishments over time, with qualitative explanations, and how they relate to each other.

Our evaluations found that positive learning experiences, as reflected in both qualitative and quantitative responses in the weekly reflections and the pre-post surveys, generally included experiences with these qualities:

- Consistent communications with mentors and peers
- A strong sense of project direction
- Trust and encouragement from mentors to take project ownership
- High quality social interactions with peers
- Feelings of accomplishment

These findings were consistent with program thinking over the years, but the availability of data provided added urgency to making sure all students have these opportunities to learn and grow, with these kinds of conditions being considered even more important and worth tracking as they move through their summer research experiences.

Discussion

Given the importance of social encouragement, it is not surprising that the few students with less positive outcomes often reported less contact with their mentor or not feeling supported. This was sometimes in reference to logistics issues at project launch, but consistent communication seemed to be essential throughout the experience. Weekly reflections might improve student learning experiences if mentors, coordinators (or peers) can identify when they are facing significant challenges or need more or different interactions with peers or mentors.

Challenges did seem to be related to outcomes, as theory might suggest. The only DIMACS student who admitted being less interested at the end was the same one who reported a lower sense of accomplishment than challenge. In Minnesota, a few students reported high levels of accomplishment throughout the project, but leading up to and through the final presentation some of them began to feel less accomplished than they did before, suggesting challenges with the final product and completion may have cut into their sense of accomplishment overall.

A recommendation is to try to make sure accomplishments are seen along the way, building toward overall success, without losing sight of and balancing the challenges of what is expected in the end. One DIMACS student may have exemplified what might be an ideal trajectory: Their project seems to have ramped up in intensity with low ratings of challenge and accomplishment initially, followed by a period of greater challenge and less accomplishment, but ending with more accomplishment than challenge. When they had the highest challenge they disagreed the work was successful, while their period of low challenge was associated with only neutral success. This seems to be consistent with a theory of productive struggle which suggests that accomplishment should follow significant challenge and support (Warshauer, 2015).

A final consideration is to consider what success looks like for each program and, perhaps, for each student. Several learners reported having successful experiences without, in the end, feeling they had completed their work. So, this raises the question of how important is the final product compared to having a positive experience and developing a growth mindset as a researcher? The answer may depend on what the objective is, unpacking what it means to be interested in a “career as a researcher” as an outcome, and what success requires.

Conclusion

The programs were largely successful in increasing student research interests and providing a positive learning experience, despite running online-only during the summer of 2021. There were a few cases where weekly reflections suggest students wanted additional attention or support, and experienced less than ideal levels of challenges/accomplishment or clarity about their roles. Especially during the online-only runs for these REUs using these reflections provided an important opportunity to assist mentors.

In conclusion, the learner reflections, made available via the weekly dashboard, were useful for identifying students’ challenges or accomplishments at different moments, and overall experiences with their research project throughout the summer. Future use of dashboards can explore making these reflections more transparent for use among students and mentors, and may reveal how reflecting on their own experiences could help students become better advocates for themselves as learners and future researchers. There is much evidence that REUs can provide a valuable learning experience for undergraduates, including clarifying their interests and encouraging continued pursuits in research fields. This paper has identified issues and opportunities that emerged when a tool was added for monitoring weekly reflections and used in coordination with other evaluation and program efforts.

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Incorporating a New HIP into Online World Language Courses

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Abstract

High Impact Practices (HIPs), as first described by Kuh (2008), are being used in higher education to improve student learning, engagement, and retention. Linder and Mattison Hayes (2018) state that the evaluation of HIPs has been focused mainly on traditional, undergraduate courses on residential campuses. HIPs have now entered the community college arena. This past year a new HIP, Global and Cultural Awareness, was accepted by the Tennessee Board of Regents (TBR), the governing body for community colleges across the state. According to the TBR website (n.d.), Global and Cultural Awareness consists of "experiences in which students learn how to communicate across cultures while developing an understanding of global interdependence and how it is influenced by culture…These courses explore difficult differences such as racial, ethnic, and gender inequality, as well as struggles around the globe for human rights, freedom, and power" (para. 1). One would think that culture is already included in higher education world language (WL) courses, when actually many courses neglect the cultural element (Yagi, 1995). WL courses are an ideal place in which to expose students to cultures and issues that are faced by people groups around the world. In asking WL instructors why they do not include much culture in their lower level WL courses, the Instructional Designer (ID) was told that they either did not know how to teach the culture or did not know how to assess the learning. This article will address how to use existing media from the internet to create activities and problem-based learning (PBL) assessments connecting the Global and Cultural Awareness HIP with traditional vocabulary and grammar themes taught in the lower level WL courses that can be embedded in an LMS.

