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Selected Research and Development Papers - Volume 1
Presented at The Annual Convention of the Association for Educational Communications and Technology

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And
Volume 2: Selected Papers
On the Practice of Educational Communications and Technology

Presented at
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2019

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Preface

For the forty second time, the Association for Educational Communications and Technology (AECT) is sponsoring the publication of these Proceedings. Papers published in this volume were presented at the annual AECT Convention in Las Vegas, NV. 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. Proceedings copies are also available at:

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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
Deborah J. Seepersaud
Editors

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Demystifying the User Experience of K-5 Students with a Digital Book Application

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Abstract:

Digital technologies have over the past few decades brought significant changes to the learning tools that are available to teachers and students. One of the reading interventions that has contributed in enhancing the reading ability of elementary school students is known as myON. This intervention helps students to easily identify books that they can use for independent reading. The primary aim of this study was to comprehend how elementary school students can obtain and use the digital book libraries through usability research. Further, this study was critical in helping to improve understanding on how myON can help students find relevant information about a book as well as their experiences while using myON website. Research findings indicated that approximately 97% of the participants showed success in task completion. This implies that the website was effective in enabling participants to successfully complete their tasks. Further, it was observed that the overall satisfaction score was above average, meaning that majority of the participants were satisfied with the website and its operations. There was a common consensus among the participants that myON was effective in enabling students to read a wide range of books online.

Introduction

The internet is widely used by students for academic purposes globally. With advancement in technology, it has become easier for students to employ the use of the internet as a research tool compared to the early years when the internet was only used for scientific research and military purposes (Syed, 2017). The internet has made significant progress to become the main tool of communication that is relied upon by everyone to convey various types of information (Radich, 2013). Despite the significant progress made in the expansion and access of the internet, there exits some negative aspects of internet use. For instance, there is limited regulation on the information that is published on the internet. In addition, information can be published over the internet by anyone, thus it can lead to the publication of biased and unreliable information which can be accessed by internet visitors (McDowell, Lytle & Rafail, 2016). Usability evaluation is critical as it emphasizes on how users can obtain and use a product to achieve their goals. Moreover, it can be used to describe the satisfaction of operators using the route. This paper sought to outline the various ways that can be used to enhance usability of digital book application to clients.

Background

Digital technologies have over the past few years dramatically changed the learning tools used by students and their teachers. The available evidence indicates that since 2007, there has been a significant increase in the number of applications and devices used for presenting digital book libraries (Biancarosa & Griffiths, 2012). The establishment of the digital reading programs was aimed at meeting the diverse learning needs and abilities of students. This is a critical aspect of successful reading programs. In the modern elementary classrooms, children possess diverse abilities. For example, some children know how to read upon entering the first grade while others do not have the basic pre-reading skills. For some children, English is not their first language, while others may suffer from learning disabilities. To address all these needs, digital reading programs have been developed to promote personalized reading. The development of the digital reading programs took into consideration the variation in students and consequently ensured that all students have access to resources that align with their level of ability (Brekhus, 2011).

One of the key objectives of user experience (UX) research is to help identify the needs as well as expectations of users and to explore their interaction with the systems (Demir et al., 2017). Usability testing is a technique that helps determine the interaction of users with the product by collecting data on effectiveness, efficiency, the success rate of task completion, time taken to complete pre-defined tasks, and user satisfaction with the product (Demir, Karakaya & Tosun, 2012). Usability testing also helps in understanding how elementary school students can obtain and use the digital book libraries. As such, this involves understanding how students employ the use of digital technologies to search for important information about a book and their experiences while using the technologies. The rapid advancement in technology and the introduction of digital learning platforms have brought about numerous advantages that will be outlined in this review.

Digital book library

Digital book libraries have made significant contribution in the development of early reading skills in children. Moreover, the digital book libraries enable the students with visual impairments or language-based disabilities to easily access reading materials. The ease with which these groups of children are able to read is promoted by the use of text-to-speech feature. Synchronized highlighting of texts helps in drawing the attention of students to some important words (Biancarosa & Griffiths, 2012). The digital reading tools provide students with practice opportunities and individualized feedback; which is critical to improving their reading skills.

Digital reading program (myON)

Digital technologies and interactive media have continued to enhance learning in children (Radich, 2013). Basic applications that are available in digital platforms such as text-to-speech features and the use of internet for collaborative learning have contributed in improving the learning experience of many children. myON program is one of the key reading interventions that has helped to improve the reading ability of elementary school students. MyON facilitates the identification of the Zone of Proximal Development (ZPD) and it also suggests the most appropriate books that can be used by elementary school students for independent reading. Further, myON helps to enhance reading skills and comprehension, and it motivates students through extrinsic rewards (Brekhus, 2011).

Usability Evaluation of myON

Usability tests are critical to evaluating the ease with which students are able to access and utilize digital libraries to enhance their reading. Prior to using myON, students are required to take the Lexile Placement Exam and Interest Inventory. The lexile score obtained helps the program to determine the books that are most suited to meet the interest and proficiency of the student (MyON, 2018).

Another critical feature of myON is that it is capable of providing valuable data regarding the number of books that an individual has opened and read, the amount of time spent reading, the quizzes taken and progress made in reading. myON has a plan that can be used to enhance student achievement as well as growth in reading. The usability tests serve to evaluate the ease or difficulty with which elementary school students are able to find a book or information about a book using myON. The usability tests help to assess the experiences of students following their interaction with myON website. myON provides quality digital books that contain multimedia supports, active reading tools, news articles, as well as real-time assessments for students.

This project focused on establishing a proper understanding about the usage and compliance of students with myON. The myON usability tests were used to evaluate the effectiveness and efficiency of myON and the satisfaction obtained by users by using the myON website. The information obtained would be used to improve the website. It is critical for the school administration and teachers to devise instructional decisions that can be used to promote growth in student learning.

The usability study was designed to determine interaction of users with regards to three key aspects; effectiveness, efficiency, and subjective satisfaction. In order to obtain the usability data, a set of tasks were given to the users. Data was then obtained on the ability of users to find a book using the application. Participants were also given a post-questionnaire and a SUS survey in order to gather quantitative data on the satisfaction of the participants with myON (Brook, 1986). The usability tests helped to identify the concerns of the participants and to obtain recommendations that would be used to improve the design of myON in order to make it more user friendly. They key questions that were developed and which helped to guide the evaluation included:

1. How effectively do participants complete predefined tasks on myON?
2. How efficiently do participants complete the predefined tasks on myON?
3. What is the satisfaction level of the users with the myON?

4. What is the difference in effectiveness and efficiency rates between the experienced and non-experienced myON users?

Method

The methodology used for this study was both qualitative and quantitative in nature. A mixed method was used so as to help understand more about the effectiveness and efficiency of myON, and the satisfaction of participants with myON website. The mixed method would also help in obtaining critical information that would be used to improve myON website where necessary.

A moderated-in-person usability study was carried out so as to evaluate how participants interacted with myON website. This was important in understanding the relevance and accuracy of information contained in the website. The ten elementary students were each given a set of pre-defined tasks in order to determine the effectiveness of the website tools. The interview session with each participant lasted approximately 45-90 minutes. This time was adequate to gather all the necessary information. The time was also not too much so as to create disinterest among the participants.

Interview method was used because it is widely acknowledged as one of the best methods that can be used to obtain first class data that has no interferences (Erickson, 1986). The participants were then asked post-test questions with the aim of obtaining qualitative feedback on myON. Finally, the users were taken through a SUS survey and a semi-structured interview, which took approximately five minutes each. The two approaches were used to collect qualitative data on the satisfaction of participants with myON.

1.1 Pre-Defined Tasks

Task 1: I want you to discover the MyON website before we start and tell me about this website.

Task 2: I want you to login to MyON using your username (..) and password (12…).

Task 3: You are now on the MyON page, search for "Big Dinosaurs" book to read.

Task 4: You need to read, " What if there were No Bees" and rate the book. How would you do this?

Task 5: You need to read "Space Leftover" book and share your thoughts about the book. How would you do this?

Task 6: Search for a 3rd book to read under the "Because I Like Seasons and Weather".

Task 7: whether "Once Upon a Time" book is in the Teacher Recommend for you to read.

Task 8: You need to open a new book from books recently opened. How would you do this?

Task 9: You need to know how much time you spent reading. How would you do this?

Task 10: You need to read "Motion" book and take a quiz. How would you do this?

Results

In order to obtain sufficient data and information that would be facilitate the development of a proper conclusion, the study involved 10 students (seven males and three female) who consented to participate in the usability tests and survey. Five of the participants were familiar with myON, while the other five were novices. Four of the participants were in the fourth grade while six were in fifth grade. Six participants were aged 11 or 12 years while four were aged nine or ten years.

1.1 *Effectiveness – Task Completion Success Rates*

The rate of success in carrying out tasks using a website determines the effectiveness of a website. There were 10 participants with each participant involved in 10 tasks. Therefore, there were approximately 10 tasks, in general, to be completed by the participants. 9 out of the 10 tasks were completed effectively, resulting in a 97% task success rate. The 97% completion rate of the tasks indicates that the website was effective in enabling the participants to complete their tasks. However, the average time to complete all the tasks for participants with experience was 100%, and the average time to complete all the tasks for participants without experience was 94%. It can be noted that three participants without experience were not able to complete task 6 which required them to search for the 3rd book to read under the 'Because I like Seasons and Weather'. It was observed that even some of the participants who had experience on how to use myON found it challenging to complete the task at the beginning. All the other tasks except task 6 experienced a 100% completion rate.

2.1 Efficiency – Task Completion Time

The efficiency of a website is determined by the amount of time taken to complete a given task. The average time to complete all the tasks for participants with experience was 29 minutes and 14 seconds, and the average time to complete all the tasks for participants without experience was 37 minutes and 58 seconds. Further, it can be observed that the time period between the longest and the shortest task for participants with experience was 7 minutes and 45 seconds, and the time period between the longest and the shortest task for participants without experience was 7 minutes and 45 seconds. The average time is taken to complete each task ranged between 24 seconds to 8 minutes and 09 seconds. In addition, the participant 9 was the fastest in completed all the tasks while participant 6 was the slowest, registering a time of 44 minutes and 59 seconds. From this, it can be concluded that participant 9 was more efficient in using the website. All the participants were completed task 8 below 1-minute and participant 6 was completed the task in 4 minutes and 20 seconds. Finally, task 6 was fairly difficult for 3 participants due to the fact they take a long time to complete the task, but the rest of the participants were able to complete the task below the average time of 7 minutes and 41 seconds.

3.1 The difference in experienced and non-experienced users in terms of effectiveness and efficiency

3.1.1 Effectiveness

The difference in effectiveness between the two participants groups was based on the success rates of completing tasks using myON. The experienced users were effective in using myON, with all the participants having 100% completion rate. On the other hand, the non-experienced users demonstrated 94% completion rate of the tasks.

Despite the failure of a few of the non-experienced users (3 users) to effectively complete their tasks, the high completion rate in the two groups illustrates that the application was effective in enabling the participants to complete tasks.

3.1.2 Efficiency

The efficiency was determined by the amount of time taken to complete a given task. The difference between the two participant groups was observed in the average time taken to complete all the tasks. The average time used by the experienced users was 29 minutes and 14 seconds, while the non-experienced users took 37 minutes and 58 seconds.

However, the two groups of participants had a similarity in the time period between the longest and the shortest task at 7 minutes and 45 seconds.

3.1.3 User Satisfaction Survey Results

For this usability test, we obtained the user satisfaction using the standard SUS survey. The outcome of the survey indicated that the mean SUS score for this usability test was 77.3 which is higher than 68. The overall SUS score was above average, this score indicates that the majority of the participants were satisfied with the website in enabling them to complete their tasks.

3.1.4 Interview Results

In order to get more information and data from the participants to test the website. Post-test questions were conducted to understand the user's experiences, how they felt about the website and to certain aspects not covered in the tasks questions. All the participants agreed that the website was fun, easy and good for kids to read the different book online. 6 out of 10 participants found that task number 6 was the most difficult task, which 3 of them failure to complete it. However, 4 participants found that task number 3 was the easiest task and that because the navigation was clear and easy to use. One of the participants claimed that “I don’t know why… when I used the search engine to search for a book to read, it does not come first”, and because of that most of participants took a long time tried to found a book.

Discussion

The outcome of this study shows that the participants found some of the tasks to be confusing. As a result, various participants did not complete their tasks successfully. For example, three of the users were not able to complete task six effectively. The participants felt that myON was not well designed. The users were required to click on the library navigation tab that directed them to the library page. Thereafter, the participants were required to scroll to the end of the page in order to see the ‘Because I like Navigation’ tab which contained a drop down menu. It was observed that some of the participants who were experienced with myON found this task challenging at the start, but were able to eventually complete it. Given the challenge faced by the participants in navigating through the library page, there is need to redesign the search engines in the website and substitute it with a drop-down menu. This will allow for all the essential features to be visible at the top of the page and thus minimize the problems encountered in navigating through the pages.

This study provides significant evidence showing that there is need for the redesign and improvement of the myON website. One of the evidence can be linked to the fact that it took a long time for the participants to locate a book using myON. For instance, it took one of the participants approximately eight minutes longer than other participants to complete the task of finding a book. The participant in this case required more assistance on how to use the website. It is therefore recommended that the website's home page should be redesigned in order to make it more clear and easy for users to find the navigation tab. Moreover, in order to eliminate the challenge faced by users in in scrolling down the page in order to find the scroll down menu, there is need to ensure the visibility of all the important features at the top of the page. This will make it easy for the users to navigate through the pages.

Ten of the participants were found to have split-attention that affected the search process as they completed their tasks. This occurred when the participants were forced to split their attention between various navigations that had similar link information. The key recommendation that can be adopted in order to avoid the split-attention effect is the need to change and redesign one of the search engines to ensure that it has a drop-down menu. This will make it easy for the students to search and locate all the books contained in the database. As such, the students will have no problem finding the books that they need.

It was also suggested by some of the participants that if the timer could be initiated when the users began reading their books, they would be able to know the amount of time spent reading a book. It is therefore necessary to include and activate this feature in myON so as to enable the users monitor the time they spend on reading a given book.

This study was able to determine the difference in the effectiveness with which the experienced and the non-experienced users were able to complete their tasks using myON. The participants who had prior experience with myON were able to complete their tasks successfully. The participants who did not have experience with myON were reported to successfully complete an average of 94% of the tasks. Even though completing 94% of the tasks is considered to be significantly high, there is need for first time users to gain more experience with myON so as to increase their success rates. As outlined earlier, some of the key issues associated with the lack of effectiveness among the non-experienced users include design problems, mislabelling, and navigation issues.

The efficiency rates showed that the experienced participants were able to complete their tasks by spending less time compared to the non-experienced participants. This served to indicate that the non-experienced users require more assistance in understanding the structure of the site and how to efficiently use the website. Further, it was observed that the overall SUS score was above average. The above average score indicated that more than half of the participants were contented with the website in facilitating their ability to complete their tasks. However, the score was not perfect and this illustrates the need for further modification and improvement of the website, which has been highlighted in the recommendations. The findings from this study also showed that the average learnability was approximately 57.5%. This indicates that the participants were not fully knowledgeable on how to use the website. As such, majority of the participants still needed to be guided no how to use the website.

Conclusion

myON is a form of digital library that has been developed to meet the requirements of the individual learners. myON provided all the essential information needed by parents and teachers to monitor and assess the progress of students as they read. The usability evaluation contained in the website is critical in determining the usability and effectiveness of the services offered by the website.

This study has evaluated the efficiency, effectiveness, and satisfaction of participants in employing the use of myON to complete various tasks. The methods used in the evaluation process include semi-structured interviews, observation by researchers, and usability scale satisfaction survey.

The outcome of the efficiency evaluation showed that the average time used to complete all the tasks by the participants with prior experience was approximately 29 minutes and 14 seconds. The participants without experience on the other hand spent an average of 37 minutes and 58 seconds to complete their tasks. The ability of the users to effectively and successfully complete their tasks was influenced by the split-attention effect in the search engine. The split-attention effect occurred when the participants were required to divide their attention between the various navigations that had similar link information.

Further, the effectiveness rate in using myON showed that 100% of the participants with experience were able to effectively complete their tasks. Approximately 94% of the participants without experience were able to complete their tasks effectively. Three participants without experience found difficulty-completing task six that required them to find a book to read under the section 'Because I like Seasons and Weather'. It was also observed that some of the participants with experience on how to use myON faced difficulty in completing tasks at the beginning. Apart from task six, all the other tasks reported 100% completion rate. The average SUS score was approximately 77.3, which was above the overall average of 68. This illustrated that a large number of the participants were satisfied with how the website enabled them to finish their tasks.

There was a common consensus among all the participants that myON was easy and fun to use, and that it was suitable for students who had difficulty in reading books online. There was no significant difference in the usability scores between the two groups with regards to effectiveness, efficiency, and satisfaction with myON.

For future research, it is recommended that eye-tracking device should be used to assess the way in which users interact with myON. This is due to the fact that the eye-tracking device provides accurate data that can aid in identifying where users are looking and the amount of time spent in specific areas on the screen.

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Creativity and Problem Solving Through Gamification in Competitive Teams

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Abstract

This study attempted to examine undergraduate students' problem solving and creative thinking abilities when they faced with the task of solving the complex communication problems about the fields of communication management, communication design, and communication technologies during the face-to-face learning classroom environment. The participants, 89, of the study are the fourth year senior students of the communication sciences faculty of Anadolu University, Turkey. The problem solving teams consist of seven students who are willing to participate in the study. The participants' achievements and motivations are the main questions of the research. Finally, the study explored the relationships between characteristics of the problem task, and interactions among students.

Introduction

The problem-based learning (PBL) is a teaching strategy that aims to move the classrooms from an instruction-based to problem-based learning environments. The term of PBL has taken a very important role ever since constructivist paradigm became so popular at the beginning of 1990s. The educational technologists and/or the instructional designers have developed many constructivist problem-based learning environments for formal and informal educational settings. When we look at the literature on PBL, we have found the first use of the PBL approach in medical sciences. The educators at the medical school of McMaster University in Canada have designed a program that has used problem-based instruction method in the 1970s. The PBL strategy and method quickly became widespread over to other medical schools. Throughout the 1980's the faculties introduced the PBL methods into many medical and professional schools across in North America, and Europe. In the 1990's the PBL methods spread to the faculty in the natural sciences. The educators in the humanities and social sciences moved more slowly in introducing the PBL method over the past decade (Burch, 2000), therefore it could be said that there were not many researches on the PBL in the social sciences area during those times. The PBL approach requires students to take their own responsibility for their learning as described in the constructivist theory of learning. The students are responsible for their learning in collaborative groups by solving concrete real world problems. The teacher's role in this setting is to guide the students' inquiries by asking Socratic questions. The PBL asserts that most students will better learn if they need it; the need arises as they try to solve the problems among the competitive teams.

The literature commend that competition is still a key element which highly motivates students to engage in the gamification tasks during the problem finding and problem solving cases among the competitive teams. There are still disagreements over the effectiveness of gamification on student learning, but many researchers have investigated the effects of gamification for learning and education and found a positive relationship between gamification and desired outcomes. Achievements of learning are one of the most important outcomes in learning and education (Kim S., Song K., Lockee B., Burton J., 2018). Many researchers have revealed that gamification for learning can improve achievement of the learners. Kim and others (2018) investigated that gamification can enhance higher order thinking skills, declarative knowledge and procedural knowledge, and test performance in the schools. In addition to these research results, some other researchers found the effectiveness of gamification on inducing psychological and behavioral changes. Hakulinen et al. (2013), Kumar and Khurana (2012), Li et al. (2012), that they all claim that gamified learning environments foster students' and learners' motivation and engagement.

In response to these research results, the researcher have decided to integrate game elements into the course contents that the students in the competitive teams would be willing to use in their problem solving practices. The following research questions guided the current study:

1) Is a gamification model effective in motivating learners in the competitive groups (teams) to complete more problem finding and problem solving activities?
2) Is a gamification model effective in motivating learners to increase the participants' motivations?

3) Is a gamification model effective in motivating learners to increase the participants' achievements?

The study and the participants

Anadolu University's Department of Communication Design and Management in the Faculty of Communication Sciences offers a course named "Creativity and Problem Solving" in the spring semester. This (2019) spring semester 82 senior undergraduate students have chosen this course as a core course of the department. During the course, each group of students (problem solving teams) has to develop a creative solution to the given complex communication problem by the instructor. The instructor chooses these problems from the communication field with the help of communication researchers. In addition, the problem solving teams have to develop creative complex problems on the given contents. In order to answer the research questions, the researcher will use some data collection tools. The first tool is a motivation scale developed by Dinçer and Doğanay in 2016. The scale has 27 items, and 5-point Likert scale to measure the participants' motivations. A group of volunteer communication experts will investigate and assess the competitive teams' problem finding and solving activities to evaluate the findings. Interviews with the students about all sections of the course are the other data collection method for the study.

Findings

Table 1. Team Working Motivation Factor Average Scores

TWM	m2	m3	m4	m6	m10	m14	m17	m18	m19	m23	m24	m28
Mean	3,63	4,45	3,90	4,28	3,59	3,70	2,67	3,34	3,65	3,83	4,12	3,61

The first factor of the questionnaire is the motivation factor related to teamwork. The average of the substances in this factor is shown in Table 1. When the scores of the questions in table 1 are examined, the lowest score in this factor is 2.67. The question with the lowest score in the factor related to motivation is "I like to study alone". As can be seen from this, the participants do not like studying alone. This situation expresses us that teamwork can increase the motivation of the participants.

The highest score in this factor is 4.45, and the question with the highest score in the factor related to motivation is "I do care about the ideas of other friends in teamwork". The results of the question showed that the participants cared about the ideas of other friends in teamwork.

When the teamwork and motivation questions are examined in general, it can be concluded that the participants love teamwork and think that doing their other lessons in this way would contribute positively to their motivation.

Table 2. Gamification Motivation Factor Average Scores

GM	m1	m5	m9	m11	m13	m21	m22	m25	m27	m29
Mean	3,68	3,80	3,39	3,44	3,71	3,61	3,38	3,54	3,37	3,78

The second factor of the questionnaire is the gamification motivation factor. The average of the substances in this factor is shown in Table 2. When the scores of the questions in table 2 are examined, the lowest score in this factor is 3.37. The question with the lowest score in the factor related to gamification motivation is "The content of my gamification design was clear to me". According to this result, the participants do not seem to complete understand the content of the game design. Therefore, in similar situations, it is recommended that the design content should be described to the participants very well.

The highest score in this factor is 3.80, and the question with the highest score in the factor related to gamification motivation is "The gamification method described in the course helped me to understand the course contents". The results of the question showed that the gamification method could help participants understand the lesson better.

When the gamification and motivation questions are examined in general, it can be concluded that the participants can learn better through gamification, but game design issue needs to be better explained to the participants.

Table 3. Gamification Achievement Factor Average Scores

GA	m7	m12	m15	m16	m26
Mean	4,38	3,50	3,84	3,65	3,60

The third factor of the questionnaire is the gamification achievement factor. The average of the substances in this factor is shown in Table 3. When the scores of the questions in table 3 are examined, the lowest score in this factor is 3.50. The question with the lowest score in the factor related to gamification achievement is “I can relate the content of gamification design to the issues I face in my own life”. According to this result, the participants do not seem to complete understand the content of the game design as the factor 2 that is related with the design issue. Therefore, in similar situations, it is recommended that the design content should be described to the participants very well.

The highest score in this factor is 4.38, and the question with the highest score in the factor related to gamification achievement is “Success in gamification design makes me happy”. The results of the question showed that the gamification design could help participants be happy, and motivate them to understand the lesson better.

When the gamification and motivation questions are examined in general, it can be concluded that the participants can learn better through gamification, but game design issue needs to be better explained again and again to the participants.

Discussions and Conclusions

The results of the research show that the teamwork method has a significant effect on student motivation in the lessons, especially in the communication related courses. Contrary to popular belief, teamwork contributes positively to students' motivation. Students express that learning is more realistic and more fun in a gamified learning environments. However, the design of gamified learning environments is the most difficult issue for students and even for the researchers. According to Dicheva, Dichev , Agre, and Angelova (2015) there are many publications on the use of gamification in education but the majority are only describing some game mechanisms and dynamics and re-iterating their possible use in educational context. This means that serious research has not yet been conducted on the use and effects of gamification in education. As a result, the researcher may say that the students could learn better through gamification, but game design issue needs to be better explained repeatedly to the students, researchers, and designers.