Introduction

One would think that culture is already included in higher education elementary and intermediate level world language (WL) courses, when actually many of these courses neglect the cultural element. Traditionally, these higher education WL courses focus more on the grammar and vocabulary than culture (Yagi, 1995). By teaching the culture in elementary and intermediate level WL courses, students can develop a global awareness to expand their understanding of their own culture as well as that of other people groups. This past year a new

HIP, Global and Cultural Awareness, was accepted by the Tennessee Board of Regents (TBR) the governing body for community colleges across the state.

My institution began implementing badging for HIPs in the course management system in the Fall 2022 semester allowing advisors and students to see which courses implement HIPs. The focus of and examples used in this article are based on higher education Spanish courses since I am an Associate Professor of Spanish. Only two of my courses were able to be marked as implementing the Global and Cultural Awareness HIP, Spanish for Hospitality Services and Spanish for Healthcare Workers, since those courses were developed by the ID. The other Spanish courses are taught by a variety of instructors with differing implementations of culture resulting in a lack of consistency in the emphasis needed in the area of culture in order to qualify for the HIP designation.

Problem

Traditionally, elementary and intermediate level world language courses in higher education do not have culture integrated in such a way as to create a significant impact on student learning. This ongoing action research project looks at ways to incorporate activities into asynchronous online WL courses to increase the global and cultural awareness elements of the courses.

Literature Review

Brief history of HIPs

While high impact practices (HIPs) have been around for a long time, the name was first mentioned by Kuh in 2008, who looked at learning activities that make an impact on students to increase learning. In this original article, Kuh did not mention online education, but it has since become an item of interest for online education. Originally there were only a few HIPs, but the number continues to grow. Linder and Hayes (2018) slightly adapted the list of HIPs to include first-year seminars, common intellectual experiences, learning communities, writing-intensive classes collaborative assignments and projects, undergraduate research, diversity and global learning, eService learning, internships, and ePortfolios. Their adaptations moved some of the elements into the online course environment. Kuh et al. (2017) state that even ten years later, HIPs continue to grow in popularity and importance for their impact on student learning. Building HIPs into all courses is considered a good practice since it can increase student learning, but it can be challenging in asynchronous online courses.

Description of a new HIP

During the 2021-2022 academic year, TBR approved a new HIP. Global and Cultural Awareness is an off shoot from the diversity and global learning HIP. Because not all students can do a study abroad program and with access to the world via the internet, a different approach was sought that could allow global learning or awareness to be done without traveling to another country. According to the TBR (n.d.) website the minimum definition of the Global and Cultural Awareness HIP is:

> Global and cultural awareness courses are credit-bearing experiences in which students learn how to communicate across cultures while developing an understanding of global

> interdependence and how it is influenced by culture – understood as the values, beliefs, practices, rituals, and behaviors held by groups of people. These courses explore difficult differences such as racial, ethnic, and gender inequality, as well as struggles around the globe for human rights, freedom, and power. These courses will provide tools to increase students' critical analysis of the global and intercultural nature of society and practice ethical reasoning to successfully navigate this world. (para. 1)

This new HIP opens up a world of possibilities for WL courses to expand student learning beyond the cookie-cutter, superficial culture traditionally taught, if any culture is taught, in higher education WL courses.

Cultural elements in traditional higher education world language courses

As I went through college level world and classical language studies, the only cultural emphasis came from looking at the literature from the culture in the upper level courses. In the lower level language courses, which is what a majority of higher education non-language major students take to satisfy their world language requirements, there is a bare minimum of culture added to the course, if any. In Spanish courses, the culture is usually just a basic introduction to the different countries that speak Spanish which is included in the textbook. This snapshot view of culture can develop stereotypes and provides a very narrow view of each country or culture (Yagi, 1995). In both situations, there is no real connection made between the culture and the language. This trend has continued to this day although a few instructors have been selecting intermediate level textbooks that are more literature or culture based, which does increase the cultural exposure to a slightly higher level depending on the course design.