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What Works for Learners in MOOCs

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Descriptors: Massive Open Online Courses (MOOCs), Learners' Reasons to Participate, Learners' Preferences of Learning Activities and Materials

Abstract

This paper intends to reveal the results of a study that examines the relationship between the MOOC participants demographics and their reasons to take these courses as well as their preferences of the learning activities/materials. It is actually a part of a larger study that intended to reach the effective MOOCs design principles for Turkish audience. This part of the larger study focused on investigation of the Turkish MOOCs participants' reasons to take these courses and their preferences of the learning activities/materials. Total 754 learners voluntarily completed the online survey developed to collect data on these reasons and the participants demographic characteristics. The results have shown that the learners mostly take these courses to learn more about the topics they are interested in. Remarkably, very few participants noted the interaction with others as an activity/material they prefer in these courses.

Introduction

The Massive Open Online Courses (MOOCs) has been one of the major contemporary hot topics in education, particularly higher education since the first offering by George Siemens and Stephen Downes in 2008. Although they seem transforming into more self-paced, professional development and degree-oriented courses, all around the world there is still a big interest in both supply and demand sides (Shah, 2017). Latest figures reveal that currently there are more than 8000 MOOC offerings from more than 800 institutions to around 60 million users globally.

The demand, or motives for registration to MOOCs, has been studied over the last 5 years in various settings (e.g.; Agarwal, 2012; Kolowich, 2013; Rice, 2013). Studies have shown that the major motives for MOOC participants, or MOOCers are curiosity for exploring the developments in the fields of their own personal interests (Kay et al, 2013; Seaton at al, 2014), getting a better insight about what they have been doing in their jobs (Wang & Baker, 2015), experience online learning, receive a certificate, and development of their professional knowledge and skills (Yuan & Powell, 2013), requiring no prior degree or certificate to participate (Vail, 2013), learning how to design online courses as well as learning online pedagogy (Blake, 2013), having a course experience with a small or no cost (Chen, Barnett, & Stephens, 2013; Wilson et al., 2013), and taking a course from a prestigious institution, famous or well-known person (Adamopulos, 2013). On the other hand, although MOOCs are considered as destructive innovation, a big majority of them adapts an instructional strategy: basically, consists of videos and readings as conveyors of information, limited -usually unmonitored- peer interaction, and some instructor-student interaction, quizzes and exams. Alexander and Boud (2016) claimed that didactic traditional teaching strategies have often been implemented in ODL courses and pointed to the potential of online learning being lost as a result. Is it true for MOOCs? Do the MOOCs usually employ the same didactic traditional teaching? What are the alternative instructional strategies that are more suitable to MOOCs and online courses? Does culture, in general and/or learning culture (learning habits and attitudes common in a society) has an effect on designing MOOCs?

These are among the questions we want to examine in a larger study focusing on investigating design principles for MOOCs specifically offered in Turkish. One part of this research project is about learning the Turkish MOOCs participants' reasons to take these courses, their preferences of the learning activities/materials, and relationship between these reasons and the learners' demographic characteristics.

Method

Anadolu University has been offering MOOCs in Turkish to mainly Turkish speaking audiences since 2015. AKADEMA is the name of the platform created to offer these courses. Currently there are around 80 courses, about variety of topics including science, sports, fine arts, writing skills, Turkish folk music, playing musical instruments, etc., run three times in a year in AKADEMA. This study was conducted with the participants of AKADEMA courses.

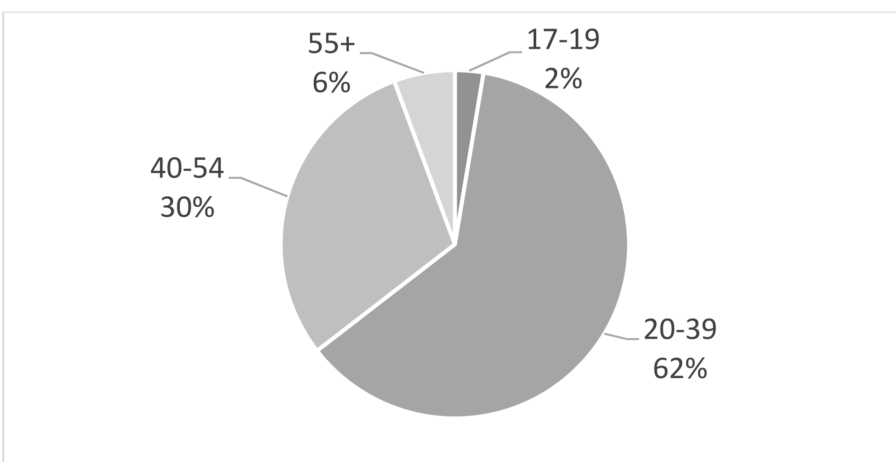
In this descriptive study, an online questionnaire was used to collect data. The related part of the questionnaire was developed based-on different previous studies about MOOCs participants' reasons or motives to take these courses, such as Milligan & Littlejohn (2017), Neuböck, Kopp, & Ebner (2015). The related part of the questionnaire provided a list of reasons (motives) for participants to indicate their reasons to attend the MOOCs and asked to indicate the most relevant top 3 reasons for them. It also included a list of activities/materials presented in MOOCs and the participants were asked to indicate their level of preference toward these activities/materials. The data collection instrument additionally consisted of questions about the learners' demographics. The other parts of the questionnaire included questions about the participants' evaluations, study habits, future plans to attend, their preferences of the topics for future, and so forth.

The questionnaire was shared with all the AKADEMA learners and kept open during 1 April – 30 May 2018. Total 754 learners voluntarily completed the online questionnaire from all over the country. Mostly descriptive statistics were used to analyze the data. Analyzes about the other parts of the study is still undergoing.

Findings

The reporting of the findings is organized according to the research variables (demographic characteristics and the participation reasons and preferences) and the cross tabulation of the findings.

Figure 1 summarizes the age range of the participants. When the table is examined, it is seen that 61.9% of the participants are in the 20-39 age range; and 29.8% between in the ages of 40-54. It is interesting to note that the percentages of the older (55-73 ages) and the younger (17-19 ages) students are quite low (5.7% older and 2.6% youngers). Additionally, as can be seen in the table, there is not a big gap in terms of the gender. Of the 52.3% participants were female and 47.7% were male.



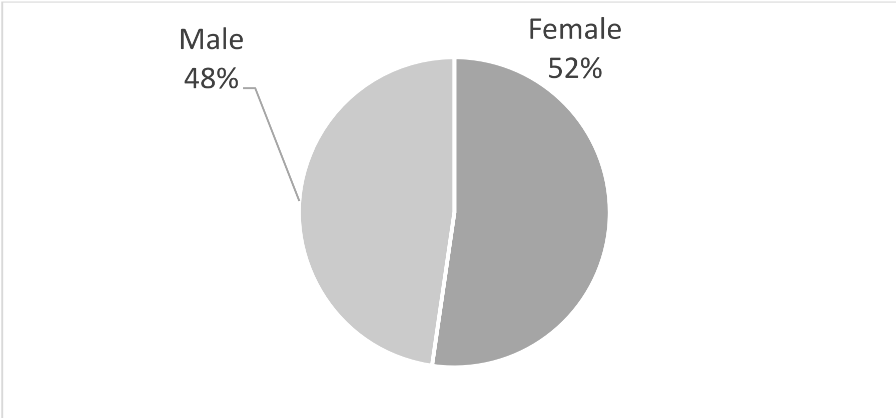


Figure 1. Demographic information for MOOC participant

Figure 2 presents the detailed data about the MOOC participants' top three reasons for taking AKADEMA courses. As can be observed, the first three statements that the participants considered as relevant, or important reason to take these courses, were 'learning more about the topics they are interested in' (90 percent), 'having a valid certificate' (68.5 percent), and 'earning a credit that may use in a formal degree program' (68.5 percent).

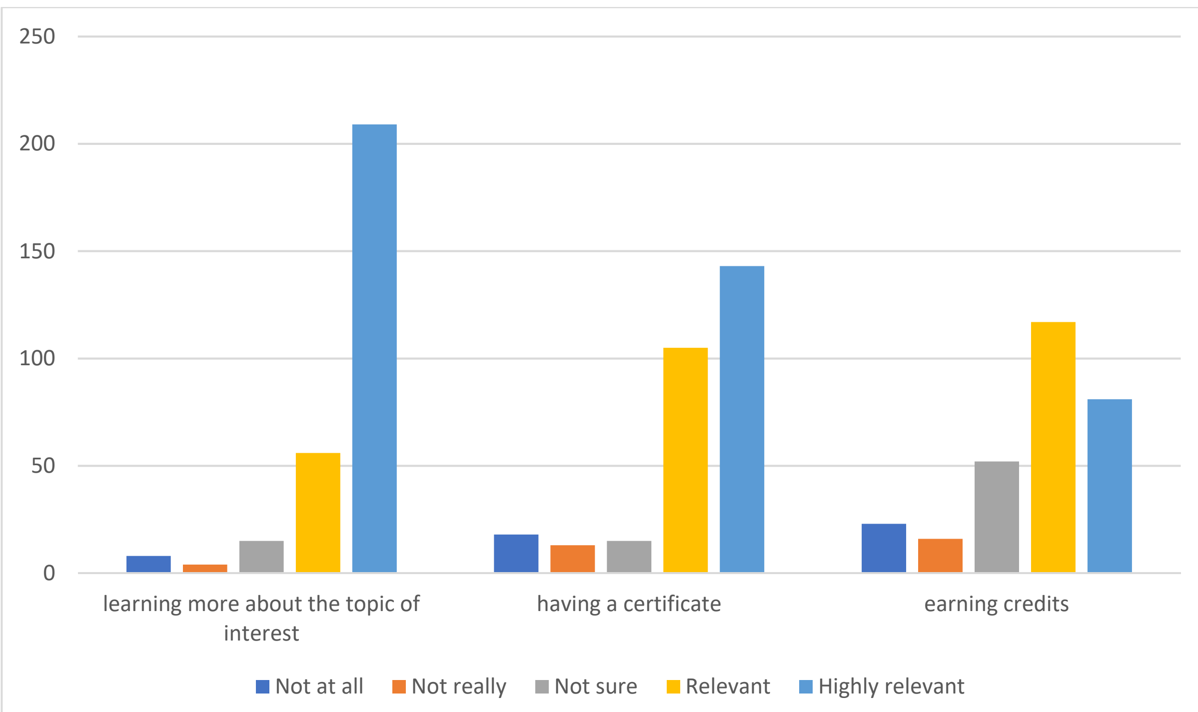


Figure 2. Top 3 reasons to participate AKADEMA MOOCs

On the other hand, figure 3 shows the participant learners' preferences of the different types of learning activities. As can be drawn from the figure, a big majority of the MOOC participants still prefers readings (87.9 percent) and videos (87.9 percent). Meanwhile the learners indicated lowest preference to the learner-to-learner interaction (49.1 percent). Interestingly, synchronous interaction with the instructors was also preferred less than others (71.2 percent).

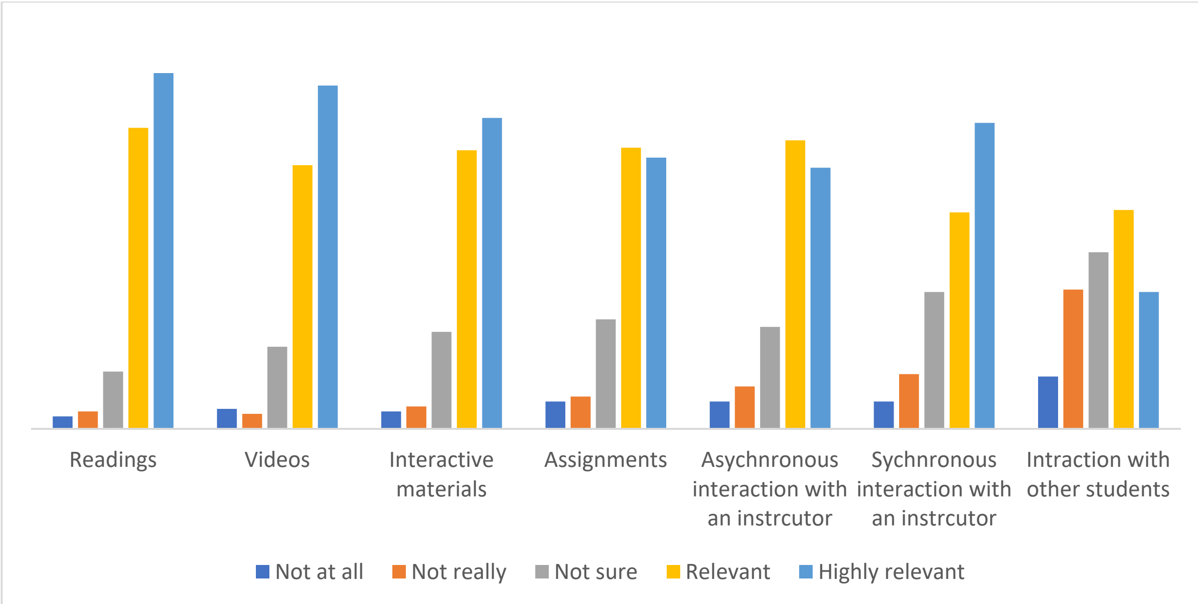


Figure 3. Learners' preferences on the learning materials/activities

Figure 4 gives some details about the top 3 reasons for MOOC participation and gender. One can infer easily infer that there is no significant difference between female and male students' motives. A similar finding was observed in the activity/material preferences of the female and male students. A noteworthy difference between genders was seen in the preferences of learners on learner-to-instructor interactions. Figure 5 also shows that male students are less willing to interact with the instructors either asynchronously or synchronously.

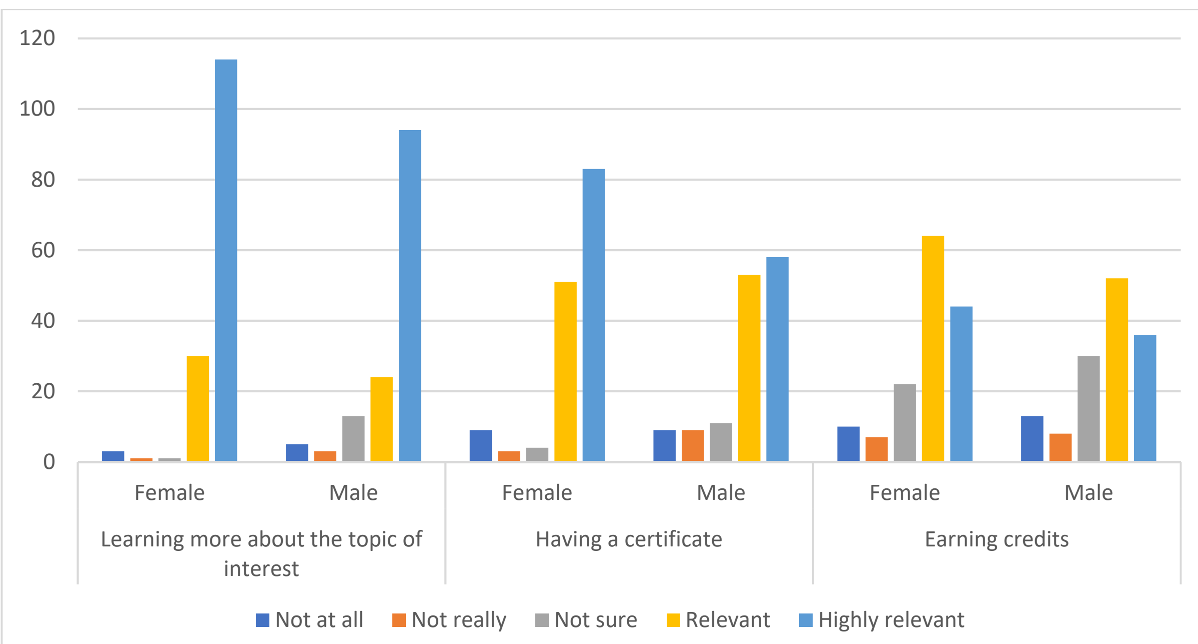


Figure 4. Gender and the top 3 reasons to participate MOOCs

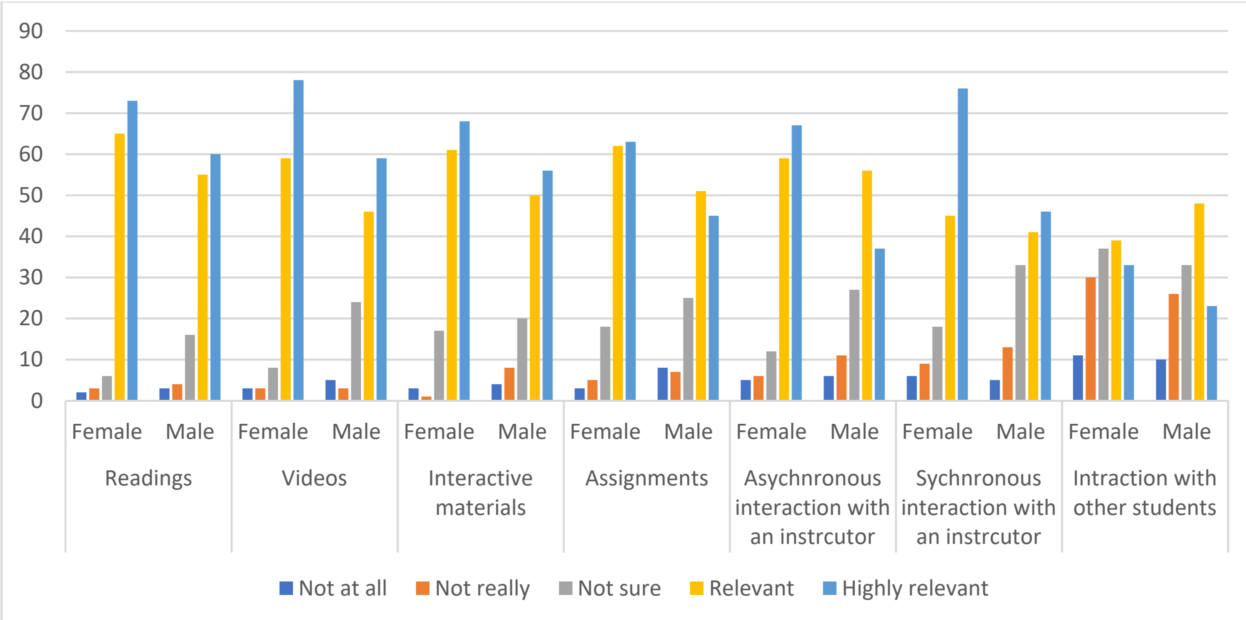


Figure 5. Gender and activity/material preferences

In terms of age groups, a great percent (90.3% relevant and very relevant answers) of those who are between in 17-19 ages indicated that the learning more about the topics they are interested in as the top reasons for taking AKADEMA MOOCs. Interestingly, all the elderly (55+) students also indicated this reason as the major reason for taking these courses. Similar results can be seen for other age groups, too.

Table 1. Age and the top 3 reasons to participate MOOCs (percentages)

Reason	Age	Not at all	Not really	Not sure	Relevant	Very relevant
Learning more about the topic of interest	17-19	6.7	0	0	20	73.3
	20-39	1.3	1.3	6.6	21.1	69.7
	40-54	1.9	1.9	25	17.2	76.4
	45+	0	0	0	0	100
Having a certificate	17-19	13.3	6.7	0	46.7	33.3
	20-39	3.9	5.3	5.3	43.4	42.1
	40-54	6.3	3.1	3.8	34.6	52.2
	45+	0	0	14.3	0	85.7
Earning credits	17-19	14.3	0	28.6	42.9	14.3
	20-39	5.4	8.1	17.6	43.2	25.7
	40-54	9.4	5	16.4	39.6	29.6
	45+	0	0	14.3	14.3	71.4

In terms of age groups and activity/material preferences of the students, all of those who are between in 17-19 ages preferred using readings and videos in their MOOCs. This group indicated peer interaction (42.8 percent) and asynchronous interaction with an instructor (71.5 percent) as the least preferred activities/material for MOOCs. Meanwhile, those who are between in 20-29 ages preferred the videos (95.7 percent) over readings (93.4) but still reading is the second preferred activity/material among this group. Similar to the previous group, this age group also indicated lesser preference of interacting with the other students (41.4 percent). However, it was interesting to notice that synchronous interaction with an instructor (67.5 percent) was lesser preferred activity/material than asynchronous interaction (76 percent). Additionally, this group also did show a lesser preference for assignments (69.7 percent). Very similar findings were observed among 40-54 years old students. They also highly preferred readings (100 percent), videos (84.8 percent) and shown less interest in peer interaction (53.1 percent) and synchronous learner-to-instructor interaction (75 percent). Finally, the elderly group shown interesting preferences although the peer interaction (57.2 percent) still indicated as the least preferred activity/material. This group has shown great interest in learning from assignments and feedback provided to their works (100 percent). Interestingly, this group also slightly preferred asynchronous interaction with the instructors (76.4 percent) over synchronous interaction (75 percent).

Table 2. Age and activity/material preferences (percentages)

Activity/Material	**Age**	**Not at all**	**Not really**	**Not sure**	**Relevant**	**Very relevant**
Readings	17-19	0	0	0	64.3	35.7
	20-39	0	0	6.7	46.7	46.7
	40-54	1.9	3.2	8.2	36.7	50
	45+	0	0	0	14.3	85.7
Videos	17-19	0	0	0	42.9	57.1
	20-39	1.3	1.3	11.8	43.4	52.3
	40-54	2.5	3.2	9.5	33.5	51.3
	45+	14.3	0	0	28.6	57.1
Interactive materials	17-19	6.7	6.7	0	40	46.7
	20-39	1.3	1.3	10.4	44.2	42.9
	40-54	1.9	3.8	12.7	38.2	43.3
	45+	0	0	14.3	28.6	57.1
Assignments	17-19	0	0	7.7	46.2	46.2
	20-39	3.9	2.6	23.7	36.8	32.9
	40-54	3.2	5.1	11.5	38.9	41.4
	45+	0	0	0	28.6	71.4
Asynchronous interaction	17-19	7.1	7.1	14.3	42.9	28.6
	20-39	1.3	6.7	16	42.7	33.3
	40-54	4.5	5.7	13.4	41.4	35
	45+	0	0	14.3	14.3	71.4
Synchronous interaction	17-19	0	7.1	14.3	42.9	37.5
	20-39	1.3	9.2	22.4	27.6	39.5
	40-54	5	4.4	15.6	30..6	44.4
	45+	0	5.3	14.3	14.3	71.4
Peer Interaction	17-19	0	35.7	21.4	21.4	21.4
	20-39	5.3	21.3	32	26.7	14.7
	40-54	8.2	17.1	21.5	32.3	20.9
	45+	14.3	14.3	14.3	14.3	42.9

Conclusions

MOOCs nowadays stand out as widespread and popular digital education applications on a universal scale. Innovative practices created by new media technologies force traditional education paradigms to change. In this context, with the development of technology, traditional education patterns are broken, and MOOCs practices appear as an alternative educational environment. MOOC s are becoming more widespread in order to make more information available to the mass circulation and to make the courses in universities accessible and flexible for the wider audience. It would be wrong to indicate that examining the MOOCs phenome might help the governments and related institutions develop policies for effective and efficient integration of information and communication technologies into educational systems.

The goal of this study was to determine the learners' reasons for taking the Anadolu University's MOOC offerings in AKADEMA platform and their preferences of learning activities/materials. The top 3 motivation of the participants to take AKADEMA MOOCs was identified respectively as learning more about the topics of interest, having a valid certificate from a well-known institution, and earning credits that can be used in a degree program. This result supported the previous studies conducted in Turkey and all around the world. For instance, Aydemir and Çelik (2018) conducted a study to determine the reasons for joining the MOOCs and the participants of that study also stated that they took those course because they were interested in learning new things, developing themselves and being interested in the subjects of the courses they took. In another study, Aybek (2016) the same phenomenon with the 24-40 age group and found out that the learners attended the courses owing to their interest and curiosity towards the courses. Similar findings were also indicated the global MOOCs literature. Learning more or gaining more experience and knowledge on the topics of interest was identified as one of major motives for taking MOOCs in many studies, such as Agarwal (2012), Allon (2012), Belanger and Thornton (2013), Breslow et al. (2013), Evans (2012), Fini (2009), Kaul (2012), Kolowich (2013), Rice (2013), etc. Meanwhile, the literature clearly presents that learners' performance in MOOCs is highly correlated with the learners' expectations in joining the courses (Hew & Cheung, 2014; Oktal, 2013; Venkatesh & Davis 2000). This might be considered as a rational for the finding about the learners' participation to MOOCs because of learning more on the topics of interest. Additionally, theory of adult learners also indicated that adults' one of the biggest motivations towards learning is learning on their topics of interest.

In terms of learning activities/materials, it was very surprising to see readings as highly preferred activities/materials as videos even among younger students. This result might be associated with the traditional distance education background of Anadolu University. Anadolu University distance education programs and courses mainly require self-paced study and asks students learn from specially designed, written, and published textbooks although nowadays more digital media are being presented. So, the learners learn by reading their textbooks and take centralized exams in order to pass their courses. This design could be effective on the MOOCs participants' preferences of the learning activities/materials in this study since a good deal of learners in MOOCs is also distance education students.

The analyses about effects of the gender and age of the participants on their motives and preferences of activities/materials have shown no significant results. In other words, there is no significant difference between female and male students' motives. A similar finding was also observed in the activity/material preferences of the female and male students. A notable difference between genders was seen in the preferences of learners on learner-to-instructor interactions. The male students are less willing to interact with the instructors either asynchronously or synchronously than females.

In the light of the results, it was concluded that readings and videos are interestingly important activities/materials for all age and gender groups. Although MOOCs promote technology-based learning, learners continue their traditional distance learning behaviors. Even in technology-rich, technology-based learning environments, the Turkish students download the materials and study mostly printed versions of those materials. So, it can be claimed that the Turkish MOOC participants carry their traditional learning behaviors into MOOCs.

A remarkable result of this study is about the participants' preferences regarding the learner-to-learner interaction in MOOCs. It is the least preferred learning activity/material among the participants of this study. Actually, Aydemir and Çelik (2018) also found a similar result in their study. One can easily relate this result with again the previous distance learning experiences of the learners. Anadolu University as well as many other distance education providers do not focus on learner-to-learner interaction rather prefer learner-to-content interaction. So, again, the learners carry their learning habits into MOOCs in this case and prefer less peer interaction. It would be interesting to create and offer a cMOOCs to Turkish community and see the effectiveness and engagement. This result might be considered as a base while designing a MOOC for Turkish learners. Also, it is a good topic for further research on MOOCs for Turkish learners.

Another interesting result is about the earning a valid certificate from a well-known institution. Those participants who are between in 20 and 39 ages indicated this as the most relevant motive for taking AKADEMA MOOCs. This result can be correlated with the high unemployment rate among new graduates of higher education, and the raise of the informal and non-formal learning and their recognition among employers. In other words, along with a university degree diploma, certificates from well-known institutions are becoming added values for getting a job. This might be an interesting clue for MOOCs designers and providers same as above conclusion:

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Effects of Design-Based Learning on Educational Outcomes

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Abstract

The purpose of this study was to determine the effects of technology-supported tools used in educational environments to support cognitive learning processes on educational outcomes in design-based learning environments. In this context, Academic Search Complete, Eric, Ulakbim, Google Scholar and CoHE search engines were scanned. Scans performed; Digital story, Game design (Kodu), Algorithm and programming (Scratch), 3D design (Tinkercad, 3D print), Mobile programming (AppInventor) and Embedded programming (microcontroller) arguments. As a result of the scanning, 164 studies were obtained. The papers accessed by researchers were examined by taking into consideration the inclusion and exclusion criteria. In this paper, motivation, attitude, achievement, class participation, metacognition and 21st century learning of design-based learning environments were examined in terms of dependent variables in studies used design based learning environments as a primary implementation context.

1. Introduction

Design-based learning (DBL) environments are environments that allow the individual to create their own cognitive processes according to their learning preferences, styles and skills (Doppelt, Mehalik, Schunn, Silk, & Krysinski, 2008). The most important feature of these environments is that the individual creates his / her own experiences with the active participation of the process. These environments are based on constructivist learning theory as it is based on the active participation of the individual. In the design of these environments, the constructivist learning theory offered; problem/project, related cases, information resources, cognitive tools, conversation/collaboration tools and social/contextual support steps to be implemented.

DBL also supports the transfer of cognitive information since it is based on learning through experience and a product is created at the end of the process. In order to ensure the transfer of cognitive knowledge to complex, new and real situations, students should be supported with cognitive tools (Jonassen, 1999). Cognitive tools can be in the form of hands-on activities or technology-supported. Use of technology-supported cognitive tools in learning environments are effective for development of academic achievement, critical thinking, problem solving, information literacy and collaboration skills (Jonassen & Reeves, 1996; Kim & Reeves, 2007). DBL environments have a positive effect on many learning outcomes due to active participation of learners in the design and development process, the development of a product, and the support of technology-supported cognitive tools. In this context, it is aimed to determine the effect of DBL environments by using different technology supported cognitive tools on educational outcomes.

1.1. The Importance of Usage Design-Based Learning in Education

Design-based learning (DBL) provides many different advantages in learning environments. Since DBL provides a relationship with the real life of the learners in structuring their knowledge, it enables the learners to be motivated against learning (Doppelt, 2003). The learners actively participates in these environments. When the learner actively participates in the learning process, the student makes sense of the new information by matching his / her knowledge with his / her existing experiences (Driscoll, 2005b). The DBL environments aim to learn with the experience advocated by constructivist learning theory. These experiences give students not only cognitive skills but also metacognitive skills such as self-esteem and personal responsibility (Waks, 1995).

DBL environments provide a learning environment in which instructor and learners have different roles traditional lecture based teaching. In lecture based teaching environments, the instructor has the role of actively giving information, and the learner has the role of passively receiving information. On the other hand, the DBL environments support a student's active participation in the learning process by providing opportunities to create products that ensure the development of cognitive strategies and processes. The design process of constructivist learning environments proposed by Jonassen (1999), as in constructivist learning theory, should be taken into consideration in DBL environments. This design process includes problem /project, related cases, information resources, cognitive tools, conversation/collaboration tools, social/contextual support.

In DBLs, learning process is supported by real life problems or project-based activities that provide experiences with the active participation of learners, facilitating and supervising the process of the teacher (Gómez Puente, van Eijck, &Jochems, 2013). In order to provide learning with experience in these environments, it is also necessary to transfer cognitive knowledge. In order to ensure the transfer of cognitive knowledge to complex, new and real situations, it is necessary to provide students with cognitive tools (Jonassen, 1999). Cognitive tools can be in the form of hands-on activities in these environments as well as technology-supported. Technology-supported learning environments have many contributions to the learning process.

The use of technology in teaching facilitates learning because it supports different types of learning in storing and remembering information in cognitive processes (Mayer & Moreno, 1998; Paivio, 1991). In addition, the presentation of technology-supported cognitive tools provides support for learning complex information and reduces cognitive load (Driscoll, 2005a). Use of technology-supported cognitive tools in educational settings; academic achievement is effective in the development of mental skills such as critical thinking, problem solving, information literacy and collaboration (Jonassen & Reeves, 1996; Kim & Reeves, 2007).

2.Research questions

The aim of this study is to determine the effect of DBL environments by using different technology supported cognitive tools on educational outcomes. Within the scope of this study, the research questions are as follows:

1. What are the effects of design-based learning environments on students';

a. motivation in different learning topics?
b. students' attitude in different learning topics?
c. achievement in different learning topics?
d. engagement in different learning topics?
e. metacognition in different learning topics?
f. 21st century skills in different learning topics?

3. Research method

This study was conducted as a literature review. For the review, Academic Search Complete, ERIC, Ulakbim, CoHE (Council of Higher Education) Thesis Center and Google scholar was used for searching articles.

3.1. Search terms and domains

In order to determine the effect of design-based learning on educational outcomes, searches were made in the databases using the topics and keywords in Table 1.

Table 1. Databases, research topics and keywords searched in literature.

Databases	Topics	Keywords used
Academic Search Complete ERIC Ulakbim CoHE(Council of higher education) Thesis Center Google scholar	Digital story	Digital storytelling Digital storytelling in education
	Game design (Kodu)	Game design with kodu Kodu in education
	Algorithm and programming (Scratch)	Programming with Scratch in education Scratch use in education Algorithm training with scratch
	3D design (tinkercad, 3D print)	Tinkercad use in education 3D print in education Sketchup use in education
	Mobile programming (AppInventor)	Mobile programming with AppInventor Mobile programming with AppInventor in education

	Embedded programming (micro controller)	Microcontroller in education Embedded programming with micro controller

3.2. Research selection criteria

As a result of the literature review, 164 studies have been reached in total in experimental and quasi-experimental studies written in Turkish and English languages, except for articles that are not allowed by the author and paid in other databases. If there are published articles of the studies carried out as master's or doctoral dissertations, this study has also been reviewed. These studies were examined by considering the inclusion and exclusion criterias in Table 2. Inclusion and exclusion criterias were determined by the researchers considering the characteristics of the DBL environments.

Table 2. Inclusion and exclusion criterias

Inclusion criterias	**Exclusion criterias**
Real world problem-based studies	Qualitative studies.
Project based studies	Opinion studies.
Active participation of students	Instructional studies with media developed by the instructor.
Experimental and quasi-experimental studies	Educational estimates of the applications prepared with tools.
Applications for all age groups	Instructional design studies.
At the end of the teaching, the student put forward a product	Literature reviews.
Quantitative dimension of mixed research	Development studies.
Formative research.	
Experience studies.	
Presentation studies.	
Study recommendations.	

As a result of the investigations, it was seen that 39 out of 164 studies examined the effects on educational outcomes in DBL environments. The design-based researches examined in detail; 12 of them are in digital story, 2 of them are in game design with code, 13 of them are in algorithm and programming with Scratch, 3 of them are in 3D design with tinkercad or 3D print, 5 of them are in mobile programming with AppInventor, 4 of them are in embedded programming with micro controllers.

3.3. Design based learning researches examined as a result of selection criteria

The studies on the effect of DBL environments on educational outcomes were examined under the headings of research type, research aim, research method, independent variable, dependent variable, data collection tools, participants and results. The design-based research studies in the literature were further investigated based on their results to answer current study's research questions.

4. Results and Discussion

The use of DBL environments in education has an impact on many educational outcomes. Design-based learning enables learners' motivation, attitudes towards the course / material, academic achievement, active participation, metacognitive skills and 21st century skills.

4.1. Research question 1: What is the effect of design-based learning environments on students' motivation in different learning topics?

Motivation is one of the factors that should be considered in the design of instruction. In other words, the designer should design the instruction by taking the necessary measures to increase the motivation of the learners. Keeping the motivation of learners high is critical for a good instructional design (Martin, 1999). Different models are used in the design of instruction to take into account motivation. One of the most well-known models is the ARCS model. This model was proposed by Keller (1979). The model consists of four steps that should be considered in instructional design to ensure motivation (Keller, 1983, 1987). These steps; attention, relevance, confidence and satisfaction. The problem-based trainings, which are designed with ARCS model in DBL environments, contribute positively to students' motivation (Koshino et al., 2013).

Active participation of an individual in the process is highly effective in increasing an individual's motivation against the learning environment (McCombs & Whisler, 1997). As DBL environments are the environments where the learner actively participates, the learner motivation increases. The increase in motivation results in the researches is due to the active participation of the students by the researchers (Topalli & Cagiltay, 2018). The effect of motivation, which is one of the learning outcomes, on different media in the DBL environments was examined. It is seen that these tools increase motivation and increase success in DBL environments (Chun-Ming et al., 2012; Demirer, 2013; Erol & Kurt, 2017; Topalli & Cagiltay, 2018). There are also studies showing the opposite of this situation. Göçen (2014) concluded in her study that the achievement of the students increased but there was no change in their motivation. In this study, where students' achievements increased and they developed positive attitudes, it was thought that students did not give sincere answers to motivation data collection tools. Increasing motivation positively develops positive attitudes in DBL environments (Demirer, 2013; Göçen, 2014), metacognition skills such as time management, self-test (Göçen, 2014) and also contributes to the development problem-solving skills from 21st century skills (Chun-Ming et al., 2012).

4.2. Research question 2: What is the effect of design-based learning environments on students' attitude in different learning topics?

Attitude is the cognitive and emotional preparation that has the power of influencing and directing the behaviors towards all objects, events and situations of interest that are formed as a result of an individual's life and experiences (Alport, 1935). Attitudes in learning environments are influenced by individual's life, knowledge level, interests, reinforcers, imitations and social learning. The presence of attitude can be explained as a result of the measurement and observation of cognitive thinking process, emotions and behaviors (Inceoglu, 1993). An individual's positive attitude towards the learning environment will facilitate learning, motivation, and acquiring metacognitive or 21st century skills in order to increase student success.

DBL environments enable students to develop positive attitudes towards technology-based cognitive tools, learning topics, and product discovery processes. When the researches were examined, it was seen that students developed positive attitudes towards the cognitive tools of AppInventor (Dabney et al., 2013), digital story (photo story 3) (Heo, 2009) and Scratch (Chiang & Qin, 2018). In addition to cognitive tools, students show positive attitudes towards the subjects they want to learn by actively participating in the learning process (Ke, 2014; Wang et al., 2017). DBL environments also enable students to demonstrate positive attitudes towards writing skills by creating scenarios as a result of the use of digital storytelling tools (Baki, 2015). It is seen that the studies on the attitude of DBL environments on attitude are incomplete in terms of Kodu game design, 3D design and microcontrollers and embedded programming. Experimental researches that will examine the effect of these areas on attitudes in DBL environments will guide educators for future uses.

4.3. Research question 3: What is the effect of design-based learning environments on students' achievement in different learning topics?

Success is one of the most frequently used dependent variables, which are used in most scientific researches and the effects of different teaching methods are examined. Success refers to the degree of ownership of the knowledge, skills and abilities that are desired to be acquired. Achievement results are one of the main variables that indicate whether a designed instruction is effective or not. The effectiveness of a teaching results from the level of achievement of the desired learning objectives. While preparing learning objectives, it is considered which theory will be developed based on which theory. These theories argue that success is affected by many different factors in learning environments. In learning environments; behavioral learning theory argues that success is influenced by environmental factors (Driscoll, 2005c), cognitive learning theory is influenced by factors in the process of information processing (Driscoll, 2005a), and constructivist learning theory is influenced by the individual's development, experiences and sociocultural structure (Jonassen, 1999).

Success depends on the performance of the learner. The lower the difference between the existing situation and the desired situation in human performances, the higher the success (Van Tiem, Moseley, & Dessing's, 2000). Human performance; organization system (instructional design), incentives (reward, reinforcement etc.), cognitive support (modeling, coaching, building scaffolding), tools (cognitive tools, technology supported tools), physical environment (classroom environment), lack of knowledge / skills, natural / hereditary (intelligence, physical features) capabilities are affected by internal and external factors (Wile, 1996).

It is essential for the individual to gain experience in DBL environments. Therefore, in these environments, active learning of the learner is ensured and practical learning is provided. Success levels vary depending on the learner's active participation. Students' achievement can be increased by using different technology supported cognitive tools in DBL environments. In the studies, it is seen that Scratch (Su et al., 2014) and 3D printing (Dahle & Rasel, 2016), one of the technology-supported learning tools used in DBL environments, increase student achievement compared to the environments where teaching strategy is used with traditional presentation. In addition to these studies, there are studies comparing the effect of different technology supported cognitive tools on success. Omar (2018) examined the impact of microcontrollers, Scratch tools and programming success in traditional environments. As a result of the study, it was observed that students using microcontrollers were more successful than Scratch users and the traditional learning group was the lowest. Korkmaz (2018) also compared Scratch and Lego Mindstorms Ev3 applications and concluded that Lego Mindstorms Ev3 contributes more to success. In addition, AppInventor (Papadakis et al., 2016) and digital stories (Büyükcengiz, 2017; Chun-Ming et al., 2012; Demirer, 2013; Göçen, 2014; Sancar-Tokmak & Incikabi, 2013) also has a positive effect on success. Students' positive attitude towards the course or application (Cetin, 2016; Chiang & Qin, 2018; Korkmaz, 2016; Lewis, 2011) and high levels of satisfaction (Chen et al., 2016) are among the factors affecting success. Collaboration in DBL environments also increases the success of individuals because it enables peer learning (Lewis, 2011).

4.4. Research question 4: What is the effect of design-based learning environments on students' engagement in different learning topics?

Participation is the inclusion of the student in the learning processes. In a learning environment, if the course is considered important by the student and falls within the student's interest, the student makes an effort to make more effort, ie to participate more (De Volder & Lens, 1982; Miller, Greene, Montalvo, Ravindran, & Nichols, 1996; Wigfield & Eccles, 2000). Therefore, providing motivation in learning environments is an important factor for participation (Skinner & Belmont, 1993). In learning environments, many technology-supported cognitive tools can be used in order to attract students' interest and to ensure their participation. Considering the students' tendency to technology, it is possible to create the necessary interest for participation with technological tools. DBL environments provide learning environments where students' participation is actively provided. At the same time, the use of technology-supported cognitive tools in students' activities / product discovery processes is also provided by the DBL environments.

As a result of the research studies conducted on the effect of DBL environments on educational outcomes, it was concluded that active participation is seen as the main element in all researches. Providing active participation in these environments plays an active role in the development of students' achievement (Su et al., 2014; Topalli & Cagiltay, 2018), motivation (Chang et al., 2017; Chun-Ming et al., 2012), positive attitude (Dabney et al., 2013; Wang et al., 2017), and development of metacognitive skills (Dere, 2017; Saritepeci, 2017) and 21st century skills (Akcaoglu & Koehler, 2014; Pellas & Vosinakis, 2018; Roscoe et al., 2014). In the researches, the effects of active participation among the effects of DBL environments on educational outcomes were not examined. The reason for this is thought to be due to the active participation of one of the main characteristics of the DBL environments. Participation in DBL environments positively affects the achievement of students of different learning levels (primary, secondary, high school and higher education). The use of different technology supported cognitive tools in these environments also plays a major role in ensuring participation. It was concluded that digital story creation tools (storyboardthat, powtoon, photo story), Scratch, AppInventor, Kodu, Microcontrollers, 3D printing and Tinkercad tools that were examined in the scope of this study had an effect on students' active participation and different learning outcomes.

4.5. Research question 5: What is the effect of design-based learning environments on students' metacognition in different learning topics?

Metacognition is defined as thinking of thinking. Metacognition in Turkish literature; executive cognition, metacognition, cognitive awareness. Metacognition is the awareness and control of an individual's own knowing processes (Huitt, 1997). Metacognition in learning environments is important in terms of contributing to the individual in terms of language development, self-control, writing, memory and problem solving skills, knowing which areas an individual is missing, and what his or her own experiences are in order to ensure permanence in learning (Flavell, 1979). In order to have metacognition, metacognitive knowledge and metacognitive skills are required. In order to have metacognition information, one has to know what he / she believes in, the state of the current knowledge and what kind of cognitive activities will be operated (Flavell, 1979). Metacognition skills are planning, observation, testing, correction, selection and evaluation of specific strategies (Brown, Armbruster, & Baker, 1986).

DBL environments enable students to operate their learning processes by being informed about their own learning with active participation. In these environments, students are able to organize their time management skills and cognitive knowledge as they seek solutions to problems in a limited time (Göçen, 2014). Furthermore, Göçen (2014) also states that in addition to time management, students contribute to metacognitive skills in terms of processing information, selecting main ideas, identifying study assistants, and self-testing and developing test strategies. Self-assessment and self-efficacy knowledge, which is one of the metacognition skills, is supported by DBL environments (Baki, 2015; Heo, 2009; Korkmaz, 2016; Liu et al., 2013). In the teaching of programming in DBL environments, the student develops his / her planning and organizing skills by providing information to the students about how they can structure information and develop information processing thinking skills. In addition, the product development process allows the individual to test, correct, select and evaluate specific strategies.

4.6. Research question 6: What is the effect of design-based learning environments on students' 21st century skills in different learning topics?

In line with the developing technology and changing learning needs, the skills required for the learners today are called 21st century skills. Individuals must have 21st century skills to become well-educated citizens (Wangenheim, Alves, Rodrigues, & Hauck, 2017). 21st century skills include the skills, education, attitudes and mental habits that today's students must have in order to find work in the future. In the study conducted by Sarıer (2010) using PISA data, it was concluded that the scores obtained from the exams conducted by OSYM in Turkey do not have any relation with academic achievement. In other words, although students are academically successful, they fail the exams. Sarıer (2010) thinks that this situation stems from the fact that the educational environments in Turkey are teacher-centered and the student is a passive listener. In line with this idea, it can be said that the students have memorized the information about their courses and forgot after some time after internalization and transfer. 21st century skills need to be developed to prevent such situations, to make students aware of their own learning, and to ensure transfer and persistence. 21st century skills are grouped under three main headings: learning and innovation skills, life and career skills, and information, media and technology skills, as shown in Figure 1 (Trilling & Fadel, 2009). The 11 skills collected under these headings are called the 21st century skills.

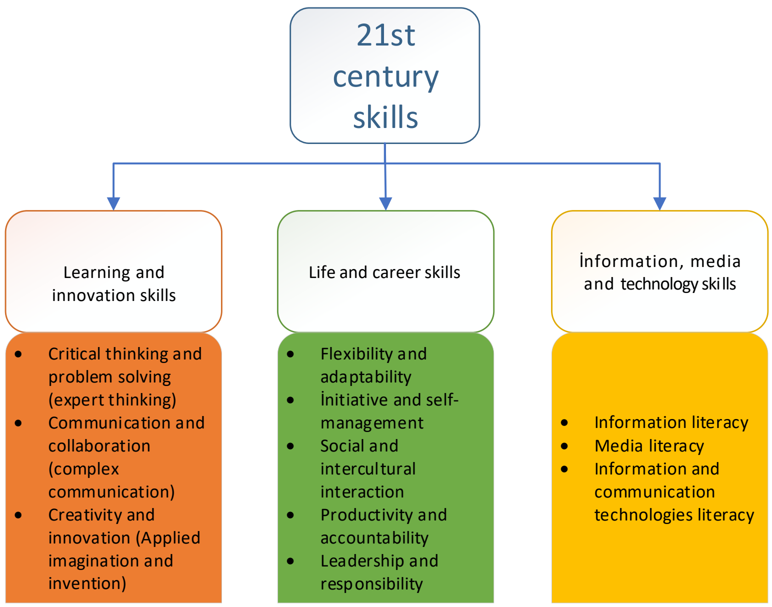

Figure 1. 21st century skills

21st century skills can be learned through problems and questions in learning environments (Trilling & Fadel, 2009). Small groups cooperative learning method, project-based learning method, problem-based learning method and DBL methods can be used in developing 21st century skills in learning environments (Bellanca, 2010; Rotherham & Willingham, 2009; Trilling & Fadel, 2009). As DBL environments provide project / problem-based learning and students are guided by the teacher during the learning process, they are one of the ideal learning environments in teaching these skills. These environments enable students to acquire learning and innovation skills, life and career skills, and information, media and technology skills.

Critical thinking, problem solving, communication and creativity skills of learning and innovation skills in DBL environments were discussed in the studies examined. Critical thinking is the ability to make explanatory and evaluative information judgments in order to decide how to behave, what to believe, and to express these information judgments verbally (Evancho, 2000). Students can make information judgments and express them with their practices in DBL environments. In this way, students' critical thinking skills are developed (Chung, 2007; Emert, 2013; Pellas & Vosinakis, 2018; Wang et al., 2017). Problem solving skills can be defined as the ability of the student to produce solutions to new problems encountered by using existing knowledge. Researches examining the effect of DBL environments on educational outcomes, it is seen that problem solving skills can be increased by means of cognitive technology supported tools (Akcaoglu, 2014; Akcaoglu & Koehler, 2014; Chun-Ming et al., 2012; Korkmaz, 2018; Kwon et al., 2012; Pellas & Vosinakis, 2018; Vatansever & Göktalay, 2018).Communication skill is the characteristic that an individual should have in order to express his / her thoughts clearly and to take part in group works. It is ensured that students' communication skills are improved through collaborative studies in DBL environments (Moreillon & Hall, 2014). The ability to creative thinking can be defined as the use of existing or new information to bring different perspectives, innovations and unconventional thoughts to different situations. (Bentley & Yıldırım, 2004). In DBL environments, students learn from their own experience, which is a requirement of constructivist learning theories. As each student's life will vary, their learning will also differ. In this learning, it is influenced by the creative ability of the students to propose solutions to the problems faced by individuals by using different tools, different scenarios, different products and different algorithms. In these environments, students develop creative thinking skills while developing products with problem-based technology-supported tools (Emert, 2013; Pellas & Vosinakis, 2018).