The American Council on the Teaching of Foreign Languages (ACTFL) (2022) encourages the inclusion of culture in all language courses based on their 5 C's (Communication, Cultures, Connections, Comparisons, and Communities). While several of these are interrelated, the focus on Cultures ties most directly to this HIP. According to ACTFL (2022), the Cultures section is described as "Learners use the language to investigate, explain, and reflect on the relationship between the practices and perspectives of the cultures studied". All three of these elements, investigate, explain, and reflect, are important to the Global and Cultural Awareness HIP. The main area that may be difficult for elementary level students could be using the target language in these activities. While not all language students are able to use the language well enough to reflect on the relationship between these cultural aspects using the target language, they can still reflect in English. This would allow for a scaling of target language usage in the activities depending on the level of the course.

Why cultural emphasis should be included in higher education world language courses

Culture, as defined by Yagi (1995), is "beliefs, values, perception, and attitudes" (p. 6) of people groups. Studies have shown that language is an important part of culture and cultural identity (Abiog & David, 2020; Rashidi & Meihami, 2017). For students to be able to better understand the language, they must also understand the culture by exploring the significant aspects of the culture and comparing and contrasting it with their own culture.

Methods

As an Associate Professor of Spanish, I have researched ways to implement cultural activities and projects that incorporate the culture, for elementary level and specialty area Spanish courses, and both the language and the culture, for intermediate level Spanish courses. These activities were then incorporated into the web classes that I designed.

Discussion

Including culture in a WL course must be more than just having the students read the cultural blubs in the textbooks. Students need to be exposed to the specific issues that are alive and active in the culture of the language. They need to be able to see or hear about more than the tourist areas, music, and food. With the use of the internet and immersive technologies, IDs or WL instructors can now bring the world to the students. Unfortunately, discussions over the years with higher education WL faculty revealed to me that many faculty do not know how to teach and/or assess culture if it is included in a WL course. It is my hope, that this article can be a starting point for why and how culture can be included in a higher education WL course to increase the level to a point where it is able to be badged as a HIP course.

Activities

Activities that promote language learning as well as global and cultural awareness can take many forms, from basic discussion boards requiring some research into authentic materials to project-based learning (Nguyen, 2021), to authentic scenario video projects (Nikitina, 2011). For the research activities, some training is required, especially if the students will be doing the research in the target language. Currently, a search can be done on the internet of other countries by using “site:(country code)”. For example, by typing “site:mx la comida” in the search bar, one would be directed to food sites on Mexico’s internet. This allows students to access authentic materials from the different countries. A list of country codes can be found at https://www.worldstandards.eu/other/tlds/. Some activities that I have used include short, directed items like discussion boards and audio recordings submitted to a drop box to more detailed semester long projects. See examples below.

Discussion boards – These can vary according to vocabulary, but should require the students to dig deeper either in the target language or in English. Once the vocabulary has been presented to the class, then students can search for information or information can be provided by the ID or instructor. The following sample allows students to explore different naming traditions and compare them to their traditions. A basic grading rubric is included in the appendix.

> Sample from Elementary Spanish I: After reading the section in the textbook and watching the teaching video on the culture of last names in Spanish-speaking countries, do a web search to find out more about the history of last names on the internet. Create a discussion board post giving the following information: 1. What is one interesting thing that you found about last names from your web search? Include the link to the website. 2. How does this tie to the culture of last names in Spanish-speaking countries? 3. How are the previous items similar to/different than the culture of last names in the United States? Once you have answered these questions, read your classmates’ postings and comment

on at least two of them. Remember that your comments must contribute to the conversation and show that you have read their posting.

Audio recordings – These can also vary according to the vocabulary and grammar, but should require the students to do some research to expose them to authentic materials and allow them to practice the target language. These can be submitted via the LMS drop box or another submission method. The following sample, while it does not ask for a comparison, it does expose them to information and authentic materials from the target culture. A basic grading rubric is included in the appendix.

Sample from Intermediate Spanish I: After watching the teaching video and reading the pages in the textbook over the vocabulary for technology, do a web search for a newspaper article in Spanish from a Spanish-speaking country that discusses technology use in that country. Create an audio file (1-minute minimum) of you reading the article in Spanish. Then post the audio file and the internet link to the article in the drop box.

Project based learning or assessment has been found to increase cultural competency and awareness (Nguyen, 2021). This is especially beneficial for higher level or specialty area courses where longer, semester long assignments or cultural projects can be used to integrate global and cultural awareness into the courses. The sample project below would require multiple submissions and assessments throughout the semester.

Sample from Intermediate Spanish II: Brief description of assignment – Each student selects a different Spanish-speaking country as their point of focus for the entire semester. Each chapter (4) covered in this semester long course covers a different topic. For each chapter, students are required to find specific information on their country from authentic sources. This allows the students to practice their research and language skills. This part of the project is submitted to four discussion boards where the students share their information, including web links to information and compare/contrast information from their countries with other country information posted. At the end of the semester, students create a 5-minute audio/visual recording presenting information about their country in the target language. The presentation must include at least one item from each of the discussion board postings as well as any additional information that they want to include. Specific grammatical elements from each chapter are also required to be used in the presentation. The final project is posted in a discussion board or similar site where their classmates then are required to watch each presentation and make comments on the information presented by choosing one element from the presentation and compare/contrast it either with their presentation country or the United States.

For the specialty courses I designed, a final cultural project is required and is usually completed in English since there is a separate final oral project that assesses linguistic and oral competence. A basic grading rubric is included in the appendix.

Sample from Spanish for Hospitality Services: Throughout the class, students are required to read and respond to (compare/contrast) cultural elements that are included in the course either in the textbook or the teaching videos. This final cultural assignment requires students to choose one area and pursue it deeper. Instructions for the Final Cultural Project: In this project, you will combine everything that you learned this semester about the culture in Spanish for Hospitality Services. Choose one of the fields covered in this class (restaurant/kitchen operations, housekeeping operations, engineering operations, or human resources) and contact a restaurant, hotel, or other organization in your area that employs Spanish speakers to request to schedule an interview with one of the supervisors/managers who works with the Spanish-speaking employees. This interview can be via phone, an online conference system or in person. Before the interview, create a list of at least 10 questions, in English, about the cultural items that you have studied to ask in the interview about their work at the organization. You might also want to ask some open-ended questions about how the supervisor/manager feels about working with Spanish-speaking employees. Take notes on the responses and record the interview. Be sure to inform the person that you will be recording the interview for class before the interview begins. After the interview, type up a document that includes information on the type of organization in which the person works, the date and time of the interview, the first name of the person you interviewed, your questions, and a summary of the responses given. You also need to include a summary of your thoughts on the interview. Also consider the following questions: Did the supervisor/manager's views match with what you learned about the Hispanic culture in class? If yes, how was it the same? If no, how was it different? Submit the document, in the Final Cultural Project Assignment.

Conclusions

In my WL courses using these activities promoting global and cultural awareness, a majority of the student responses have been positive. The students appreciated the chance to be more immersed in the culture of the target language. Some even reported that this focus on global and cultural awareness was their favorite part of the course. In courses with live sessions, the students reported that the days that incorporated more of the culture were days that the wanted to be sure that they were present in class. The students from the Intermediate Spanish II course who completed the semester long project reported that they felt that they had learned more about the language and culture and felt a genuine connection to and understanding of the culture. There was also a noted increase in student participation in these activities and days.

As technology continues to advance and more applications and websites are created, more opportunities are created for students to interact with the world. This article only presents a brief view of some activities that can be used with free resources and that can be created inside the LRM system to expand student learning. There are many more ways to bring the world into the classroom using various other applications and websites. In general, an effort needs to be made in higher education WL courses to bring more cultural elements into courses to engage students and expand their thinking about issues and concerns in other cultures to increase their connection with the language and culture that they are studying.

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Appendix

Sample scoring rubrics

For discussion boards:

Criteria	Exemplary	Meets expectations	Developing	Not acceptable
Completion	5 pts. – Submission includes all of the assignment components and meets or exceeds all requirements indicated in the instructions.	4 pts. – Submission includes most of the assignment components and meets requirements indicated in the instructions.	3 pts. – Submission is missing some components and/or does not fully meet the requirements indicated in the instructions.	0-2 pts. – Submission is missing essential components and/or does not address the requirements indicated in the instructions or does not complete the assignment.
Comprehensibility	3 pts. – Message is clear and contains appropriate level of complexity in syntax.	2 pts. – Message is mostly clear but confined to simpler sentences or structures.	1 pt. – Message is not clear and contains basic types of errors which affect comprehensibility.	0 pts. – Message is largely incomprehensible or does not complete the assignment.
Technical quality	2 pts. – No grammatical or spelling errors.	1.5 pts. - One to two grammatical and/or spelling errors.	1 pt. – Three to four grammatical and/or spelling errors.	0 pts. – five or more grammatical and/or spelling errors or does not complete the assignment.