In the experimental and quasi-experimental studies on design-based learning environments, there is no direct research that measures life and career skills. However, studies also asserted that students can develop self-management and entrepreneurship skills through developing games (Kafai & Burke, 2015), and increase their social skills by interacting teachers and peers through collaboration activities. Also; Lewis (2011), in his research, argued that productivity could be higher than students' single work. In addition, students gain leadership skills in group work. In all of the researches, students have the responsibility skills since they develop a solution for a problem / have their own projects.

The DBL environments also contribute positively to the 21st century skills of information literacy, media literacy and information and communication technologies literacy skills. These environments contribute to information literacy through the development of reflective thinking and writing skills (Baki, 2015; Çıralı, 2014). Computational thinking skills can be defined as system design with the use of computer sciences, problem solving and revealing human behaviors (Wing, 2006). Students' computational thinking skills can be improved with the use of computer-aided tools in DBL environments (Büyükcengiz, 2017; Morelli et al., 2011; Roscoe et al., 2014).

5. Conclusions

As a result of the current study, it was concluded that DBL environments have a positive impact on many learning outcomes. However, it was observed that some learning outcomes were not included in the examined studies. In the literature, there is no experimental research about flexibility and adaptability, assertiveness and self-management, social and intercultural interaction, productivity and accountability, leadership and responsibility skills. Similarly, DBL environments have been interpreted as enabling metacognitive skills of practice, feedback and evaluation, but experimental studies are not included. In future studies, the effects of different technology supported cognitive tools not included in the research can be examined. In addition, the number of experimental and quasi-experimental studies in which different independent variables were examined was found to be low. In the same way, the number of samples was observed to be low. Increasing the number of studies and sample numbers will increase the effect size. In the studies, it was observed that evaluations were made frequently with questionnaires, success tests and scales. In the literature, very few findings have been encountered for the evaluation of the products developed by the students. Since these products are thought to have a major impact on learning outcomes, they should not be ignored in future studies.

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Using Khan Academy Mappers for Math Differentiation

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Descriptors: Khan Academy Mappers, Math,

Abstract

In the 2017-18 school year, Henderson County Schools (HCS) adopted the 1:1 student-technology policy to incorporate a blended learning environment to increase student engagement and achievement. The HCS technology team applied and won the technology grant that supplied the district with Chromebooks. During our convocation, our theme of the year was "providing differentiation through technology." HCS provided numerous professional developments for faculty that included classroom management, Google Apps for Education (GAFE), and SAMR models. These professional developments helped to learn how to integrate technology into the classroom. Therefore, the faculty was excited about the prospects of designing technology-enhanced lessons that provided differentiation within the class. However, the excitement was short-lived. During the parent-teacher conferences, there were various parents upset about the lack of differentiation within the lessons. The outrage that their children weren't academically challenged, especially in math. The math department was called in for a meeting after school to discuss some potential strategies to increase differentiation within the classroom. We were sent on more professional developments.

However, these training lacked innovated techniques to provide math differentiation above the elementary level. Also, most of the methods were already being implemented or just impractical for our class sizes. Therefore, the math department was tasked with finding instructional strategies that provided differentiation for each Rasch Unit (RIT) band of math using technology. There is a lack of professional development and low-cost web-based tools that are tailored to provide differentiation in math for a large, diverse student population. It is our responsibility as math educators to offer rigorous and practical math instruction to all students.

Every year, Kentucky students participate in the NWEA's Measure of Academic Progress (MAP's) testing for reading and mathematics. The MAP testing is usually completed in the Fall, Winter, and Spring to measure the academic growth of our students. Teachers are expected to provide intervention and differentiation for each student to achieve their growth goal. However, the traditional general classroom is comprised of twenty-five to thirty students with varying Rasch Unit (RIT) band scores. Therefore, Khan Academy (a free non-profit educational technology tool) partnered with the NWEA (creators of MAP testing) to design and personalize rigorous instruction for each RIT band in each of the tested categories on the MAP testing.

Khan Academy Mappers is a math classroom-tested instructional strategy for differentiation. This learning technology consists of instructional videos, lessons, and interactive whiteboard for students to practice math skills at their own pace. Each lesson includes four to eight rigorous problems that span from concrete based math drills to real-world application word problems. Students are encouraged to self-learn and use the resources provided to complete each lesson at 100% accuracy. Additionally, Khan Academy offers students remedial lessons to complete to activate prior knowledge if needed. Teachers are categorized as Instructional Coaches on Khan Academy and, therefore, can monitor each student and their progress on completing lessons.

Description:

The roundtable session introduces the technological tool of Khan Academy Mappers and its instructional use to differentiate math in a blended classroom environment. Khan Academy Mappers is a joint endeavor with the Northwest Evaluation Association (NWEA) that created personalize lessons that catered to each Rausch Unit (RIT) band. The discussion will provide instructional strategies and a handout detailing the steps to set-up student scores and data-tracking examples.

Background of standards:
According to the National Council of Teaching Mathematics (NCTM), the three primary principles and standards are the following:

- Equity: "Excellence in mathematics education requires equity-high expectations and strong support for all students" (NCTM, p.2, n.d.)
- Learning: "Students must learn mathematics with understanding, actively building new knowledge from experience and previous knowledge" (NCTM, p.2, n.d.)
- Technology: "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (NCTM, p.3, n.d.)
- Integrating Khan Academy Mappers ensures the standards are being implemented for all math students using the best instructional strategy to incorporate personalized lessons for each RIT band that is customized to each student's RIT scores.
- The Khan Academy Mappers aligns with the Common Core Standards and mathematical practices for each grade level. Therefore, students are completing rigorous coursework per the Common Core Standards guidelines.

Significance to teachers:
The Professional Growth Plan (PGP) is the Kentucky teacher accountability program that is used for annual evaluation. Some of the primary components on the PGP are the following:
Domain 1—Planning and Preparation: 1D- Demonstrating Knowledge of Resources.
Domain 2— Classroom Environment: 2B- Establishing a Culture of Learning.
Domain 3— Instruction: 3C- Engaging Students in Learning and 3D- Using Assessment in Instruction.
Domain 4 — Professional Responsibilities: 4A- Reflecting on Teaching and 4B-Maintaining Accurate Records.

The clusters stated above are some of the units of measurement that counts as teacher's annual evaluations. The integration of Khan Academy Mappers is a great educational tool that will aid teachers in achieving professional growth while increasing student growth scores on the measures of academic progress (MAPs) testing.

Moreover, Khan Academy Mappers provides math teachers an instructional strategy to differentiate math for different ability levels for a large classroom. Most intervention courses and programs require small group instruction.

However, Khan Academy is a technological tool that aids teachers in differentiating math instruction and provide rigorous coursework for students of multiple ability levels at the same time. Instructional time is precious, and teachers are required and expected to teach the curriculum while simultaneously personalize instruction to increase student learning outcomes. Khan Academy Mappers is a tool that will aid in the teacher's instructional design to achieve professional goals without sacrificing precious instructional time.

Domain 1—planning and preparation: 1d- demonstrating knowledge of resources
The subdomain demonstrating knowledge of resources is an easy component to reach an accomplish status by the end of the year. The subdomain requires that educators know of the available resources that can be integrated into the classrooms to increase student learning outcomes. One of the primary options to fulfill the criteria is to attend professional developments or conferences that will enhance awareness of new resources or new instructional strategies to incorporate resources in the classroom. Another option to fulfill the criteria is the effective planning of the resource to integrate into the classroom, then share the implementation and results with colleagues and parents.

Henderson County provided a technology professional development at the end of every school year. At one of the sessions, the math department chair, Stacey Hyslop, introduced Khan Academy's new beta feature Khan Academy Mappers. The tool was a cooperative endeavor from NWEA and Khan Academy to compile a lesson for each RIT band in each of the math domains for elementary and middle grades. The focus of the presentation is the introduction of a technological tool that would be useful for advanced math students that wanted to challenge themselves and increase the growth scores on the MAPs testing. Also, to provide another valuable resource for the educational tool kit.

After the session, additional research was needed to learn how to implement the resource into weekly instruction effectively and how to use the tool for students of different math abilities. The decision to use Khan Academy Mappers, the next school year as a differentiation tool to increase student growth scores, and communicating with parents about the importance of Khan Academy Mappers tool in the classroom will aid in demonstrating knowledge of the resource.

Domain 2— classroom environment: 2b- establishing a culture of learning

Teachers are held accountable for establishing a culture of learning in the classroom. Some strategies to ensure a positive learning environment is to set high expectations for students, explain the "why," and encourage parent involvement. Setting high expectations is critical for establishing a culture of learning. Students need to know what is expected of them so they can strive to achieve the goal. Also, explaining the "why" it is essential and "why" is it necessary to learn math is critical to increasing student engagement and motivation to complete the math assignments, especially for difficult concepts.

Therefore, when introducing the Khan Academy Mappers, it is essential to instill high expectations of independent thinking, critical thinking, and self-learning for students. Students need to learn how to think for themselves. Independent thinking is such a hard concept to develop. However, when students are taking the standardized test or trying to solve a problem, they need to be equipped with the problem-solving strategies that will help in making the right choice. Students will not always be told how to solve the problem, and therefore, they need critical thinking skills to identify new techniques to solve problems or find unique solutions. Also, students need to learn how they best learn a new concept. As a middle school educator, a part of the job is ensuring students are ready for the next stage in their school career. In high school and college, students will have the expectations to retain the knowledge the best way for them and are expected to transfer or apply the knowledge in everyday situations and on academic assessments.

Moreover, explaining the "why" is just as important. Students need to know why they must learn these skills. So, when introducing Khan Academy Mappers as a new formative assessment tool to complete during class and at home, it is crucial to justify the reasoning. In the Henderson County School district, students are enrolled in specific math courses based on their MAPs scores. If the goal for the student is to participate in the advance or double advance math courses, they will need to reach their growth score and score a distinguish rating on MAP testing. If the students do not want to take an extra math course as intervention, they will need to meet their growth score and grade level benchmark. So, explaining the facts to the students piques their interest in learning more about growth, benchmark, and the novice, apprentice, proficient, and distinguished scores. Also, explaining what growth means and how it works is beneficial for students to visualize their goal at the end of the school year.

As previously mentioned, setting high expectations for students is necessary for establishing a culture of learning. Therefore, giving students an arbitrary point to achieve by the Spring of the school year aids in a concrete goal for students to complete. For example, in my classroom, I tell all students that growth is six points above their Spring score. I will also tell students that the six points are divided by the three MAP tests that they take throughout the school year, so two points for Fall, two points for Winter, and two points for Spring. So, if a student previously scored a 225 in the Spring of last school year, by the Spring of the current school year, students must reach a 231. Alternatively, for the students that score higher such as a 250, their goal by the end of the Spring of the current school year is 256. Most students will gasp and start to think it is impossible. Yet, it is not. That's when I introduce Khan Academy Mappers. Letting the students know that the Khan Academy Mappers is a site that will provide personalized instruction within their focus areas will help them reach their growth goal since the NWEA that wrote the MAP testing is the same organization that helps create the Khan Academy Mappers. Try giving the scenario of basketball players need to attend and give 100% at practice, so they can play the game to win. It is the same; students will need to participate and give 100% to completing the lessons to achieve the goal during the MAP testing.

Furthermore, the Khan Academy Mappers will produce a productive struggle for the students. The lessons are personalized within their RIT bands; some of the lessons may prove to be challenging or new to the students, which is why it is crucial to encourage parent involvement. Communicating with parents about the importance of Khan Academy Mappers and providing additional resources that will help students to learn new math concepts outside of the classroom is critical for success. Students need to know that the parents and teachers are on the same page for their education to help establish the culture of learning.

Domain 3— instruction: 3c- engaging students in learning and

Integrating Khan Academy Mappers in class is an essential component for student engagement. Scheduling a block of instructional time for students to only work on Khan Academy Mappers will help in instilling the importance of Khan Academy Mappers and time for the students to work on new skills that may need some guidance from the teacher. In my classroom, every Friday during their second math block is called Khan Academy Friday. Students are in a routine to enter the class, log in to their Khan Academy accounts and start working on that nine weeks strand (1^{st} nine weeks Operations and Algebraic Thinking, 2^{nd} nine weeks Real and Complex Numbers, 3^{rd} nine weeks Geometry, and 4^{th} nine weeks are Statistics and Probability). However, the setup for students can vary with each teacher; I use this set-up as it aligns with my curriculum map, and students are all working on the same strand at the same time.

Domain 3— instruction: 3d- using assessment in instruction

Furthermore, I use Khan Academy as a formative assessment for student grades. Some students need that extra motivation for completing lessons, especially for those students that have over fifty lessons to complete within a strand due to their RIT band. So, assigning students a set of lessons to complete within the nine weeks is beneficial to prevent student shut-down. For instance, in my classroom, students are required to complete at least ten lessons each nine weeks. Favoring student choice as another engagement factor is beneficial, so I allow students to choose which ten they want to complete within that nine-week strand. To encourage students to complete additional lessons, I offer classroom rewards such as candy, extra credit, or tech time for students that complete five extra lessons, ten extra lessons, or fifteen extra lessons, respectively. The reward factor is beneficial for students that need extrinsic motivation to complete the Khan Academy Mappers.

Moreover, Khan Academy Mappers permits students and teachers to update MAP scores to gain new lessons as the students continue to improve on the MAP test. The updating feature on the Khan Academy site is beneficial to continually personalize lessons for students as they continue to grow and increase their scores on MAP testing.

Domain 4 — professional responsibilities: 4a- reflecting on teaching

Reflecting on teaching is an essential skill for every teacher. Learning and understanding what worked well in the classroom and adjusting throughout the year to lessons that need refinement are imperative. When integrating Khan Academy Mappers, it is vital to observe student behaviors, attitudes, and engagement levels to identifying each student's zone of proximal development (ZPD). The role of the teacher is to facilitate the Khan Academy Mappers, where the lessons generate productive struggle. However, if lessons are too complicated, students will become frustrated or anxious and not succeed in completing the lessons. Also, a negative connotation will be attached to Khan Academy Mappers.

Exceeding the ZPD is not the objective of Khan Academy Mappers. So, it is essential to reflect on teaching, to adjust the number of lessons, assign particular lessons that the students will need for the current grade level, adjust percentages achieved for specific lessons, or introduce or reteach strategies to help students understand the concept. For instance, I had a student that scored above grade level on the MAP test. Once the raw score for each strand was entered in Khan Academy Mappers, it generated lessons that were high school level. After careful observation, I conferenced with the student to identify some lessons that were grade level within the strand and some challenging lessons that I adjusted the percentage achieved. The strategy of reflecting on teaching was essential to identify what lessons are necessary for optimal growth in the eighth grade and which lessons will challenge the student's math abilities.

Domain 4 — professional responsibilities: 4b-maintaining accurate records.

Khan Academy Mappers does not have a teacher monitor screen unlike the regular classroom version of Khan Academy. Therefore, it is vital to maintain accurate records of student's completed lessons and students' scores on the MAP test. Having a history of students MAP scores from spring of the last academic school year, fall, winter, and spring of the current school year is critical to use as students prepare for the MAP test to know what their goal to reach, to let the teacher know if the student is succeeding, and to provide as documentation for PGP. It is easy to create a data sheet for each class using Google Docs. On Google Docs, I created a table with the title listing the class period underneath the title in the right column is a list of the student's name, the next column has the students last year's spring MAP score. The next column is the fall score, next column is the winter goal, the next column is the winter score, the next column is the spring goal score, the next column is the spring score, and the last column is the student's novice, apprentice, proficient, or distinguish level based on their spring MAP score. Figure 1 is a snapshot of a template I created to use for my classroom and that I shared with colleagues to use for their class. It is color coated to help make the document easy to read. As a result, I let the students know if they completed their growth goal through a celebration. Students that meet their goal will have the names on a poster, have their choice of soft drink, and a bag of chips. Again, reflecting on teaching at the middle school level, some students need extrinsic motivation to fulfill their potential and engage in learning.

MAP's Growth Test 19-20

Student	Spring '19	Fall	Winter Goal	Winter	Spring Goal	Spring	Rating N, A, P, D

Figure 1. MAP's Growth Test Snapshot

Furthermore, our math department chair Stacey Hyslop created a document for students to track their data and goals. The data-tracking sheet is a great resource to use for students to have a visual and a reminder of their goals that they need to achieve. The tracking sheet also encourages students to take ownership of their learning. I usually complete the top half of the sheet for the students. The bottom half displays the Khan Academy Mappers website and the strands for the fall, winter, and spring. Figure 2 displays a snapshot of the student data-tracking tool for the 2019-2020 school year with a few modifications that I made to suit my classroom and students.

8th grade Math MAP Scores 2019-2020

Math Goal	Fall	Winter	Spring
Distinguished	249-350	251-350	253-350
Proficient	230-248	233-250	235-252
Apprentice	210-229	213-232	215-234
Novice	100-209	100-212	100-214

Name: ________________________________

Spring-2019________________________________

Goal Fall(2019)__________________________

Fall-2019________________________________

Goal Winter-2020______________________

Winter-2020___________________________

Goal Spring-2020:______________________

Spring-2020____________________________

KHAN ACADEMY MAPPERS: khanacademy.org/mappers

Fall Strands: Operation and Algebraic Thinking_______

Real and Complex Numbers___________

Geometry_____________

Statistics and Probability____________

Figure 2. Snapshot of Student Data-Tracking Sheet

Khan Academy Mappers in classroom

Implementation in the classroom

Henderson County North Middle School, typical schedule is two blocks of math, two blocks of English and language arts (ELA), Cadets in Action (CIA), and two blocks of electives. Therefore, I will have three groups of students twice a day. In a typical math class, the morning session consists of daily instruction, and the afternoon session is review and practice.

After the first two weeks of school, I will gather the NWEA MAP data for each of my students and separate the data by class. Once each class is divided, I would go through the students' score sheets and write their Spring Goal. During each afternoon session, I will introduce Khan Academy Mappers and explain the "why" for completing the Mappers. Then, I would model the instructions for the students to complete. On the smartboard, I will display the Khan Academy Mappers website, and show how students will log in and put in their scores. At this step, students may start to feel overwhelmed based on how many lessons they will need to complete lessons usually range from one to one hundred and fifty. Therefore, to reduce the feeling of panic, I will assign a set amount of lessons for the students to complete each term. Usually, I will assign ten lessons (each lesson will be worth 10 points) for the entire nine weeks, and the students will have a designated day to work on during class time. Those designated days are called "Khan Academy Fridays". In addition, I assign the students the same strand to work on during the nine weeks. Khan Academy Mappers recommends for students to work on the strand that scored the lowest on first, but I like my classes to be uniformed and for the Khan Academy Mapper lessons to align with the units that I am teaching.

The Khan Academy Mappers is a formative assessment grade. Each lesson is worth ten points for a total of a hundred points. Students will have the entire nine-weeks to complete the assignments. Students have the option to stay after school one day of the week to work on the Khan Academy Mapper lessons. Students must score at least a seventy percent to obtain full points. Since the Khan Academy Mappers is still in Beta testing, the teacher can not monitor student progress on the Khan Academy Coach screen. Therefore, students must take screenshots of completed lessons, paste screenshots on a Google document, and upload the Google document to Google Classroom for submission. Students are rewarded for completing additional lessons. For every five other lessons students complete they will receive PBIS points and candy, for every ten other points students will earn three extra credit points on lowest formative assessment, and if the student completes fifteen or more additional lessons, they will receive ten minutes of tech time during the afternoon session of math class.

As illustrated in table one, units and the timeframe for every nine weeks are listed with the corresponding strand. Some strands will occasionally overlap with some of the other units, but the majority are aligned. One of the major units in eighth-grade math is the slope. The slope is practice in operations and algebraic thinking strand, so it is a great conversation starter and introduction to the slope. Students that practice slope during the operations and algebraic strand typically develop an understanding of how to identify and calculate slope on a concrete level. Thus, the group of students that complete slope lessons, have fewer difficulties during the slope unit and most likely become peer tutors throughout the unit. However, it is necessary to practice geometry during the third nine weeks since the KPREP is completed during the fourth nine weeks, and geometry is one of the primary math strands tested.

Table 1.

Eighth Grade Math Curriculum Map		
Nine Weeks	Thematic Units	Khan Academy Mappers Strand
First Nine Weeks August through October (before fall break)	Unit 1: Exponents Unit 2: Rational and Irrational Numbers Unit 3: Solving Equations (first half)	Operations and Algebraic Thinking Students complete ten lessons of their choosing from this strand.
Second Nine Weeks October (after fall break) through December	Unit 3: Solving Equations (second half) Unit 4: Volume Unit 5: Slope	Real and Complex Numbers Students complete ten lessons of their choosing from this strand.

Third Nine Weeks January through March	Unit 6: Pythagorean Theorem Unit 7: Systems of Equations Unit 8: Functions Unit 9: Scatterplots	Geometry Students complete ten lessons of their choosing from this strand.
Fourth Nine Weeks April through May	Unit 10: Transformations Unit 11: Angles	Statistics and Probability Students complete ten lessons of their choosing from this strand.

MAP correlation to KPREP

A significant factor for teachers and students is to understand the MAP score correlation with the KPREP. The NWEA website offers multiple tables to display various types of correlations. The correlation that I print out for each of my students and review are the KPREP scores and the spring MAP scores. Therefore, starting with the end in mind, the students will identify their goal for KPREP and the score they will need to achieve on the spring MAP test to ensure that they are on the right track. Figure 3 shows the correlation tables of the KPREP scores and percentiles with the corresponding spring MAP testing scores.

Grade	**K-PREP**			
	Level 1 *Novice*	Level 2 *Apprentice*	Level 3 *Proficient*	Level 4 *Distinguished*
3	100-191	192-209	**210**-233	234-300
4	100-193	194-209	**210**-228	229-300
5	100-191	192-209	**210**-228	229-300
6	100-190	191-209	**210**-230	231-300
7	100-191	192-209	**210**-230	231-300
8	100-191	192-209	**210**-231	232-300

Grade	MAP							
	Level 1 *Novice*		Level 2 *Apprentice*		Level 3 *Proficient*		Level 4 *Distinguished*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-191	1-19	192-204	20-53	**205**-217	54-84	218-350	85-99
4	100-198	1-15	199-212	16-47	**213**-225	48-78	226-350	79-99
5	100-202	1-12	203-220	13-47	**221**-235	48-80	236-350	81-99
6	100-205	1-11	206-223	12-45	**224**-238	46-78	239-350	79-99
7	100-212	1-18	213-230	19-54	**231**-245	55-83	246-350	84-99
8	100-214	1-19	215-234	20-57	**235**-252	58-87	253-350	88-99

Notes. 1. %ile=percentile.
2. Bolded numbers indicate the cut scores considered to be at least "proficient" for accountability purposes.

Figure 1. Correlation of KPREP and spring MAP scores (NWEA, 2017)

Another exciting factor that teachers can use as a method of reflection and aid in completing the mid-reflection is the correlation tables of the KPREP scores and the fall and winter MAP scores. Our school district, MAP test in the fall, winter, and spring. Therefore, the added piece of data is beneficial to identify students are falling behind, on-track, or exceeding the expected goals. Figure 4 is a great conference and communication tool to use with students one-on-one to encourage students to keep working hard or to identify the potential areas and strategies that students may need additional guidance.

Grade	K-PREP Level 1 Novice	Level 2 Apprentice	Level 3 Proficient	Level 4 Distinguished
3	100-197	198-209	**210**-225	226-300
4	100-196	197-209	**210**-226	227-300
5	100-197	198-209	**210**-225	226-300
6	100-198	199-209	**210**-226	227-300
7	100-198	199-209	**210**-225	226-300
8	100-198	199-209	**210**-224	225-300

Grade	MAP FALL							
	Level 1 *Novice*		Level 2 *Apprentice*		Level 3 *Proficient*		Level 4 *Distinguished*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-178	1-26	179-190	27-55	**191**-202	56-81	203-350	82-99
4	100-187	1-24	188-199	25-53	**200**-213	54-83	214-350	84-99
5	100-193	1-21	194-206	22-52	**207**-221	53-85	222-350	86-99
6	100-200	1-24	201-210	25-48	**211**-225	49-83	226-350	84-99
7	100-203	1-23	204-214	24-50	**215**-228	51-82	229-350	83-99
8	100-208	1-28	209-220	29-58	**221**-234	59-86	235-350	87-99

Grade	MAP WINTER							
	Level 1 *Novice*		Level 2 *Apprentice*		Level 3 *Proficient*		Level 4 *Distinguished*	
	RIT	%ile	RIT	%ile	RIT	%ile	RIT	%ile
3	100-186	1-27	187-197	28-54	**198**-208	55-80	209-350	81-99
4	100-193	1-24	194-205	25-55	**206**-218	56-84	219-350	85-99
5	100-198	1-21	199-210	22-51	**211**-224	52-84	225-350	85-99
6	100-204	1-25	205-213	26-48	**214**-227	49-81	228-350	82-99
7	100-206	1-24	207-217	25-51	**218**-229	52-79	230-350	80-99
8	100-211	1-31	212-221	32-56	**222**-235	57-85	236-350	86-99

Notes. 1. %ile=percentile.
2. Bolded numbers indicate the cut scores considered to be at least "proficient" for accountability purposes.

Figure 2. Correlation of KPREP and fall and winter MAP scores (NWEA, 2017)

Results

Khan Academy Mappers provided differentiation to all students on various RIT levels. Parents were satisfied with the level of rigor that the students were practicing math at home and in the classroom. The students were motivated to gain new skills that increased their MAP scores and understanding of math concepts.

Also, Khan Academy provided the flexibility of updating the student's scores after each MAP test to allow students to continue to improve their MAP scores. At the end of the year, most of the students surpassed their goal and growth score on the spring MAP testing. The effective use of Khan Academy Mappers differentiation narrowed the achievement gap within the school district.

During the fall of the 2018-19 school year, KPREP scores were released, and the math department was praised in the increase test scores of the students. The HCS middle school math scores were 8th in the state with a score of 66.3, which surpasses the state average of 47 by 19.3 points.

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Using Social Network Analysis to Review the Research in Open and Distance Learning

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Abstract

This study presents a social network analysis of the keywords attached to articles published in the Turkish Online Journal of Distance Education (TOJDE), a prominent journal in the field of open and distance learning. The social network analysis applied was based on a data mining and analytics approach. A total of 1120 keywords from 784 selected articles constituted the sample of the study. The keyword analysis revealed that the articles published in the TOJDE largely focused on technology-related issues, suggesting that the issues related to educational technology are a popular research area. However, the analysis also found that there was an imbalance between educational technology-related topics and pedagogy-related topics, a critical issue that needs to be further considered.

Introduction

For any discipline, it is important to understand the empirical evidence that has been gathered to realize its origin and future direction. Past experiences and empirical contributions are helpful in providing a sense of the continuum from the past to the present and the future. From this point of view, researchers in the field need to analyze and synthesize research trends to gain a better vision for future implications. Moreover, it is crucial to define the research areas of distance education and to fill the content of these areas with scholarly works and research-based evidence. Guided by this understanding, this paper aims to explore patterns by conducting a social network analysis of the keywords in articles published between 2000 and 2015.

According to Bozkurt and Akgun-Ozbek (2015), identifying research patterns is a critical task, insofar as these patterns can serve as a guide to researchers in the field. In this regard, much research has examined the scholarly landscape in the field of distance education from a global perspective (Amoozegar, Khodabandelou, & Ale Ebrahim, 2018; Berge & Mrozowski, 2001; Bozkurt et al., 2015; Çakiroğlu, Kokoç, Gökoğlu, Öztürk, & Erdoğdu, 2019; Hauser, 2013; Koble & Bunker, 1997; Lee, Driscoll, & Nelson, 2004; Orellana & Nethi, 2019; Rourke & Szabo, 2002; Tuncay & Uzunboylu, 2010; Wong, Zeng, & Ho, 2016; Zawacki-Richter & Naidu, 2016; Zawacki-Richter, Alturki, & Aldraiweesh, 2017; Zawacki-Richter, Bäcker, &Vogt, 2009; Weller, Jordan, DeVries, & Rolfe, 2018) as well as from local perspectives (Asdaque & Rizvi, 2019; Asdaque, Rizvi, Jumani, & Ahmed, 2018; Bozkurt et al., 2015; Durak et al., 2017; Gökmen et al., 2017; Horzum, Özkaya, Demirci, & Alpaslan, 2013; Panda, 1992; De Olivera Neto, & dos Santos, 2010; Ritzhaupt, Stewart, Smith, & Barron, 2010). To note, similar to the aim of this study, there have been two previous studies conducted that have analyzed the research trends in TOJDE. The overall objective of these other studies was to identify the research trends in TOJDE over a specific period.

In the first of these studies cited as being similar to the present, Latchem (2009) conducted a content analysis of the Notes for Editors and the articles published in the TOJDE between 2000 and 2008. The analysis involved determining the articles' countries of origin, the sectors represented, and the focus and frequency of the topics covered. It was reported that the majority of articles originated from Asian countries, with Turkey providing the largest number of contributions. There were also many papers from the Middle East, Africa, South America, the USA, Eastern and Western Europe, and Australia. According to Latchem, some of the papers that presented non-Western perspectives were particularly illuminating. The earlier articles tended to be descriptive or theoretical, while more recent ones examined distance education and elearning needs, policies, procedures, practices and outcomes through a quantitative-experimental and qualitative-descriptive lens. The second of these two similar studies, which was conducted by Özarslan, Balaban-Sali and Demiray (2012), involved analysis of the articles in TOJDE published between 2000 and 2010, where the focus was on research topics, methods, instruments, statistical methods, author numbers and their institutional affiliation. They reported that single-author articles constituted the most substantial proportion of TOJDE articles. It was also indicated that Turkey, the USA, India, Nigeria, Malaysia, Pakistan, Australia, Canada, the UK, Bangladesh, Greece, and Iran, respectively, were the chief contributors to TOJDE. In addition, the researchers identified research topics covered in TOJDE articles. Accordingly, (1) Learner and instructor experiences in online learning environments; (2) information about the system and program; (3) the economic, social and cultural dimension of distance education, and (4) pedagogical, political, philosophical, legal, ethical reflections in distance education were the top four research topics addressed in TOJDE. In terms of method, it was found that quantitative studies far outweighed the qualitative and mixed studies. The study further revealed that document analysis was the most frequently used research instrument, which was followed by surveys, scales and interviews. In terms of data-analysis methods, descriptive statistics, content analysis, variance analysis and t-test were reported to be the most frequently used analysis methods.

Methodology

Research design

The present study is a review study that has aimed to examine (1) keywords of articles and (2) the publication network in cited references in articles published in the TOJDE. To conduct this review, social network analysis, a data mining and analytics approach, was applied to arrive at a synthesis.

Social Network analysis

Social network analysis provides a powerful way to map, summarize, and visualize networks and to identify critical nodes that occupy strategic locations and positions within the matrix of links (Hansen, Shneiderman, & Smith, 2010; Scott, 1988). In this research, a social network analysis was used to examine the patterns that emerge from the keywords in selected articles published in the TOJDE.

Sample: Articles published in TOJDE

TOJDE is an open access journal published by Anadolu University in Eskisehir, Turkey. For this study, all the articles published in the TOJDE between 2000 and 2015 were surveyed (N=784) (Table 1). Book reviews and editorials were excluded from the sample.

Table 1. Number of articles published per year in the TOJDE (Volumes 1-16)

Year	No. of issues	No. of articles	Year	No. of issues	No. of articles
2000	2	12	2008	4	54
2001	2	6	2009	4	57
2002	4	27	2010	4	51
2003	4	23	2011	4	71
2004	4	34	2012	4	90
2005	4	37	2013	4	93
2006	4	56	2014	4	75
2007	4	51	2015	4	47
Total					**784**

Limitations

First and foremost, since this study analyzed only those articles published in the TOJDE, it provides but a partial view. Hence, the findings derived from this study should be considered as complementary to those from other studies and be used for purposes of comparison and contrast. Second, though Open and Distance Learning (ODL) and Distance Education are terms similar in scope, they each have important unique features. However, throughout the research, these terms were used interchangeably due to the fact that their distinction was not so clear in the articles published in the TOJDE.

Findings

The analysis revealed there to be a total of 1120 keywords. The top 150 keywords with a minimum frequency of two are provided in Table 2. Descriptive statistics were used to provide insight into the current state of TOJDE publications.

Table 2. List of the most frequently used keywords in articles published in the TOJDE between 2000 and 2015.

#	Keyword	*f*	%	#	Keyword	*f*	%
1	Distance Education	175	15.6	76	Student	4	0.4
2	E-learning	75	6.7	77	Student Support Services	4	0.4
3	Distance Learning	45	4.0	78	Students	4	0.4
4	Online Learning	32	2.9	79	Teachers	4	0.4
5	Higher Education	28	2.5	80	Television	4	0.4
6	Blended Learning	22	2.0	81	Training	4	0.4
7	Internet	19	1.7	82	Virtual Classroom	4	0.4
8	Education	18	1.6	83	Adult Learners	3	0.3
9	Open And Distance Learning	22	2.0	84	Australia	3	0.3
10	Turkey	15	1.3	85	Blogging	3	0.3
11	Evaluation	14	1.3	86	Blogs	3	0.3
12	Learning	14	1.3	87	Challenges	3	0.3
13	Mobile Learning	19	1.7	88	Computer Anxiety	3	0.3
14	Technology	13	1.2	89	Cooperative Learning	3	0.3
15	Attitude	11	1.0	90	Critical Thinking	3	0.3
16	Online Education	11	1.0	91	Curriculum	3	0.3
17	Web 2.0	11	1.0	92	Digital Natives	3	0.3
18	Assessment	10	0.9	93	EFL Learning	3	0.3
19	Web-based Learning	10	0.9	94	Educational Technologies	3	0.3
20	Instructional Design	9	0.8	95	English Language Teaching	3	0.3
21	Teacher Training	9	0.8	96	Faculty	3	0.3
22	Interaction	8	0.7	97	Faculty Development	3	0.3
23	Learner Support	8	0.7	98	Flexible Learning	3	0.3
24	Multimedia	8	0.7	99	Gender	3	0.3
25	Online	8	0.7	100	Hellenic Open University	3	0.3
26	Professional Development	8	0.7	101	Individual Differences	3	0.3
27	Teacher Education	8	0.7	102	Information	3	0.3
28	Allama Iqbal Open University	7	0.6	103	Instructional Technology	3	0.3
29	Attitudes	7	0.6	104	Internet-based Education	3	0.3
30	Collaboration	7	0.6	105	Knowledge Management	3	0.3
31	Collaborative Learning	7	0.6	106	Language Learning	3	0.3
32	Globalization	7	0.6	107	Learning Environments	3	0.3
33	Learning Management System	7	0.6	108	Lifelong Learning	3	0.3
34	Learning Styles	7	0.6	109	Management	3	0.3
35	Open And Distance Education	7	0.6	110	Material	3	0.3
36	Perception	7	0.6	111	Mathematics Education	3	0.3
37	Anadolu University	6	0.5	112	Mobile	3	0.3
38	Blog	6	0.5	113	Nursing	3	0.3
39	Constructivism	6	0.5	114	Online Courses	3	0.3
40	Educational Technology	6	0.5	115	Online Instruction	3	0.3
41	Information Technology	6	0.5	116	Online Professional Development	3	0.3
42	Motivation	6	0.5	117	Pedagogy	3	0.3
43	Quality	6	0.5	118	Perceptions	3	0.3
44	Satisfaction	6	0.5	119	Physics Education	3	0.3
45	Student Satisfaction	6	0.5	120	Problem Solving	3	0.3
46	Academic Achievement	5	0.4	121	Quality Education	3	0.3
47	BOU	5	0.4	122	Science	3	0.3
48	Development	5	0.4	123	Skills	3	0.3
49	Distance Learners	5	0.4	124	Student Achievement	3	0.3
50	Facebook	5	0.4	125	Sustainability	3	0.3
51	Moodle	5	0.4	126	Teaching	3	0.3
52	Open Education Faculty	5	0.4	127	The Internet	3	0.3
53	Open Learning	5	0.4	128	Virtual Environments	3	0.3
54	Participation	5	0.4	129	Virtual Worlds	3	0.3
55	Social Networking	5	0.4	130	Web Based Learning	3	0.3
56	Teaching Practice	5	0.4	131	Web-based Education	3	0.3
57	Weblog	5	0.4	132	Women	3	0.3
58	Basic Psychological Needs Theory	4	0.4	133	Zimbabwe Open University	3	0.3
59	Blog And Social Network	4	0.4	134	AIOU	2	0.2
60	Certificate Program	4	0.4	135	Academic Performance	2	0.2
61	Communication	4	0.4	136	Access	2	0.2
62	Connectivism	4	0.4	137	Achievement	2	0.2
63	Culture	4	0.4	138	Achievement Motivation	2	0.2
64	Innovation	4	0.4	139	Adult Learning	2	0.2
65	Internet-based Learning	4	0.4	140	Africa	2	0.2
66	Learning Environment	4	0.4	141	Assignment	2	0.2
67	Malaysia	4	0.4	142	Assignments	2	0.2
68	Open Education	4	0.4	143	Audio	2	0.2
69	Physical Education	4	0.4	144	Awareness	2	0.2
70	Qualitative Research	4	0.4	145	B.Ed Programme	2	0.2
71	Second Life	4	0.4	146	Bangladesh	2	0.2
72	Self-efficacy	4	0.4	147	Barriers	2	0.2
73	Self-regulated Learning	4	0.4	148	Belief	2	0.2
74	Social Media	4	0.4	149	Benefits	2	0.2
75	Social Presence	4	0.4	150	Cognitive Load	2	0.2

For instance, in Table 2, it shows that following *Distance Education*, learning-oriented keywords (e.g., *elearning* [#2], *distance learning* [#3], *online learning* [#4], *blended learning* [#6], *open and distance learning* [#9], *mobile learning* [#13], *web-based learning* [#19], etc.) occupy the upper part of the list. Another interesting finding from the list is the institutional affiliations related to the territorial information used as keywords in reference to the physical context of the papers published in the TOJDE; these keywords include *Allama Iqbal Open University* (#28), *Anadolu University* (#37), *Hellenic Open University* (#100), and *Zimbabwe Open University* (#133), as well as the keywords referring to the country itself, such as *Turkey* (#10), *Malaysia* (#67), *Australia* (#84), *Africa* (#140), and *Bangladesh* (#146). Consistent with the observations made by Latchem (2009) and Özarslan, Balaban-Salı and Demiray (2012) in their studies, the descriptive information gives the impression that TOJDE is a local and global voice for the field, particularly for those from Asia and Africa.

In order to better understand the research patterns in the articles published in the TOJDE, a social network analysis based on keywords used in each article was conducted. In this research, keywords were identified as nodes, while their relationships, which were based on co-occurrence, were identified as ties. Of the 1120 keywords examined, a total of 130 that had a minimum co-occurrence of three were identified. From this identification, a visual of the keyword network was created. The network graph created represents 130 nodes with 499 ties among them. (Figure 1). The nodes in the network were grouped using the Clauset-Newman-Moore cluster algorithm, and the Grid layout algorithm was used to lay out the graph.

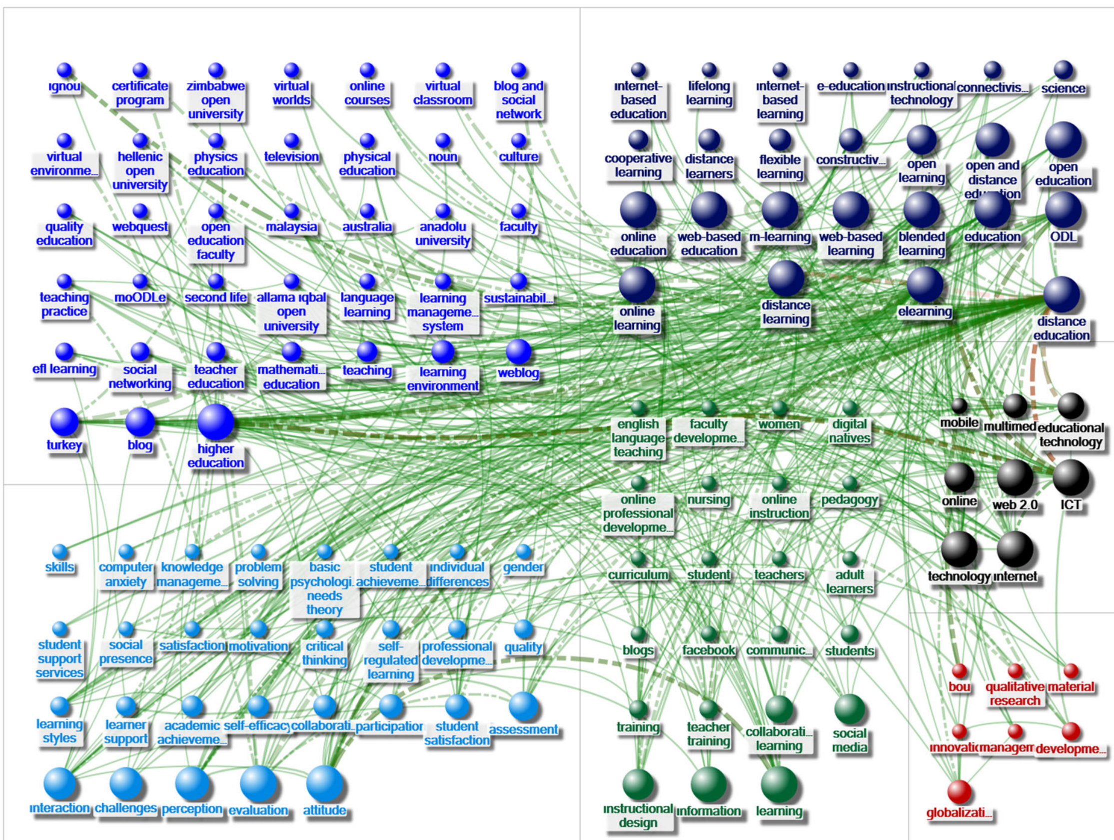

Figure 1. Social network analysis of the keywords used in the articles published in theTOJDE between 2000 and 2015

The analysis was based on betweenness centrality, which demonstrates both the bridging score of the nodes and their strategic position. Unsurprisingly, distance education emerged as the central node and was found to be strongly linked to elearning, higher education, Internet, distance learning, technology, ICT, and online learning (Table 3). One of the most salient findings from the social network analysis conducted was the tendency towards excessive dependency of distance education on “technology-based” practices (e.g., Internet, technology, and ICT) (see Figure 1 and Table 3).

Table 3. The nodes with high betweenness centrality scores

Node	Degree	Betweenness Centrality
Distance Education	81	3502.0
elearning	50	1442.2
Higher Education	28	564.2
Internet	22	391.0
Distance Learning	30	390.5
Technology	26	332.2
ICT	29	318.0
Online Learning	25	307.3

Following the investigation of the nodes, the ties among the nodes were examined according to their weights (Table 4). In confirmation of the results of the betweenness centrality analysis, the strongest relationship appeared to be between *distance education* and *elearning*. This was followed by *distance education* and *ICT,* which was expected considering the growing influence of technological developments and capacity increase due to the opportunities provided by ICTs. Similarly, *distance learning* and *elearning*; *distance education* and *educational technology*; *higher education* and *ICT,* and, lastly, *elearning* and *ICT* emerged as significant links. Overall, the weights of the links showed that distance education has established strong bonds with online practices and educational technology, with a focus on higher education.

Table 4. The relationship of the keywords with high weight scores.

Node 1	Node 2	Weight
Distance Education	eLearning	21.83
Distance Education	ICT	13.67
Distance Learning	elearning	10.67
Distance Education	Educational Technology	9.00
Higher Education	ICT	7.00
elearning	ICT	5.83

The findings from this study indicate that open and distance learning has evolved into a digital form, with a growing interest shown to online modes of delivery (see Table 3). This confirms earlier studies reporting that online learning, or elearning, has become the new normal for open and distance learning (Amoozegar, et al., 2018; Weller et al., 2018; Wong et al., 2016) and is in line with the study by Çakiroğlu et al.(2019), who claimed that "new pedagogical approaches and online learning designs have played a triggering role in research topics" (p. 1). Another interesting finding from this study is the strong relationship between ICT and distance education practices (see Table 4). This, as expected, stems from the accessibility opportunities provided by ICT (Çakiroğlu et al., 2019; Lee, 2017), which provides learners flexible, open, online learning options that help to facilitate and increase learners' independence and autonomy (Harasim, 2000; Canadian Council on Learning, 2009). While there have been many opportunities that have emerged with ICT, and these opportunities have led the way for online learning and elearning, Lee (2017) highlighted that pedagogic developments and technological development have not advanced in an equal manner. The findings from this study also partly confirm those reported by Lee (2017), insofar as they demonstrated that pedagogic keywords neither hold secondary positions (Table 2) nor have lower betweenness centrality metrics (Figure 1). This may derive from the marketing potentials of online learning / elearning practices (Harting & Erthal, 2005) and from the conflict between for- profit, commercial ambitions and the core values of open and distance learning (Evans & Pauling, 2010). However, it should be noted that the interpretation of these findings was derived from the analysis of only one journal and thereby provides only a partial view of the current state of open and distance learning. These findings should, therefore, be validated in future research.

Conclusions

With the aim of identifying patterns in the keyword network, this study examined articles published between 2000 and 2015 in the TOJDE. The findings show that TOJDE reflects research from local (e.g., Anadolu University) and global perspectives, where in the case of the latter, the focus is on specific characteristics of regional practices. This is thought to be promising in terms of providing diverse points of view and representing a territorially broad voice for this field.

Another intriguing finding from the study is the growing influence and dominance of technology-based practices. This is thought to be significant in terms of tracking trends in the field of distance education through regional journals such as TOJDE and of providing a complementary view by comparing results of similar studies. However, as discussed in the previous section, the pedagogical topics seem to be under the lure of technology-related research topics (e.g., ICT, elearning, online learning, etc.), a situation that could create a future bottleneck in the field.

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Assessing the Effectiveness of an Intelligent Tool that Supports Targeted Teacher Responses to Student Ideas

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Abstract

This paper reports on the design and development of an intelligent, natural language processing tool, the Teacher Responding Tool (TRT), that provides response recommendations to teachers to foster consistent, content-specific feedback based on student cognition. Placing student ideas at the center of instructional decisions promotes equitable teaching. Results indicate that the TRT selected accurate recommendations and that the interface promoted the teachers' thoughtful consideration of these recommendations. Future design recommendations are provided.

Introduction

Research in teacher education shows that placing student ideas at the center of instructional decisions is critical for promoting equitable student participation, achievement, and agency (NCTM, 2014). However, responding to students in the moment is complex. First, teachers must infer the current understanding of the student (Coffey, Hammer, Levin, & Grant, 2011). Second, teachers must prioritize which understandings to focus on for the sake of the student, the class, and the intended learning goals (Ball, 1993). Third, the delivery of the response must be student-specific, be given in manageable chunks, do more than highlight errors, and avoid comparisons with other students (Shute, 2008). Finally, teachers should ask questions that support further student discourse (Chapin, O'Conner, & Anderson, 2009).

Given this complexity, providing teachers with opportunities to develop these skills is important, and there have been calls to develop a variety of "approximations of practice" (Grossman, Compton, et al., 2009). This paper describes the design and development of an intelligent tool to scaffold teachers' skills at giving high quality, student specific feedback. The Teacher Responding Tool (TRT) is a natural language processing (NLP) tool grounded in design principles for worked examples and developing thinking skills (Clark & Mayer, 2016) that provides recommendations to support teachers while they respond to students. The TRT builds upon research with technologies that automatically respond directly to students (Aleven & Koedinger, 2002) and that provide teachers with insight into student thinking (McDonald, Bird, Zouaq, & Moskal, 2017).