For audio recordings:

Criteria	Exemplary	Meets expectations	Developing	Not acceptable
Completion	2 pts. – Completes all elements of the assignment.	1.5 pts. – Completes most elements of the assignment.	1 pt. – Is missing two or more elements of the assignment.	0 pts. – Does not follow instructions or does not complete the assignment.

Technical quality	5 pts. – No grammatical errors.	4 pts. – one or two grammatical errors.	2-3 pts. – Three to four grammatical errors.	0-1 pts. – five or more grammatical errors or does not complete assignment.
Vocabulary	3 pts. – Uses a wide variety of vocabulary correctly; no errors.	2 pts. – Uses a variety of vocabulary; one or two errors in usage.	1 pt. – Uses only basic vocabulary; three to four errors in usage.	0 pts. – Uses limited vocabulary; five or more errors in usage or does not complete assignment.
Pronunciation and fluency	5 pts. – No pronunciation errors; smooth delivery with 0-1 pauses/repeats	3-4 pts. – One to two pronunciation errors; fair delivery with one to two pauses/repeats.	2-3 pts. – Three to four pronunciation errors; rough delivery with several long pauses and/or repeats.	0-1 pts. – Excessive pronunciation (5 or more) errors that impede understanding; very rough delivery or does not complete assignment.

For final cultural project:

Criteria	Exemplary	Meets expectations	Developing	Not acceptable
Organization	9-10 pts. – Organized as a coherent, thoughtful essay. Language and tone are professional and appropriate to the topic	7-8 pts. – Organized mostly as a coherent essay. Language choices and tone are mostly consistent and professional.	5-6 pts. – Organization is basic, such as a summary or list of points. Tone is mostly professional	0-4 pts. – Little or no apparent organization. Tone is unprofessional or no assignment submitted.
Description of the interviewee	18-20 pts. – Student write-up shows an exceptionally vibrant description of the interviewee and his/her roles.	15-17 pts. – Student includes brief bio of interviewee and describes his/her roles in a few sentences.	10-14 pts. – Student only states the name of the interviewee and his/her role.	0-9 pts. – Student does not include any information about the adult interviewed or no assignment submitted.

Summary of the interview	18-20 pts. – Summary of the interview presents an excellent record of the answers to all of the questions in the instructions.	15-17 pts. – Summary of the interview presents the answers to all of the questions in the instructions.	10-14 pts. – Summary of the interview presents the answers to more than half of the questions in the instructions.	0-9 pts. – Summary of the interview presents the answers to less than half of the questions in the instructions or no assignment submitted.
Analysis of experience and learning on cultural aspects	36-40 pts. – Student fully reflects on and describes in appropriate detail insights from the interview to illuminate the cultural differences.	32-35 pts. – Student adequately reflects on and describes sufficient details from the interview to illustrate the cultural differences.	28-31 pts. – Student only partially reflects on and describes only minimal details from the interview to illustrate the cultural differences	0-27 pts. – Student does not reflect on and does not describe sufficient details from the interview to illustrate the cultural differences or no assignment submitted.
Grammar and spelling	9-10 pts. – Assignment has no grammar or spelling errors.	7-8 pts. – Assignment has one grammar or spelling error.	5-6 pts. – Assignment has two grammar or spelling errors.	0-4 pts. – Assignment has more than two grammar or spelling errors or no assignment submitted.