Theoretical Framework

This study is informed by instructional design principles aligned with the cognitive theory of multimedia learning (Mayer, 2014). These research-based principles describe how to design for learning in contexts that involve text and images. While our design is text-based, the assumptions of this theory and many of the design principles that follow from it guided our design. For example, this study is aligned with the assumptions that learners have a limited capacity to process information, and that learners engage in active processing via selecting, organizing, and integrating text. We build upon those design principles that suggest limiting extraneous material, adding cues and highlights, using worked examples, and focusing on authentic job-relevant thinking skills (Clark & Mayer, 2016).

Design of the Teacher Responding Tool (TRT)

The TRT system consists of three interacting sub-systems: the training dataset creation sub-system, the natural language processing (NLP) recommendation engine sub-system, and the user interface sub-system. The TRT system is designed to be implemented within authentic learning contexts. To set-up the system for a given learning context, two steps need to be taken. First, the training dataset needs to be created and then used to train the NLP recommendation engine. The training dataset is created by consulting with the teacher users and collecting their prior or suggested responses to prior student explanations for the given context. Second, the TRT needs to be connected to the learning management system that the students will be using so that it can pull new student explanations after they have been written and push teacher responses back to students. When the TRT is in use, new student explanations are pulled from the learning management system and used to select feedback recommendations. The recommendations are presented to teachers via the user interface, and the teacher response is then made available to the students by pushing these responses to the learning management system. The TRT system is designed to include teachers into the feedback process and requires teacher user interaction. As such it is intentional that this system does not provide instantaneous feedback to students. Figure 1 illustrates the subsystems and overall system flow.

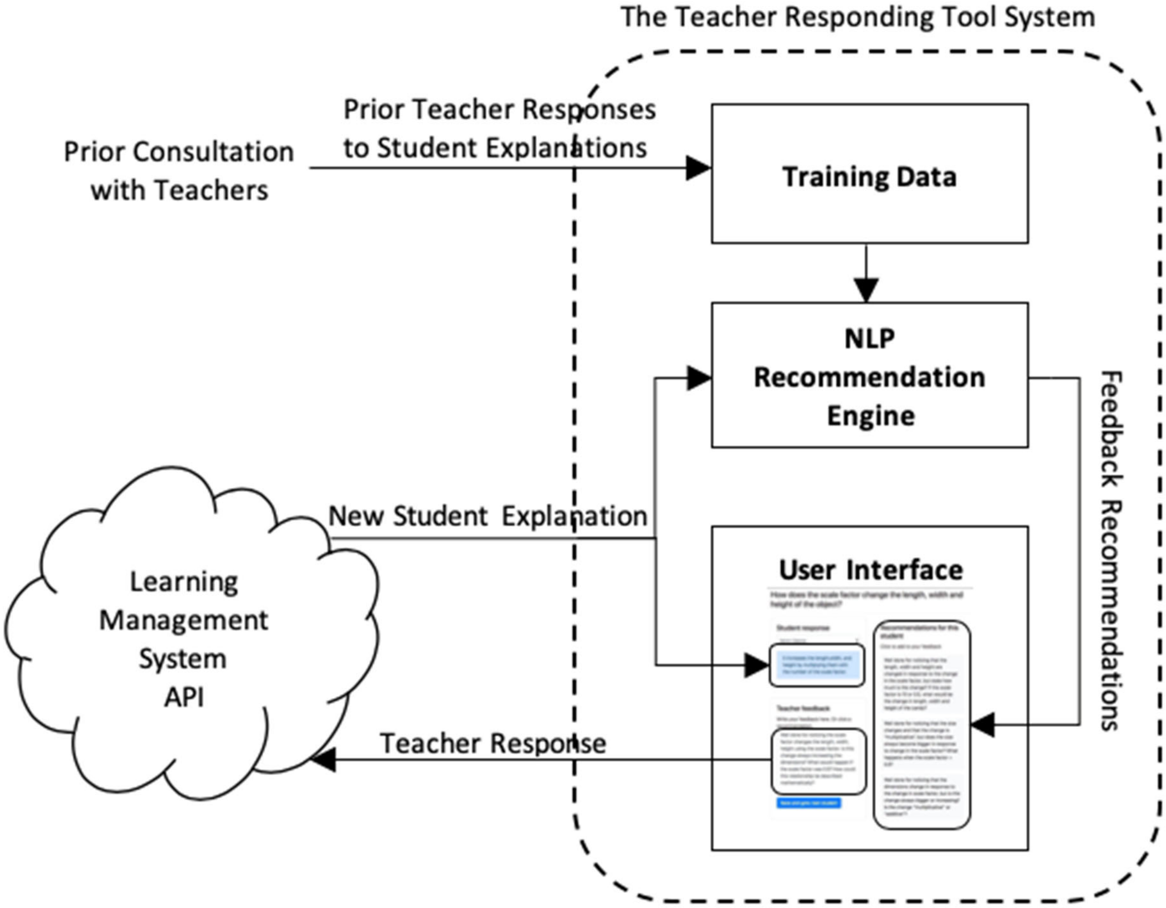

Figure 1. The Teacher Responding Tool (TRT) system.

Training data subsystem

Training data creation should aim to use authentic student explanations. In our study we began with student explanations collected during a prior implantation of the project within the same context (i.e. same school, same course, similar student population). The teacher responses were created by: first, consulting with the teachers about how they would respond to each of the student explanations; second, drawing upon research finding for how to best provide formative feedback; and third, drawing upon researcher expertise to standardize the responses. This led to a training dataset consisting of pairs of student explanation and teacher response written in natural language text. Table 1 shows the first few records of training data used for one of the questions in this study. A different training dataset needs to be created for each question prompt.

Table 1. A sample of the 116 student explanation and teacher response pairs in the training dataset for the question prompt: “How does the scale factor change the length, width and height of the object?”

Student Explanation	Teacher Response
It gets bigger	Well done for noticing that there is a change, but what is “it”? Is the change always larger? What happens when the scale factor is 10 or 0.5?
It makes the size bigger. the scale factor times by the scale	Well done for noticing that the dimensions change in response to the change in scale factor and that change is "multiplicative", but is this change always bigger or increasing?

It multiplies the original length by the number of scale factor.	Well done for noticing that the length changes in response to the change in the scale factor and that the change is “multiplicative”, but what about the other dimensions – width and height?
Length and width and height multiplied by the 3	Well done for noticing that the dimensions changes and that the change is "multiplicative", but what change in the scale factor causes these changes? What happens to the dimensions when the scale factor is 0.5?
The bigger the scale factor the bigger the dimensions get.	Well done for noticing that the dimensions become bigger as the scale factor becomes bigger, but what happens when the scale factor is made smaller rather than bigger?
The new measurements are way higher than the old measurements, its shape has increased.	Well done for noticing that the size changes, but does the size always increase in response to change in the scale factor? What happens when the scale factor = 0.5? What is "it"? Expand on your answer.

We developed training datasets for each question that were on average about 100 records (pairs of student explanation and teacher response) long. Generally, larger datasets are known to improve the recommendation engine performance. However, factors such as the generality the question being asked and the number of different recommendations to choose from also impact how large the training dataset should be (Burrows, Gurevych, & Stein, 2015; Zehner, Sälzer, & Goldhammer, 2016). At the same time, the advantages of larger datasets are offset by the time and cost involved in creating them. Based on these considerations, we concluded that about 100 records represented a reasonable dataset size.

NLP recommendations engine subsystem

The NLP recommendation engine consists of two components: the preprocessing of student explanations, and a tf-idf (term frequency-inverse document frequency) model (see Figure 2). The recommendation engine is initialized using the training dataset. Each of the student explanations in the training dataset are preprocessed and then used to build the tf-idf model. The recommendation engine is used by querying the model with new student explanations that have been preprocessed in the same way, and the recommendations selected are outputted.

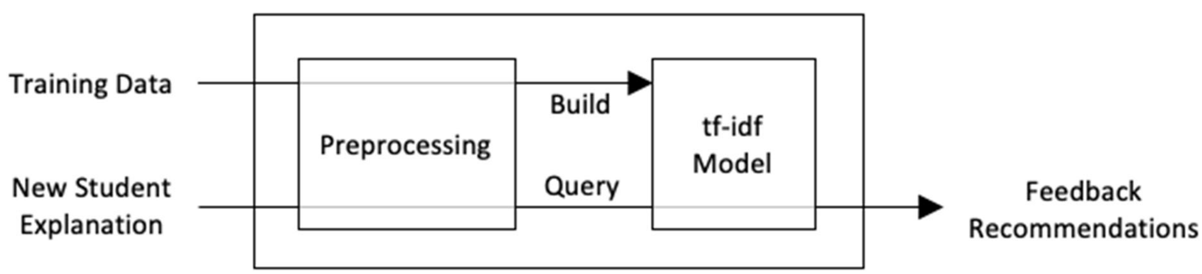

Figure 2. The natural language processing (NLP) recommendations engine subsystem.

Preprocessing involves separating a student explanation into individual words (tokenizing) and then applying automatic spelling correction to each word. Each word is then converted to its stem, so that words like “increases,” “increasing,” and “increased” all become “increase.” Finally, common high frequency words, or stop words, such as “a,” “the,” and “at” are removed. Tokenizing and stemming are performed using the Python *nltk* package, the spelling correction is performed using the Python *autocorrect* package, and the stop word list included in the Python *sklearn* package is used.

The model is built by creating vector representations of each preprocessed student explanation. Weights for each word are determined using tf-idf (term frequency-inverse document frequency) which assigns higher weights to words that occur less often in the training dataset (Zehner, Sälzer, & Goldhammer, 2016). The model is queried by finding how similar a new student explanation is when compared to each of the training dataset student explanations. Similarity is determined using cosine similarity, i.e. the cosine of the angle between vector representations of student explanations. The teacher feedback in the training dataset that corresponds to the student explanations that are most similar to the new student explanation are then examined and the top three unique teacher feedback responses are selected as the recommendations. The model building and querying was performed using *TfidfVectorizer* within the Python *sklearn* package.

User interface subsystem

The TRT user interface is an interactive webpage that presents teachers with the question prompt, the student explanation, and a teacher-response field (see Figure 3). The three TRT-recommended responses are shown in a column on the right side of the screen. When mouse-clicked, the text of the recommendation is copied to the teacher-response field, and any text in the teacher-response field can be edited. This allows teachers to use the recommendations without making changes, customize a recommendation, take parts of different recommendations, or ignore the recommendations and write their own response.

The layout of the user interface was designed to reduce the extraneous cognitive load that result from navigating the page, allowing the teachers to focus their working memory on considering of the recommendations. Recommendations were presented near to the student explanations, no scrolling was needed to navigate the page, clicking recommendations copy-and-pasted the text, and important text was subtly highlighted.

The decision to present three recommendations was based on a trade-off between providing teachers with enough recommendations to promote the thoughtful consideration of different perspectives, but not too many so as to make the cognitive load of the task high and overwhelming. For each recommendation, teachers were expected to read the text, consider it in relation to the student explanation, and compare it with other recommendations. From this perspective, and considering the length of the text of the recommendations, four recommendations were considered by the designer to be the upper limit, two a lower limit, so three were chosen.

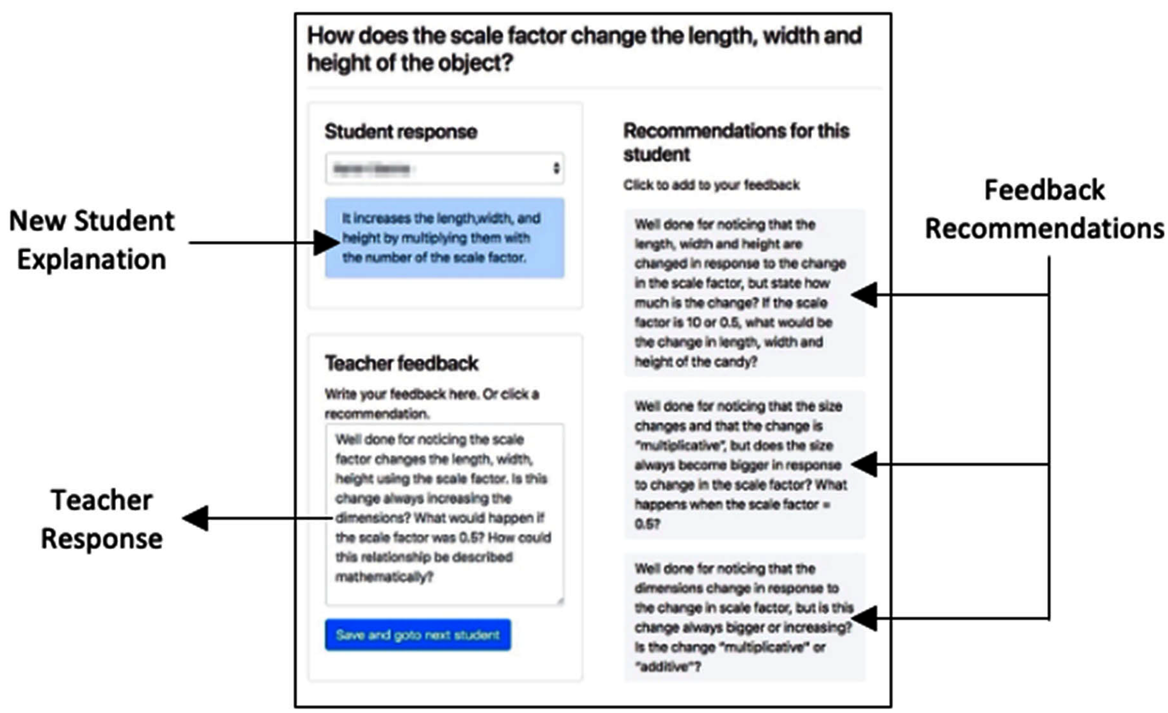

Figure 3. The user interface subsystem. The teacher user interface displays the question prompt for which the training data was collected (top), the new student explanation (top left, in blue), the three recommendations from the NLP recommendations engine, and space for the teacher response (bottom left).

Method

Research Questions

To assess the effectiveness of the tool we asked:

1. How accurately does the TRT select recommendations?
2. How effectively do teachers interact with the TRT?

Data Collection

Context

The data for this study was collected in from high school geometry students and their teachers. The demographics of the school, located in a rural mid-Atlantic region of the United States, were 12% Black, 44% Hispanic, and 38% White students, with 68% of the students receiving free or reduced lunch and 39% of the students classified as having Limited English Proficiency. The students participated in a mathematical modeling project that focused on how scale factor impacts the dimensions, volume, and surface area of a rectangular prism. During the project, the students were asked to write explanations for three different question prompts. The student explanations and teacher responses from a prior implementation of the project were used to create the training datasets used to answer research question 1. The teacher interactions with the TRT during a subsequent implementation of the same project but with different students were used to answer research question 2.

Research question 1

In order to assess the effectiveness of the TRT in terms of how accurately it selects recommendations we created three training datasets as describe above, with a different dataset for each of three question prompts (see Table 2). High school geometry students

Table 2. *A summary of the three training datasets used to assess the accuracy of the TRT at selecting recommendations.*

Training dataset	Question prompt	Number of student explanation and teacher response pairs	Number of different teacher responses
1	How does the scale factor change the length, width and height of the object?	116	29
2	How does the scale factor change the volume of the object?	99	6
3	How does the scale factor change the surface area of the object?	85	6

For each training dataset we performed a leave-one-out cross-validation (Borra & Di Ciaccio, 2010). To do this for a given training dataset we first removed one of the student explanations and its corresponding teacher feedback. Second, we used the remaining training data to build a tf-idf model as described above. Third, we used the removed student explanation to query the model, and finally, recorded whether the recommendations obtained from the query included the teacher feedback corresponding to the removed student explanation. If so, we counted this as a success; if not, a failure. This process was repeated, leaving out a different student explanation from the training dataset each time, until all the student explanations in the dataset had had their turn to be left out. The proportion of successes for each training dataset was found by dividing the total number of successes by the size of the dataset, and to account for successes that are expected by random chance we calculated kappa for each dataset. A kappa of 0 indicates that all the success is due to randomness and a kappa of 1 indicates success every time (Cohen, 1968).

Research question 2

To assess the effectiveness of the TRT in terms of how teachers interact with the user interface, four classroom teachers were observed using the user interface while following a think-aloud protocol which encouraged the teachers to verbalized their thinking as they interacted with the tool. Video screen capture, audio, and researcher fieldnotes were recorded throughout. In addition, the four teachers also participated in individual interviews several days later with included questions about their use of the TRT. The transcripts of think-aloud and post-project interviews were analyzed to identify reoccurring themes and evidence that confirmed or diverged from the themes. The screen capture video was analyzed for the frequency that recommendations were selected or edited by the teachers and the time that they spent interacting with the TRT.

Results

System Effectiveness

Research question 1

After performing leave-one-out cross-validation for each of our training datasets we found kappa values of 0.51, 0.84 and 0.76 (see Table 3). These results are comparable to those found in other studies that used natural language processing technology with open-response items. Liu and colleagues (2014) report average kappa values for such studies to be between 0.62 and 0.81. However, the questions considered in these studies only distinguish between two and five categories of response, making them more comparable to the question 2 and question 3 dataset results rather than the result for the question 1 dataset which is lower, we expect, due to the high number of unique recommendations included in this dataset. Therefore, we conclude that the accuracy of the TRT recommendation selection is comparable to those used by other studies.

Table 3. Number of explanations, unique recommendations, proportion of successful recommendation selections, and kappa values by question

Training dataset	Number of student explanations	Number of unique recommendations	Proportion of successful selections	Kappa
Question 1	116	29	0.560	0.509
Question 2	99	6	0.919	0.838
Question 3	85	6	0.882	0.764

Research question 2

Teachers interacted intuitively with the TRT interface. None of the teachers were observed asking about how to use the interface or expressing frustrations with the interface while responding. Instead, teachers were positive about their interactions, for example, Henry commented that “it was a very clever interface” and that “it was nice to be able to see what [the students] did, try to give a tailored response to give them a hint towards where they supposed to be going, and it was also nice to be able to personalize it for them.”

Teachers interacted thoughtfully with the TRT interface. The teachers interacted with the recommendations provided by thoughtfully considering the merits of the different recommendations with respect to the student explanation. Mike described that he would “look at the recommendations and think ‘Well, that one clearly isn't what I see happening here. This one is the closest to [the student explanation], but I think I need to just qualify it a little bit, modify it to fit this situation.’” And Sam said that the recommendations were “something to start off of and decide if I agreed with what was there, or if I needed to make up my own.” Nina commented, it was beneficial to her that the recommendations were not “everything I want to say as verbatim exactly what I want … because if it was exactly like what I wanted to say, then I feel like [responding to students] would just be a little more mindless for me.”

Thoughtful teacher interactions were supported by the functionality of the TRT interface. The teachers thought that the TRT selected the recommendations well. For example, Henry commented that the TRT “generally, did a good job pulling recommendations that fit the situation. Many of them I was able to use.” However, because the recommendations were often not exactly how a teacher wished to respond to a student, the teachers made use of the user interface functionality for selecting and editing the recommendations. As Nina explained, “I could kind of pick apart different pieces. It was more of editing, manipulating, or rephrasing what was already given.” The results from the analysis of the user interaction data collected from the screen capture video confirm that teachers interacted with the recommendations often while responding to students. On average across all teachers, one fourth of the teacher responses were unedited recommendations and half of the responses were edited recommendations. At the same time, there was some divergence in how the teachers used the recommendations, with Sam mostly writing responses without using the recommendations, and Mike mostly using unedited recommendations (see Table 4).

Table 4. Average responding time (in seconds) and the use of recommendations in responding, by teacher.

		Number (percentage) of submitted teacher responses that used:		
Teacher	Average responding time (seconds)	*no* recommendation	an *edited* recommendation	an *unedited* recommendation
Sam	76.7	5 (56%)	3 (33%)	1 (11%)
Nina	69.6	4 (14%)	21 (75%)	3 (11%)
Mike	48.2	4 (14%)	7 (25%)	17 (61%)
Henry	84.7	5 (29%)	10 (59%)	2 (12%)
Total	66.2	18 (22%)	41 (50%)	23 (28%)

Discussion

The Teacher Responding Tool (TRT) was designed and developed to scaffold teachers' skills at giving high quality, student specific feedback. This required that the text of the recommendations aligned with research based-practices, that appropriate recommendations were selected for a given student explanation, and that teachers were able to interact thoughtfully with the selected recommendations via the user interface. The results from this study demonstrate that, for the context in which this pilot version of the TRT was tested, i.e. in the context of high school students writing explanations of their understanding during a mathematical modeling project, these requirements were satisfied. The TRT was able to select recommendations as accurately as other natural language processing tools and, importantly, the teacher users considered the recommendations selected to be appropriate. The user interface design supported thoughtful teacher interactions by providing three recommendations, functionality for selecting and editing recommendations, and a low extraneous cognitive load layout. A prior study (Bywater, Chiu, Hong, & Sankaranarayanan, 2019) demonstrated that thoughtful teacher interactions with the recommendations contributed to improved teacher responding practice. This study provides evidence that these interactions were facilitated by the TRT design.

Recommendations

Several recommendations for designing natural language tools for learning follow from the results of this study.

1) Natural language processing (NLP) tools that are designed for learning should understand their impact on teacher professional skills. In learning contexts, NLP tools are typically used to automatically respond to students so that teachers are able to focus their time on those students who are most in need (e.g. Gerard, Matuk, McElhaney, & Linn, 2015). In this study, the TRT design included teachers into the responding process so that teachers had opportunities to notice how their students were thinking and to develop their responding skills. We recommend that designers of NLP tools for learning consider how to they can support research-based teacher practices.
2) Training the system requires specific and purposeful data. The requirement of 'big data' is often associated with natural language applications and might be thought to limit the applicability of NLP techniques to specific learning contexts. This study suggests otherwise. Training a system with a smaller dataset that is specific to the applied context can be effective and can support the use in specialized, non-normative, or underrepresented learning contexts.
3) Teacher input into the training dataset content is critical to generate authentic, rich recommendations. The process of creating the training dataset might also be considered a novel professional development activity that builds upon established practices within the field for teachers collaboratively examining student work.
4) For tasks that are cognitively demanding, extraneous cognitive load can be reduced by using a minimalist user interface design that retains all necessary functionality. In this study, reducing extraneous cognitive load involved both how to best present information and how to reduce the load associated with interacting with the information. The TRT user interface combined the select-copy-select-paste steps that a user frequently repeats into a single click. This simplified the interaction steps for teachers when selecting and editing.
5) Connecting the TRT with different learning management systems requires permissions to share identifiable user data and technical expertise. These challenges continue to present adoption hurdles but are being addressed within the educational technology community (e.g. Learning Tools Interoperability, 2019) and we recommend common standards and protocols to mitigate these challenges.

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Online Graduate Students' Success via the Use of Video-based and Text-based Discussions

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Keywords: Online learning, Video-based Discussions, Text-based Discussions, Students Success

Abstract

Text-based discussions have been used in online discussions arguably since the inception of online education. However, in recent years, different platforms have been introduced to enable video-based discussion. This study aims to find if there are differences between the success rate of the students who use text-based discussions and video-based discussions. The result of this study will contribute to the value of each discussion format, and discuss possible recommendations to facilitate the effectiveness and engagement.

Introduction

A major component of any online course is how one, often the instructor, creates a sense of community. Having discussions, has been one way to achieve this, which has led to online discussions becoming a key feature in asynchronous learning activities. The topic on online discussions has been explored in various ways; for example, Russo and Benson (2005) discuss the importance and relationship between online presence and cognitive learning outcomes. Their study focused on students and instructors' perceptions of how online presence affects learning. Other studies have shown that text-based discussions have been used widely for a long time as a method to show students' presence in an online environment. Video-based discussions also have been proved as a rich and powerful model to foster online learning (Yousef, Chatti, & Schroeder, 2014).