Cognitive Presence in Online Courses: Design and Facilitation of Collaborative Learning

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Abstract

With increased interest in collaborative learning on asynchronous online courses, the Community of Inquiry (CoI) framework has gained most attention from scholars and practitioners for its capability of guiding the design and structure of collaborative-constructivist learning (Park & Shea, 2020). According to the CoI framework, collaborative learning occurs at the intersection of the three presences–social presence, teaching presence, and cognitive presence (Garrison et al., 2000). Cognitive presence as part of the COI is operated by the principles of the Practical Inquiry Model (PIM) to support and maintain a purposeful collaboration among members of the online community (Garrison, 2017). Therefore, it can be used as a guide to design the type of collaboration where members are able to experience the cognitive inquiry process from a low level of understanding up to the high level of reflection where new knowledge has been constructed together (Garrison, 2017). However, research states that cognitive presence has been one of the least examined presences among all three CoI presences (Sadaf, Wu, & Martin, 2021). Therefore, more research is needed to guide collaborative learning through the inquiry process (Garrison, 2022). This proceeding of the conference panel explores what previous research studies examined regarding design and facilitation of cognitive presence for collaborative learning. The findings of this literature review will help researchers and practitioners more effectively connect research to practice where cognitive presence is part of collaborative learning design and facilitation.

Introduction

With transition to new pathways in teaching and learning, e.g., HyFlex approach that provides flexible learning for students whether they prefer online attendance or in-class participation, course instructors need to be equipped with advanced evidence-based knowledge of how students learn and what instructional strategies can be designed and facilitated to help them learn. During the COVID-19 pandemic, courses moved to emergency-remote learning where instructors had to implement online teaching to continue the learning process (Lockee, 2021; Roitsch et al., 2021). Currently, the field of distance education is observing that more and more traditional face-to-face courses prefer to integrate online learning to provide more flexible options for their students.

However, to keep the benefits of face-to-face interaction, engagement, and constructive feedback in online teaching, researchers have been actively examining how students' cognitive learning is being designed and facilitated when instructors use an online teaching approach. It is true that recent migration to online teaching showed that educators need more support from professionals who have extensive experience combining research findings with practice. Expert recommendations on how the current research findings can be implemented into online courses are extremely needed.

The Community of Inquiry (CoI) framework has proved to have the capability to guide design and facilitation of meaningful online teaching with the emphasis on students' cognitive learning (Garrison, 2022). The CoI framework consists of three overlapping presences: cognitive presence, teaching presence, and social presence (Garrison et al., 2010). The CoI framework is focused on the construction of both individual and collaborative understanding. However, the main core of the framework is to guide the collaborative learning process so that students can progress from low level of critical thinking to the higher order of learning together (Garrison, 2022). This main core is known as a cognitive presence that guides construction of collaborative meaning through reflection and discourse (Garrison et al., 2001). Cognitive presence is operationalized through the Practical Inquiry (PIM) model that supports the dynamics of reflective thinking and a collaborative inquiry process (Garrison et al., 2001).

In addition to cognitive presence, there are other two presences within the CoI framework: social presence and teaching presence. Social presence is known as the ability to project oneself as an actual person both socially and emotionally in an online collaborative environment (Garrison et al., 2000: Lowenthal & Moore, 2020). Teaching presence is known as "the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (Anderson et al., 2001, p.5). Both social presence and teaching presence are essential to establishing and maintaining cognitive presence (Garrison et al., 2010b). In addition, both social presence and teaching presence can not only enhance students' cognitive presence but also, they can predict students perceived cognitive presence (Akyol & Garrison, 2019). To support students to transition from social presence to cognitive presence, effective teaching presence through design and facilitation should be provided by an online facilitator or students themselves such as peer feedback (Killis & Yildrim, 2018).

This proceeding shares and discusses previous research found on actual and perceived students' cognitive presence and what type of instructional strategies are effective to design and facilitate collaborative cognitive presence processes in online teaching.

Perceived and Actual Cognitive Presence

In this part of the proceeding, we will focus more on the findings about students' perceived and actual cognitive presence to explain and discuss how cognitive presence has been viewed and examined. Cognitive presence is based on the phases of Dewey's (1933) reflective thinking and a collaborative inquiry process (Garrison et al., 2001): (1) triggering events: identifying a problem or an issue through initiating the inquiry process, (2) exploration: searching for relevant information and offering explanations, (3) integration: interpreting and constructing possible solutions to make decisions, and (4) resolution: providing or defending potential solutions by means of practical applications (Garrison, 2011; Moore et al; 2019; Moore & Miller, 2022).

Student Perceived Cognitive Presence

The recent study by Ozogul and colleagues (2022) entitled “Student Perceptions and Actuals of Cognitive Presence: A Case Study of an Intentionally Designed Asynchronous Online Course” examined perceived cognitive presence by using the CoI survey and by conducting the interviews. The findings revealed that students self-reported a high cognitive presence (4.25 out of 5 where 5 was strongly agreed according to the CoI Likert survey scale). According to Ozogul et al. (2022), the results of perceived high cognitive presence can be explained by students’ population nature as they were all high performing students who were admitted and selected for their graduate study; students shared similar proficiency level and interests. Findings from the interviews confirmed that students shared that despite the time they allotted to work on the course while balancing job, personal life, and school commitments, course assignments helped them stay cognitively present. Examples that helped students stay cognitively present included: (1) instructor created a dialogue in online discussion, (2) guest speakers, weekly recap, (3) orientation videos, (4) instructional feedback, (5) case-based online discussions, (6) meaningful hands-on activities, (7) hands-on online project, and (8) overall instructor presence in the course (Ozogul et al., 2022).

Moore and Miller (2022) in their systematic review “Fostering Cognitive Presence in Online Courses: A Systematic Review (2008-2020)” examined 24 articles that empirically analyzed cognitive presence in online courses. The authors identified the following studies that used the CoI survey to examine perceived cognitive presence: Bissessar et al.(2020), Choo et al. (2020), Ice et al. (2011), Joo et al. (2011), Kucuk and Richardson (2019), Leader-Janssen et al. (2016), Morueta et al. (2016), Patwardhan et al. (2020), Pillai and Sivathanu (2020), Poluekhtova et al. (2020), Saadatmand et al. (2017), Sağlam and Dikilitaş (2020), Shea et al. (2010), Shea and Bidjerano (2008, 2009). Out of these studies, the following studies focused on perceived cognitive presence: Bissessar et al. (2020), Leader-Janssen et al. (201), Poluekhtova et al. (2020), Saadatmand et al. (2017), and Shea and Bidjerano (2008) while the rest examined other factors, e.g., course satisfaction, enrollment, engagement, and course design (Moore & Miller, 2022).

Student Actual Cognitive Presence

In this section we will continue reviewing Ozogul et al (2022) findings about observed cognitive presence. However, before we share Ozogul et al. (2022) study findings, we would like to note that previous studies have been consistent in findings that student’s actual cognitive presence frequently stayed at low level of exploration phase more than at the higher levels of integration or resolution phases (Bissessar et al., 2020; Galikyan & Admiraal, 2019; Kilis & Yildirim, 2019). On the contrary, other studies found that actual students’ cognitive presence could stay at higher level of integration and resolution; it depends on the assignment type, facilitation style, and/or delivery mode (Akyol & Garrison, 2008; Chen et al., 2019; Molnar & Kearney, 2017; Sadaf et al., 2020). Findings that cognitive presence could stay at the higher levels of integration and resolution phases are consistent across both graduate and undergraduate students (Akyol et al., 2011; Olesova et al., 2016).

In their case study Ozogul et al. (2022) found that all designs they implemented, e.g., case discussion, guest speaker discussion, evaluation concepts, or evaluation models discussion could foster student actual cognitive presence. Ozogul et al. (2022) adopted Zhu et al.’s (2019) study to analyze actual cognitive presence in the form of cognitive engagement using cognitive processes and analytic categories. Ozogul et al. (2022) found that students' observed cognitive presence may stay at high levels due to the intentionally pre-designed activities or assignments in online courses, e.g., critical discourse, providing meaningful experiences, feedback, instructor video presence, and using case studies. This is consistent with previous studies where students' actual cognitive presence also stayed at high levels when courses were intentionally pre-designed by using scripted roles, case-based discussions, and PIM-based question prompts (Olesova et al., 2016; Sadaf & Olesova, 2017; Sadaf et al., 2022).

Therefore, as the studies found evidence that the level of cognitive presence phases is closely related to how instructors designed and facilitated online activities and assignments in their online courses, the next section will overview findings from other studies where researchers examined what types of strategies could help promote student cognitive presence.

Fostering Cognitive Presence

Moore and Miller (2022) synthesized the literature focusing on the ways instructors can use to develop student cognitive presence. Moore and Miller (2022) found that even though reaching higher levels of cognitive presence phases – integration and resolution – was not common, it was still optimal. Moore and Miller (2022) confirmed that to promote higher levels of cognitive presence phases, instructors need to align their learning objectives with the learning outcomes at appropriate levels of cognitive presence phase. It should be noted that it is not necessarily the goal of any instruction to achieve the higher level of cognitive presence, it is the question of which learning objective can support specific levels of cognitive presence phase, i.e., exploration or integration. In addition, Moore and Miller (2022) recommended providing clear participation requirements, identifying multiple ways to integrate technology, and designing structured discussion forums in fostering the development of cognitive presence.