There are numerous theories that can be used to explore this topic. One such theoretical framework is Community of inquiry (CoI) proposed by Garrison, Anderson, and Archer (2000) includes three independent elements: social presence, teaching presence, and cognitive presence in online learning. Cognitive presence plays an important role that allows any participant in a community to produce productive communication, especially in online education. Teaching presence emphasizes the role of instructors in designing, developing, and delivering online learning activities. Social presence supports cognitive presence by focusing on the role of participants in an online community. These three basic elements have been applied in research studies to create interactive and meaningful online learning environment.

A study by Clark, Strudler, and Grove (2015) investigates the differences in social presence and teaching presence when students communicate via video versus text-based discussions. This study captures the value of using video and suggest the combination multi-models in online discussions. According to Johnson and Lock (2019), online learning using text and video discussions will foster higher-order thinking in enhancing interaction and engagement.

It is clear that most of the previous studies focus on comparing text-based and video-based discussions in online learning (Clark, Strudler, & Grove, 2015; Swartzwelder, Murphy, & Murphy, 2018) or investigate the social presence or students engagement. There is not much information about the relationship between students' success and video-based and text-based discussions. According to Greogry (2016), a number of factors have been used to describe successful online learners, such as GPA, goal-oriented, organized, responsible, self-disciplined, and self-motivated.

Based on the above characteristics of successful online learners, this study will focus on investigating how text-based and video-based discussion relate to students' success in online learning. The study is guided by the following research question "Is there any difference between the success rate of the students who use text-based discussions and those who use video-based discussions?"

Methods

This study focuses on finding graduate students' success in online discussion. For that purpose, the researchers chose the survey method, which provides descriptions of participants' trends, attitudes, or opinions of a group sample (Creswell & Creswell, 2014), to collect data for this study.

The researchers sent emails to recruit graduate students at Oklahoma State University, who have taken online courses. The purposes of choosing these participants were (1) all participants were involved directly in online discussion, and (2) they had experiences about text-based discussions and video-based discussions in online learning. These selections of participants served as important factors to provide the strongest data for this study.

After obtaining IRB approval, the researchers created an online survey, including both open-ended and closed-ended questions in Qualtrics. An anonymous link was then generated and distributed via emails. Participants (N=66) provided answers to the questionnaires.

Findings

This section provided main findings from the data collection to answer the research question "Is there any difference between the success rate of the students who use text-based discussions and those who use video-based discussions?" The data showed that more than 80% of the participants had taken an online course in the last two years; thus, the participants were able to express their experiences of online discussions.

Table 1 illustrated the mode of discussions in online learning and graduate students' preference. As can be seen from the table, text based discussion was chosen as the most preferred mode for online discussions.

Table 1. Participants' Preference of Discussion Mode

No.	Online Discussion Options	Count	%
1	Text Based Discussions (i.e. discussion boards)	31	46.96
2	Video Based Discussions (e.g. FlipGrid)	13	19.70
3	I have no preference	11	16.67
4	It depends	11	16.67

Another question asked participants about their success in an online class based on Gregory's (2006) definition of students' success in online learning. All participants indicated that they were successful in an online class (Table 2). From this response, it can be confirmed that the success of graduate students in an online course was not affected by a specific discussion mode.

Table 2. Participants' Success in an Online class

	Answer	Count	%
Have you been successful in an online class?	Yes	66	100
	No	0	0

Discussion

The results of this study indicated that graduate students were successful in an online course as well as in online discussions. It can be inferred from the finding that there is no major difference between students' success and modes of online discussions. Both text-based or video-based discussions can be a great platform for online discussions. The results also showed that most of the participants prefer using texts when participating in online discussion boards. These results were consistent with participants' cognitive presence in online learning as described by Garrison, Anderson, and Archer (2000). Based on the results, online instructors should consider applying methodologies and implementing different discussion modes in online courses.

Because this study collected data from a small sample size, N = 66, and only focused on online graduate students, it is difficult to generate the results to different online learners, such as undergraduate students. Another limitation of this study was that the study analyzed data from graduate students' awareness of their success in an online course. Further research can collect data from a larger sample size to confirm the relationship between different modes of online discussions and learners' success. Additional data should be collected to examine students' perception of text based discussions and video based discussions. The role of instructors and students in online discussions should be considered in order to examine graduate students' success in online learning.

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It’s a Small World After All: Decreasing the Distance One Tweet, Snap, & Post at a Time

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Keywords: Distance Education, Distance Learning, Online Education, Social Media, Learning Theories, Higher Education

Abstract

As distance education programs become more common and attract more students, institutions are grappling with ways to support online students at a distance. Graduate students face numerous obstacles creating meaningful academic and professional relationships that on-campus graduate students do not encounter. Supported by statistics and literature, this paper illustrates how students and a professor in the Instructional Systems Design and Technology doctoral program at Sam Houston State University utilize social media as a communication and collaboration tool, to facilitate the minimization of these obstacles by creating socially interactive and supportive peer-peer and instructor-peer communities.

Technology, coupled with the Internet, has recreated the landscape of much of our day-to-day lives. The advent of social media has simultaneously made the world larger and smaller, and this has significant implications for postsecondary distance education. Since social media has gained prominence, educators and researchers have explored the applicability of this tool in a learning context. Building connections and relationships between professors, students, and peers emerge as crucial components of online learning environments, which are on the rise (Babson Survey Research Group, e-Literate, & WCET, 2017; Haythornwaite, Kazmer, Robins, & Shoemaker, 2018). These relationships are especially important for graduate students who are preparing for academia and professions (Gersick, Bartunek, & Dutton, 2000).

Further, social media has made it easier to access and create networks by providing easier ways to connect with increasingly large amounts of people and information. Watts and Strogatz (1998) introduced the idea of "‘small-world’ networks … popularly known as six degrees of separation" (p. 440). This concept showcases the strength of a dynamic network consisting of nodes in which ideas, information, and disease can spread quickly via shortcuts. Inspired by this idea, this paper aims to examine how social media networks cross-connect with distance education, various learning theories such as social constructivism and transactional distance, and recommended strategies.

Status Update: The State of Distance Education, Social Media, and Theory

Distance education and face-to-face networking have existed for a very long time, and there is no doubt that time and technology have transformed what this looks like today. While social media is relatively nascent, it, too, has undergone tremendous growth and transformation in its short life span. The connection between the three has created a modern learning context in which the lines between work, school, and private life often blur.

Distance Education

Distance education has its roots in correspondence studies of the late 1700s (Keegan, 2002). However, the modern definition has been redefined as a system of "teaching and planned learning in which teaching normally occurs in a different place from learning, requiring communication through technologies as well as special instructional organization" (Moore & Kearsley, 2012, p. 2). As the delivery method has moved from the postal service to the modern era of web-connected devices, the distance learner has come to include a broader range of people.

As of 2015, almost 6 million students in higher education were participating in at least one distance education course (Babson Survey Research Group, e-Literate, & WCET, 2017). These figures are estimated to contribute to almost 32% of higher education enrollments as of 2016 (Seaman, Allen, & Seaman, 2018). Interestingly, while overall enrollments in traditional higher education programs are decreasing, enrollment in distance education programs is increasing, as shown in Figure 1 (Babson Survey Research Group et al., 2017). Generally, public institutions are outpacing private schools in offering distance instruction, as more students take advantage of the available opportunities (Allen, Seaman, Poulin, & Straut, 2016).

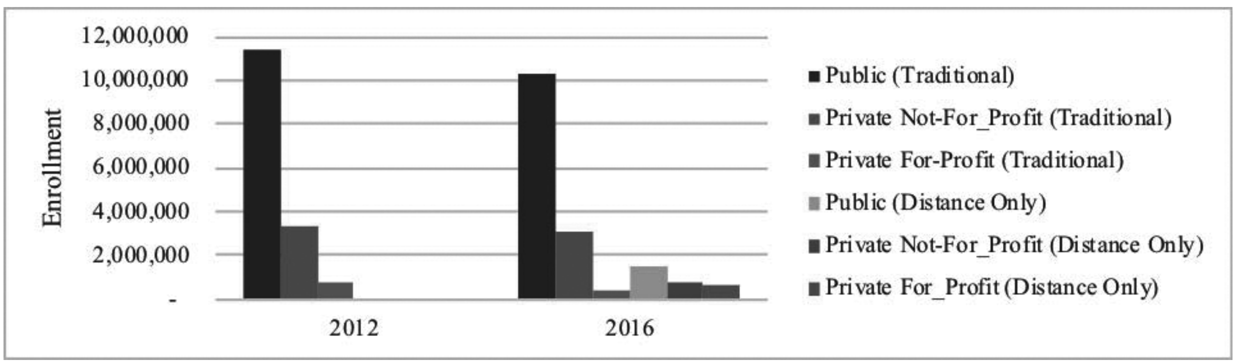

Figure 1. Overall Trends in Distance Education in The United States

Adapted from "Grade increase: Tracking Distance education in the United States," by J. Seaman, I. Allen, and J. Seaman, 2018, http://onlinelearningsurvey.com/reports/gradeincrease.pdf.

The overall trend towards increased participation in distance education also holds true for both undergraduate and graduate programs, as shown in Figure 2 (Seaman et al., 2018). As a result, educational leaders are taking note and consider online education options as part of their long-term institutional viability and strategy (Allen et al., 2016). While at times, there have been varying levels of confidence regarding the quality of distance education programs, this perception is quickly changing, and the majority of education leaders believe the quality is on par or superior to traditional face-to-face learning (Allen et al., 2016).

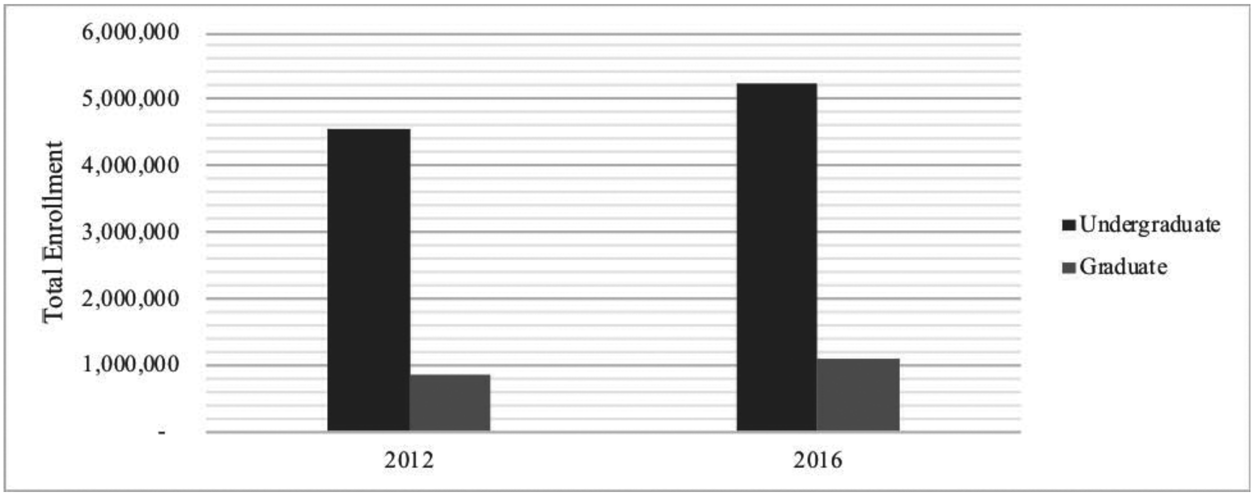

Figure 2. Comparison of Overall Distance Education Undergraduate and Graduate Enrollments in the United States

Adapted from "Grade increase: Tracking Distance education in the United States," by J. Seaman, I. Allen, and J. Seaman, 2018, http://onlinelearningsurvey.com/reports/gradeincrease.pdf.

Demographics and Characteristics of Distance Education Students

In higher education settings, almost 30% of students participate in distance education courses, with nearly half exclusively enrolled in distance coursework (Babson Survey Research Group et al., 2017). The majority of these learners attend public universities, followed by non-profit private and for-profit private institutions, respectively (Babson Survey Research Group et al., 2017). Additionally, the majority of distance education students are enrolled in home-state institutions (Seaman et al., 2018). While there are differences in the number of graduate and undergraduate students enrolled in distance courses depending on the type of institution, graduate students are still more likely to pursue distance coursework compared to undergraduate students (Babson Survey Research Group et al., 2017). Of these students, the majority considered to be exclusively enrolled in distance programs tend to live in the same state as the institution they attend (Babson Survey Research Group et al., 2017).

Some research indicates that the demographics of distance learners is characteristic of the U.S. as a whole and that most are looking to advance their career (Cleary-Estep, 2016). Others find that distance learner characteristics are fluid and constantly in flux (Latanich, Hudson Gail, & Nonis Sarath, 2001). Still, distance learners generally tend to be older than traditional students (between the ages of 25-50), female, and work full-time (Cleary-Estep, 2016; Halsne & Gatta, 2002; Latanich et al., 2001; Moore & Kearsley, 2012; Smith, 2014). The specific percentages in these categories may vary, but the inclination remains valid. Distance learners also have a propensity to make more than a $40,000 salary and are predominantly white (Halsne & Gatta, 2002; Shriner, 2015). However, African-American and Hispanic student enrollments are significantly higher in distance education programs compared to that of traditional environments (Shriner, 2015). While there are some distinguishing characteristics, one study reports that online and traditional students share similar traits in the areas of marital status, socio-economic status, level of education, and level of employment (Pentina & Neeley, 2007).

Just as there is variation in demographics, distance education programs seem to attract students with certain characteristics. The convenience of distance education due to its flexibility may no longer be novel and requisite, as students look for quality, personalization, individualization, and convenience (Pentina & Neeley, 2007). Overall, learners who choose distance education programs display higher levels of motivation and risk-taking (Latanich et al., 2001). Coupled with more experience in higher education and full-time employment (Latanich et al., 2001), instructors have an opportunity to leverage these characteristics when designing distance learning experiences.

Quality of Effective Distance Education

The quality of distance education programs has been a long-standing topic of discussion. Although the tools to deliver distance education have changed, Keegan (2002) notes that "distance education has a history of more than 150 years, where institutions [have] offered high-quality education to learners '*free of time and place*'" (p. 92). Rather than focusing on whether to offer distance opportunities, institutions should focus on quality assurance measures that evaluate the effectiveness of distance learning and accreditation (Carlsen, Holmberg, Neghina, & Owusu-Boampong, 2016; Muilenburg & Berge, 2001).

Once course quality is present, attention must turn to learner needs and perceptions. According to Lawless and Richardson (2002), students' perceptions of distance education are associated with their approach to studying; this implies that course design should address effective study skills specifically for distance learning (Lawless & Richardson, 2002). This opinion is also informed by the judgment of workload appropriateness, clarity of goals, assessment, materials, and teaching quality (Lawless & Richardson, 2002). Instructors must be able to provide clear course objectives, organizational structure to the course, clarity of instructions, and a choice between group and individual projects (Jones & Blankenship, 2017). Moore's theory of transactional distance supports these assertions on distance learning (as cited in Vasiloudis, Koutsouba, & Giossos, 2015).

Faculty and instructional designers must also be prepared to construct quality instruction specifically targeted for virtual distance environments. Institutions must ensure ongoing professional learning is provided to faculty on pedagogy, technology integration, and appropriate instructional strategies for distance learning (Broady-Ortmann, 2002; Falowo, 2007). As discussed previously, maintaining the quality of communication and social interactions in an online environment is essential for distance learning success (Copeland & Warren, 2004; Haythornthwaite, Kazmer, Robins, & Shoemaker, 2018; Mayisela, 2013).

Universities will also have to reevaluate pedagogical considerations for distance learning, adult learners, and collaboration in an online environment (Gearhart, 2001). Pedagogy in online education environments must address intellectual engagement, communication, collaboration, and discussion (Lee, 2017; Xin & Feenberg, 2006). The key to success for online education appears to be increased interaction with the instructor and content (Mbwesa, 2014). As Ascough (2002) stated, "good pedagogy requires an awareness of the opportunities and limitations of the mode of education" (p. 1). Institutions should also ensure that online programs meet standards of rigor and quality; they must also address the unique aspects of distance education (Stella & Gnanam, 2004). As a result, online courses must provide students with ongoing social interactions that elicit analytical and reflective discussion with feedback (Jones & Blankenship, 2017).

Table 1. Top Social Media Platforms Amongst Global Internet Users, Excluding China

Platform	**Founded**	**Description**	**Estimated Users**
Facebook	2004	Platform to connect with friends	2.2 billion
YouTube	2005	Platform for video sharing	1.8 billion
WhatsApp	2009	Smartphone messaging application	1.3 billion
Facebook Messenger	2011*	Messaging application	8 million
Instagram	2010	Platform for sharing images and videos	1 billion
Twitter	2006	Microblogging platform	1.6 billion***
Google+**	2011	Platform to connect with friends	351 thousand***
LinkedIn	2002	Professional networking site	575 million****
Skype	2003	Video and voice call platform	23.6 million***
Snapchat	2011	Messaging app for time-limited images and videos	186 million

**Based on Facebook Chat released in 2008.*
***Shut down for users with personal accounts in April 2019 ("Consumer Google+ shutdown," 2019).*
****Organic users.*
*****Registered users.*
Adapted from "The history of social media: Social networking evolution!" by K. Terrell, June 16, 2015, *History Cooperative,* https://historycooperative.org/the-history-of-social-media.
Adapted from "15 most popular social media networks and sites [+160 data points]," by C. Brenner, July 18, 2018, *G2*, https://learn.g2.com/social-media.

Social Media

In order to create effective and engaging online instruction, the rise and impact of social media in higher education needs to be explored. Boyd and Ellison (2007) use the term social network site to describe a web-based service in which users create a profile that allows them to connect with other users and their respective connections in a manner that elevates the relationship. Furthermore, these connections among users are transparent to everyone on the platform (Boyd & Ellison, 2007). As the terminology has shifted towards the use of "social media," these platforms are now web-based and mobile apps in which users can connect and communicate through user-generated content (Kaur Kapoor et al., 2018).

The emergence of social media platforms can be traced back to 1996, but truly emerged in their modern form in the early 2000s (Singh, 2019). With platforms such as LinkedIn, Facebook, Twitter, Instagram, YouTube, and more, the number of worldwide users has jumped from almost a billion in 2010 to 2.62 billion in 2018 (McFadden, 2018; Singh, 2019). Messaging platforms such as Facebook, Snapchat, WhatsApp, and Facebook Messenger tend to be the most popular platforms, as shown in Table 1 (GlobalWebIndex, 2018).

Demographics in Social Media

Focusing on users in the United States, the Pew Research Center has been tracking social media trends since 2005 (Perrin, 2015). Amongst adults, social media use has skyrocketed from 7% in 2005 to 65% in 2015 (Perrin, 2015). Globally, 98% of Internet users are also social media users who have an average of 8.5 accounts (GlobalWebIndex, 2018). Generally, social media platforms tend to be used for different purposes (GlobalWebIndex, 2018). While 18-29-year-old young adults have the highest rate of usage at 90%, all demographic age groups have shown increases in adoption rates (Perrin, 2015). There are similar usage rates across gender, race, and ethnicity; however, social media is used at higher rates by those living in urban areas and attaining higher levels of education and income, as shown in Figure 3 (Perrin, 2015).

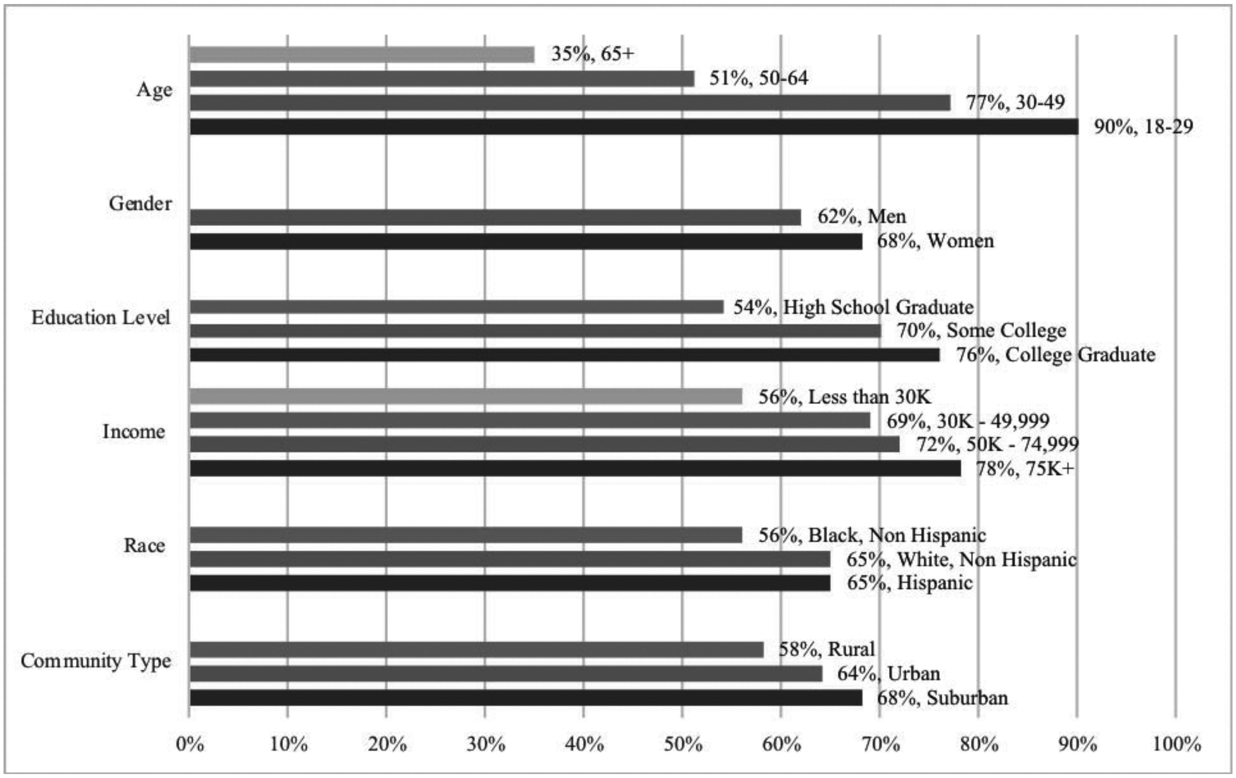

Figure 3. Demographic Trends for Social Media Users in the United States

Adapted from "Use social networking sites report (Pew Research Center Report)," by A. Perrin, 2015, https://www.pewinternet.org/2015/10/08/social-networking-usage-2005-2015.

Social Media Use in Higher Education

Most data on social media usage in higher education tends to focus on younger undergraduate students, which is not representative of non-traditional distance education students, as previously outlined. However, this data is still instructive in developing an understanding of use in higher education settings. On-campus undergraduate students report that they prefer platforms that focus on personal relationships rather than professional networking (Knight-McCord et al., 2016). As a result, students preferred using Instagram, Snapchat, Facebook, and Twitter, respectively (Knight-McCord et al., 2016). Overall, undergraduate students tend to maintain a presence on multiple platforms, feel that it can improve academic discussions, and is more convenient (Jacquemin, Smelser, & Bernot, 2014).

Graduate student use of social media illustrates a shift towards incorporating professional and academic pursuits into their social media use. Much like undergraduate students, graduate students show a preference for Google+ (no longer available to the public), Facebook, Twitter, and Instagram, respectively (Romero-Hall, 2017).

While they use these platforms primarily for personal use, there is increased usage of platforms such as LinkedIn for connecting to academic or professional communities (Romero-Hall, 2017). Graduate students tend to use fewer platforms and feel that it is far more convenient than using other online options such as those provided within an LMS (Jacquemin et al., 2014).

Instructional Uses

Instructionally, social media platforms are being incorporated into many aspects of higher education. The Internet and social media have created a vast depository of knowledge that is decentralized and always available to both instructors and students (Cortés & Lozano, 2014). In one study, graduate students felt that using Twitter exposed them to information they may not have otherwise found (Jacquemin et al., 2014). While students sometimes feel uneasiness in using social media as a learning tool, they often find that their opinion changes as they see the utility of transparent communication with professors and other classmates (Bista, 2015). In addition, many students also found value for social media use in their professional or personal applications (Bista, 2015). Other studies highlight the varied use of Twitter for instruction, faculty communication, and professional development (Lewis & Rush, 2013).