Sadaf and Olesova (in press) in their study "Strategies to Promote Cognitive Presence in Online Courses: A 20-Year Systematic Review of Empirical Research" provided a practical guidance for promoting cognitive presence through selecting appropriate instructional strategies in online courses. Based on the findings, Sadaf and Olesova (in press) identified five key themes that emerged from this systematic review that have implications for strategies to design and facilitate cognitive presence phases: (1) state high-level critical thinking learning outcomes, (2) create the learning tasks in alignment with the learning outcomes, (3) plan pre-structured learning process from low level of triggering events to the higher level of resolution phase based on the learning task, (4) add metacognitive scaffolding to support self-regulated learning that students can work independently through intentionally pre-structured learning, and (5) consider variety of students' roles and responsibilities based on the levels of cognitive presence phases. Sadaf and Olesova (in press) recommended the following instructional strategies to foster cognitive presence for collaborative learning: (1) case-based discussions, (2) debate, (3) role-play, (4) inquiry-based discussions, and (5) problem-based discussions. The authors noted that the mentioned instructional strategies should be combined with instructional design elements, e.g., structured tasks, pre-structured process, and metacognitive scaffolding to help students engage in intentionally pre-designed collaborative inquiry while progressing through all four phases of cognitive presence to achieve higher level learning outcomes. This is consistent with what Ozogul et al. (2022) found in their study and recommended for practical implications to foster collaborative learning.

Discussion

Most studies on cognitive presence focused on graduate-level students, followed by undergraduate students, and then adult learners (Moore & Miller, 2022). Both course design and facilitation are indicators of teaching presence within the CoI.Moore and Miller (2022) found that cognitive presence and teaching presence were linked to student learning and satisfaction. Further, Moore and Miller (2022) also analyzed studies that focused on social presence, the third element within the CoI. Studies (Kucuk & Richardson, 2019; Shea et al., 2010; Shea & Bidjerano, 2009) found that teaching presence and social presence contributed to the observed levels of cognitive presence (Moore & Miller, 2022).

To facilitate cognitive presence in online courses, instructors usually use online discussions (Akyol et al., 2011; Akyol & Garrison, 2008; Chen et al., 2019; Cho & Tobias, 2016;

DuBois et al., 2019; Gašević et al., 2015; Kumar et al., 2011; Molnar & Kearney, 2017; Moore, 2016; Rolim et al., 2019) where they design collaborative activities that students can actively participate (Moore & Miller, 2022). Students also can participate as moderators of online discussions; in this case, they play the role of facilitator and promote teaching presence themselves (Garrison, 2022; Sadaf & Olesova, in press). Students can use the following facilitation techniques: (1) playing an expert role, (2) summarizing online discussions, and (3) sharing information with their peers (Chen et al., 2019; Olesova et al., 2016). However, to foster cognitive presence, instructor's participation is needed, for example, posing discussion prompts, branching conversations, coordinating online activities to bring students together, mentoring students and organizing collaborative groups (Moore & Miller, 2022).

Future Research and Conclusion

Future research on cognitive presence is entering a new phase where a more careful consideration of how cognitive presence can be designed and facilitated in collaborative learning to enhance the inquiry process. This proceeding overviewed the current research to further explore cognitive presence in online courses, specifically, when new forms of learning become available, e.g., HyFlex that we mentioned earlier. In addition, new technologies, e.g., social media has become affordable to support student collaborative learning (DuBois et al., 2019; Saadatmand et al., 2017).

This proceeding found that studies usually report the final outcomes in terms of the frequency of posts per cognitive presence phase. It could be reasonable to pay closer attention to the type of the inquiry task and how it facilitates the process of cognitive presence. For example, researchers stated that intentionally designed courses can foster the cognitive presence process (Moore & Miller, 2022; Ozogul et al., 2022; Sadaf & Olesova, in press).

Further, researchers can pay more attention to how course design, facilitation techniques, and instructional strategies guide the process of students' collaborative progression through all the phases of cognitive presence. Finally, studies can examine how intentionally designed collaborative inquiry learning environments allow learners to regulate cognitive processes.

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