Communities of Learning

Oftentimes, social media can also be used to develop informal communities of learning. In these cases, people with similar interests can develop or find communities with which to connect and share information (Lewis & Rush, 2013). While common interest communities and collaboration naturally occur in many face-to-face environments, social media has the power to enlarge the circle of people with whom you interact (Amin & Rajadurai, 2018). Moreover, social media affords the prospect for dialog between communities (Kumar & Nanda, 2019). According to Lewis and Rush (2013), social media plays a role in creating useful networks or communities of practice for those in higher education.

Relationship Status: Social Media + Distance Education + Theory

The use of social media within online distance education programs seems to be a natural fit; multiple educational theories support this conviction. Next, the relationship between social media, distance education, and various learning theories will be examined.

Learning Styles

While the term learning style generally refers to a method by which students learn best, there are many different ways to approach this concept. Gardner (1991) proposed multiple intelligences in which learners may have linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, and intrapersonal strengths. Learning styles also frequently refer to modalities, such as visual, kinesthetic, auditory, and tactile (Fleming & Baume, 2006; Lake, Boyd, & Boyd, 2017; Sousa, 2001). While these are two of the most common interpretations, learning styles may also address personality, learner preferences, and learner approaches (Lake et al., 2017).

According to Halsne and Gatta (2002), online learners have historically tended to prefer visual instruction, while traditional students prefer auditory and kinesthetic instruction. Many students like the instructional use of social media due to its high use of audio-visual content, which is in line with this idea (Stathopoulou, Siamagka, & Christodoulides, 2019). Others suggest that social media's ease of use may be more important than learning style (Balakrishnan & Gan, 2016). While using multimedia for instructional purposes is not new in distance education, social media platforms provide the added opportunity to design "rich learning situations" enhanced by multimedia and social networks (Cortés & Lozano, 2014, p. 67; Reiser, 2018).

Instructors must also take into account the skills a student must acquire in order to achieve the intended learning outcome (Roblyer, 2015). Gagné (1985) proposed five categories of learning: verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills. Similarly, Bloom classified skills into cognitive, affective, and psychomotor domains (Anderson et al., 2001; Roblyer, 2015). In this context, the instructional objectives determine the skills a student is expected to acquire, and the instructional design should reflect appropriate sequence, strategies, and media to achieve the specified outcome (Roblyer, 2015). Because there are such a variety of social media platforms that can be used in many different ways, these platforms can almost always meet some preferences or needs of the learner (Stathopoulou et al., 2019).

Constructivism

Constructivism serves as an overarching paradigm in which many individuals have contributed significant theories of how learners construct knowledge. According to Piaget, learners create knowledge by interacting with others through a social and physical environment (Schrader, 2016). While Piaget focused on a biological perspective of cognition, Lev Vygotsky proposed a sociocultural theory in which cognitive development is built from the social and cultural connections of the learner (Woolfolk, 2001). In this sense, learning serves an interdependent social function before it is internalized into individualized knowledge ("Social development theory (Vygotsky)," 2014). Constructivism promotes two essential ideas. The first is learners should be provided a learning task that is within their cognitive ability level, and second is students can achieve beyond their independent level with support (Woolfolk, 2001). In the context of social media, these platforms provide ample social interaction opportunities with people of all levels. There is initial evidence that using social media with a constructivist pedagogy can lead to improved academic performance (Amin & Rajadurai, 2018; Hashim, Rashid, & Atalla, 2018). According to Amin and Rajadurai (2018), social media platforms lend themselves to the aspects of the ideal constructivist classroom.

The reality is that online learning experience is based in social *and* cognitive development. According to the Community of Inquiry Framework, online education is based on the dynamic relationship between social, cognitive, and instructor presence (Garrison, Anderson, & Archer, 2010). Social and cognitive engagement is also integral to the success of the distance learner. In fact, instructors who create a digital culture of dialogue, risk-taking, and interaction between students and the instructor increase the feeling of social inclusion for distance learners, and by extension, the potential for success (Brown et al., 2012).

Cognitive presence integrates Dewey's ideas on reflective inquiry, while social presence relies on building community through purposeful communication (Garrison et al., 2010). The instructor's presence may be a key element in which an instructor establishes structures and processes that facilitate learning through a community in a manner that addresses the cognitive and affective domains (Garrison et al., 2010; Roblyer, 2015).

Of course, these are not the only theories that can help explain why social media has the potential to be an ideal instructional tool or environment. Situated cognitive theories lend credence to the idea that knowledge has meaning within authentic contexts, while connectivism promotes having learners link ideas, information, and people (Cortés & Lozano, 2014; Schrader, 2016).

Transactional Distance

Moore's theory of transactional distance posits that distance can be a geographical and pedagogical experience (Moore & Kearsley, 2012). There are five types of interaction in which transactional distance can be measured: learner-instructor, learner-learner, learner-content, learner-interface, and learner-environment (as cited in Yilmaz, 2017). Yilmaz (2017) found that the Facebook environment produced positive perceptions of transactional distance. Social media studies have supported learners increased interaction in all transactional distance relationships (Amin & Rajadurai, 2018; Bista, 2015; Lewis & Rush, 2013). Studies have found that social media use for learning included increased use of resources, quality interactions, engagement, interest, and collaboration (Ricoy & Feliz, 2016; Tess, 2013).

Connectivism

The idea that social media increases connectedness and interactions among distance education environments is becoming more visible; this has led to new theories about how we might learn best in this new digital age. Connectivism is a theory proposed by George Siemens and Stephen Downs, which suggests that the age of ubiquitous technology and connections has changed the way people learn (Ungvarsky, 2019). Whereas knowledge used to be stored in textbooks and disseminated by the instructor expert, learners now continually access and assess their learning via networks, which is markedly different from the linear path instruction used to follow (Ungvarsky, 2019). In other words, students must be active participants in co-creating their own learning experience (Cortés & Lozano, 2014).

Direct Message: The Future of Social Media and Distance Learning

As exclusively online students in a graduate program, the research presented in this paper resonates with the writers' experiences. In what is often an isolating, lonely, and arduous path of independent learning and research, social media has provided a user-friendly platform in which to connect and learn from peers in this program. It has afforded the writers much-needed forums to clarify, mentor, educate, ask questions, celebrate successes, share and learn from failures, complain, and seek or provide motivation. Social media has provided opportunities to connect and learn from experts in the field that would have otherwise been unavailable in a traditional face-to-face program, which has resulted in tremendous growth of professional networking opportunities. While there is no doubt that social media has allowed a deeper level of learning and application, the overarching benefit is the lifelong relationships that have developed and grown into friendships based on respect, collaboration, and peer mentoring. Social media is undoubtedly impacting and changing education in ways that will surely be more visible or measurable in the future, yet in its relatively short existence, it has already changed how the authors learned and view learning. Discussing higher education strategies for graduate students can be categorized as institutional, instructional, and professional.

Institutional Strategies for Online Graduate Students

Institutions must always determine how to enhance the student experience in order to retain students (Aversa & MacCall, 2013; Britto & Rush, 2013). When discussing online versus on-campus programs, many point to the difference in services and experience as a key decision-making factor in the selection process (Nelson, 2017). According to Britto and Rush (2013), the challenge has been in simply offering online students comparable services already provided to face-to-face students. These include services such as online technical support, safety alert systems, online advising, support for first-time, fully online students, student readiness assessments, online student orientations, online tutoring, and school newsletters. Social media can connect students with the right services or communities of support designed for the distance learner.

Instructional Strategies for Online Graduate Students

Instruction is the most important element of any educational institution. When discussing online instruction, the role of the instructor is often deeply intertwined with the design and delivery of a course (Fedynich, Bradley, & Bradley, 2015). While feedback was generally positive for the online experience, Fedynich et al. (2015) noted that students reported lower levels of satisfaction with instructor feedback and peer interactions. Unfortunately, some instructors find online instruction and technology platforms difficult to use, which can lead to poor instructional experiences for students (Bawa, 2016).

Kumar and Nanda (2019) offer many opportunities for how social networking can be used instructionally in higher education. These suggestions include student coursework collaborations, quality online feedback, and online communities to support increased student engagement, participation, and learning (Hashim et al., 2018; Kumar & Nanda, 2019). With the proper instructor support, learners can be empowered and gain confidence as participants and learners within a social media community (Ricoy & Feliz, 2016). The authors have experienced first-hand how social media can be used to authentically connect with, learn from, and obtain feedback from others in the field. These types of experiences elevate an assignment into an authentic collaboration with an artifact of learning that furthers a professional social media presence.

Professional Strategies for Online Graduate Students

Online graduate students tend to already be working professionals (Cleary-Estep, 2016). As a result, higher education institutions benefit from providing services that support the professional goals of their students. In this regard, social media can be a great tool to invite participation from online students who may not be able to attend events in person. Whether it is a campus tour, lecture series, campus communities, professional groups, or mentoring, social media can be used to share information and create interactive online experiences (Kumar & Nanda, 2019). Professionally, LinkedIn provides a unique platform that institutions can use for recruitment, fostering professional connections, and promoting alumni (Kumar & Nanda, 2019). As Nelson (2017) noted, online students often lack access to key networking opportunities such as internships. In addition to this, the authors have also noted a lack of opportunities for research and teaching that are often available to on-campus graduate students.

While it may be impossible to offer an online program that is comparable to an on-campus program, the goal should be to provide equitable services and experiences using any available platform. There are several questions that higher education and instructors can ask themselves.

How can social media be used to:

- create communities of and for learners at the institutional, program, department, and course level?
- provide online graduate students with opportunities for ongoing mentorship and research?
- train online instructors in the effective use of technology tools for instruction, collaboration, and engagement?
- create authentic learning experiences?
- develop or support professional and alumni networking?
- provide online graduate students virtual research and teaching opportunities?
- support the transition from personal to professional social media use?

- accessing the most current information and emerging discussion on a subject?
- extend beyond the “classroom” and include discussions or collaborations with others in the field?

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Findings and Implications from a Mixed Methods Study of Principals' Experience Using Data Analytic Tools

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Introduction

In an era of broad accountability and recent technological advances, more educational data is available now than ever before; but the potential benefits of data usage have not been realized (Murray, 2014; Schildkamp, Poortman, Luyten, & Ebbeler, 2016). As primary decision-makers for their schools, principals are expected to analyze large amounts of educational data to inform everything from allocating resources to promoting instructional strategies (Siemens et al., 2011). "Data use lives and dies in the principal's office because principals are in contact with so many aspects of data use—their own data use, their teachers' data use, and their district's data use" (Wayman, Cho, & Johnston, 2007, p. 55). Educational leaders are investing in new data analytic tools (Murali, 2014), but research to understand the process, context, and consequences of these efforts is limited (Coburn & Turner, 2011).

This mixed method study provided an overview of the experiences of principals and the challenges they face in making sense of the vast amount of data available to them with the tools available to them. This study has responded to the continued need to understand how principals use data in their weekly practices at schools (Spillane, 2012). The purpose of this study was to examine the experiences of principals using digital data analysis tools and identify tensions that exist between theory and practice.

Theoretical Framework: Activity Theory

Introduced into the field of human–computer interaction in the late 1980s, activity theory has been used to understand the role of tools in everyday life and how they shape people's interaction with information (Clemmensen, Kaptelinin, & Nardi, 2016; Kuutti, 1996; Nardi, 1996). Building upon the work of other researchers in the field of education and HCI (Allen, Karanasios, & Slavova, 2011), activity theory can be used to frame and describe the mediated relationships among (a) a subject, the school leader; (b) the object, data; and (c) the school community. The objective of engaging in such activity is to gain insight, which has been described as a discovery resulting in new understanding (Dove & Jones, 2012). The ultimate outcome of analyzing data is to transform insight into a decision that will be implemented in order to have an impact (Mandinach, Honey, & Light 2006) and this outcome is what motivates the subject's activity (Kuutti, 1996). The components of this framework, visualized in Figure 1, were selected in alignment with the literature reviewed around motivation for data analysis, factors influencing data use, and the intended outcome of data visualization tools.

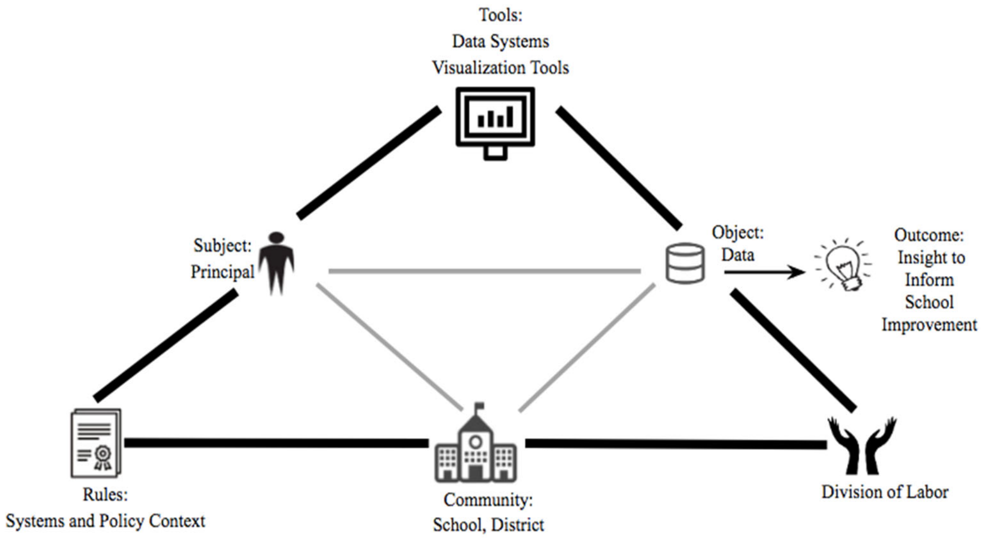

Figure 1. Principals' data use as an activity system.

Research Methods

Activity theory served as the foundation for shaping the research questions and research design. The four main research questions were: (1) What types of data and data analytic tools do principals use? (2) How do principals use data analytic tools? (3) What factors influence principals' use of data analytic tools? (4) How do principals describe the impact of data analytic tools on their work? There were two distinct phases in the mixed methods study. Figure 2 shows the explanatory sequential design of this study. During Phase 1 quantitative data was collected from 70 participants through a 15-minute online survey sent to all 256 public school principals in the Hawaiʻi Department of Education resulting in a representation of 27% of the population. The survey instrument consisted of subscales from two primary sources: (a) Factors Promoting and Hindering Data-Based Decision Making in Schools Survey (Schildkamp et al., 2016), and (b) Teacher Data Use Survey: Administrator Version (Wayman, Wilkerson, Cho, Mandinach, & Supovitz 2016). Descriptive statistics were applied to the information gathered from the survey to identify trends and select interviewees for the qualitative data collection. Six respondents who indicated a willingness to participate in Phase 2 and represented demographic variation to the greatest extent possible were asked to participate in the think-aloud and semistructured interview. Principals in Phase 2 participated in the 30-minute think-aloud protocol and observation in which they demonstrated how they used various tools, followed by a 30-minute semistructured interview about their experiences. The data were triangulated and coded for emerging themes in alignment with the research questions and theoretical framework.

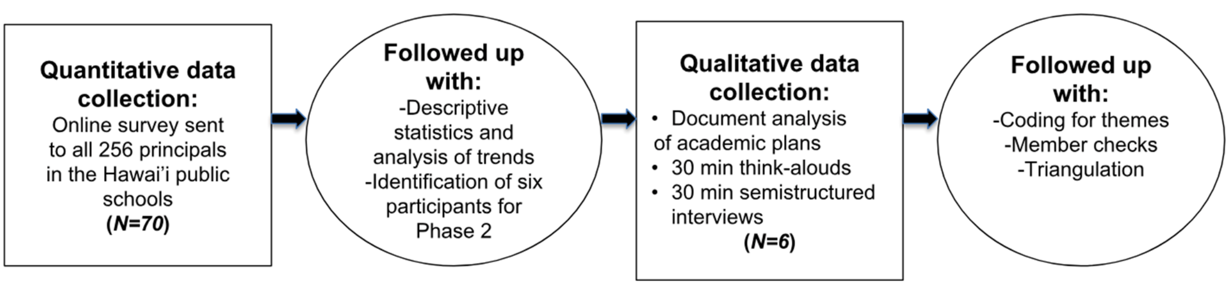

Figure 2. Explanatory sequential design of this study

Data Analysis

The researcher followed the major data analysis steps suggested for a mixed methods explanatory sequential design: (a) collect the quantitative data; (b) analyze the quantitative data; (c) design the qualitative strand based on the quantitative results; (d) collect qualitative data; (e) analyze qualitative data; and (f) interpret how the connected results answer the quantitative, qualitative, and mixed methods questions (Creswell & Plano Clark, 2011). During the qualitative phase, instead of waiting until the end of data collection, the researcher took an inductive analysis approach to reflect on the meaning of what was heard in order to develop hunches (working hypotheses) about what was meant throughout the study. In order to represent general trends, frequency data and descriptive statistics were used, including measures of central tendency, such as the mean. The measures of variability, such as the range and standard deviation, indicated the spread of scores (Creswell, 2008). Tables and charts were generated, using both SPSS and Tableau. Based on the data analysis, the researcher decided which participants to invite to Phase 2 and what results required further explanation (Creswell & Plano Clark, 2011). Major findings from the Phase 1 quantitative data analysis were recorded into summary statements with implications for the Phase 2 qualitative data collection. The audio recordings from the think-aloud sessions were analyzed along with the information from the semistructured interviews for common patterns of actions, unique behaviors, or actions that seemed incongruent with the verbal descriptions. After reviewing the list of generated codes from each source, the researcher clustered codes into larger categories and identified emerging themes (Creswell, 2008).

Findings

To answer the first research question, principals were asked on the survey how frequently they used various types of data and various tools. As shown in Table 1, there were five types of data that at least 30% of principals reported using at least weekly: teacher observation data (42.8%), student attendance data (34.3%), data about best instructional practices (34.8%), resource management data (31.9%), and feedback from teachers (30%). Data that provided information about resource allocations, accountability and performance, or anecdotal feedback was typically used once a month or less followed by student demographic data which was used least.

Table 1. *Frequency of Use by Types of Data (N=70)*

Data Type	Do not use = 1	Less than once a month = 2	Once or twice a month = 3	Weekly or almost weekly = 4	A few times a week = 5	Mean	Std. deviation
Teacher observation data		21.4%	35.7%	31.4%	11.4%	3.33	0.94
Student attendance data		25.7%	40.0%	25.7%	8.6%	3.17	0.92
Data about best practices for instruction	4.3%	24.6%	36.2%	26.1%	8.7%	3.10	1.02
Resources management data	1.4%	26.1%	40.6%	29.0%	2.9%	3.06	0.86
Feedback from teachers	1.4%	34.3%	34.3%	24.3%	5.7%	2.99	0.94
Effectiveness of school programs	7.2%	26.1%	43.5%	18.8%	4.3%	2.87	0.95
Other	29.4%	11.8%	23.5%	17.6%	17.6%	2.82	1.51
Teacher-generated authentic assessment data	11.4%	34.3%	27.1%	17.1%	10.0%	2.80	1.16
Student growth data	4.3%	35.7%	42.9%	15.7%	1.4%	2.74	0.83
Data about curriculum needs	4.3%	38.6%	42.9%	14.3%		2.67	0.77
Benchmark assessment data	10.0%	30.0%	47.1%	10.0%	2.9%	2.66	0.90
Universal screener data	7.1%	35.7%	47.1%	4.3%	5.7%	2.66	0.90
Student language data	2.9%	55.1%	31.9%	10.1%		2.49	0.72
Feedback from students	10.1%	43.5%	36.2%	10.1%		2.46	0.81
School performance data	4.3%	62.3%	24.6%	8.7%		2.38	0.71
Standardized test scores		68.6%	25.7%	5.7%		2.37	0.59
Perceptions of the learning environment	5.7%	70.0%	18.6%	5.7%		2.24	0.65
Report card data	13.2%	66.2%	13.2%	4.4%	2.9%	2.18	0.83
Student socioeconomic data	11.4%	72.9%	14.3%	1.4%		2.06	0.56
Student ethnicity data	17.4%	73.9%	5.8%	2.9%		1.94	0.59
Student gender data	26.1%	68.1%	2.9%	2.9%		1.83	0.62

As seen in Table 2, four digital tools were used by the majority of principals on a weekly basis: Google Suite, though not supported by the district, stood out at the top (80%), followed by Excel spreadsheets (58%), Infinite Campus the student information system (51.5%), and tools generated at the school level (50.8%).

Table 2. Frequency of Use for Digital Data Tools (N=70)

Tool	Do not use = 1	Less than once a month = 2	Once or twice a month = 3	Weekly or almost weekly = 4	A few times a week = 5	Mean	Std. deviation
Google Suite	2.9%	5.7%	11.4%	21.4%	58.6%	4.27	1.06
Excel spreadsheets	5.8%	15.9%	20.3%	34.8%	23.2%	3.54	1.18
Infinite Campus	7.4%	20.6%	20.6%	20.6%	30.9%	3.47	1.32
School-based	22.2%	12.7%	14.3%	25.4%	25.4%	3.19	1.51
eCSSS	11.4%	22.9%	28.6%	17.1%	20.0%	3.11	1.29
PDE3	6.0%	19.4%	47.8%	20.9%	6.0%	3.01	0.95
LDS	5.7%	51.4%	28.6%	11.4%	2.9%	2.54	0.88
ARCH	2.9%	61.4%	30.0%	4.3%	1.4%	2.40	0.69
HSAP	10.0%	60.0%	24.3%	5.7%		2.26	0.72
iReady	62.3%	4.3%	18.8%	13.0%	1.4%	1.87	1.21
Other	69.2%		15.4%	7.7%	7.7%	1.85	1.41
Renaissance Learning	55.9%	19.1%	17.6%	7.4%		1.76	0.99
AVA System	54.3%	37.1%	4.3%	4.3%		1.59	0.77
SchoolView	63.8%	33.3%	1.4%	1.4%		1.41	0.60
Jupiter Grades	94.3%	1.4%		2.9%	1.4%	1.16	0.69

In the interviews, many principals talked about the benefits of the Google Suite tools because they provided the flexibility to collect various kinds of data, such as perceptual data, as discussed in the following example:

For other types of data, perspective data, like, we do use Google Survey a lot, or Google Forms rather, to survey. Like, for example, we just did an evaluation of our kindergarten orientation with the parents, and so that was through a Google Form. We'll do an interest survey. And then we also use Messenger to push out the surveys. Our Wellness Committee put together a Cooking Up the Rainbow Night. And so we just did the sign ups over Google Forms, and then were able to see, you know, who signed up. Capture that data really easily. Every year we have STEM Ho'ike. For the past two years we've been having kids showcase what they're learning in STEM and their engineering design. And so—this is just simple—and it wasn't really doing a Likert scale or anything, but we just asked two simple questions: What do you want to see repeated? What you want to see improved? And just capturing that data there. (Principal 6)

Other staff members often factored into these activities because they shared the ability to use Google tools collaboratively. The majority of digital data tools supported by the district were used for student learning and demographic data analysis with limited school process and perception data. No common tools formally supported by the district for principals integrated all of the data types.

To answer the second research question, principals that participated in the think-aloud were asked to demonstrate how they used each tool. Principals used data analysis tools for various purposes including making comparisons, planning, and reporting. Data was used to make comparisons between time intervals, schools, different teachers, specific groups of students, and between programs. Trends emerged showing that were used for academic planning, goal setting, budgeting, staffing decisions, and to make decisions about teacher support needs.

To answer the third research question, principals answered interview questions and survey questions in alignment with the following subscales: (a) data use for school development, (b) school organization characteristics (vision and norms, leadership, and support), (c) user characteristics (knowledge and skills, dispositions to use data), (d) computer system characteristics (e) data characteristics (accessibility of timely data, usability, and quality) (Schildkamp et al., 2016). Factors that negatively influenced principal use related to the tools included problems with access (i.e. log in issues, privacy limits, etc.), lack of integration between systems, lack of desired functionality (i.e. visualizations and dashboards), and difficulty with user interfaces. Data factors that negatively influenced use included poor data quality (i.e. lagging, irrelevant, and unreliable data) as well as the overwhelming quantity to sift through.

The nine items from the Data Use for School Development scale in Schildkamp's Factors Affecting Data Use Survey (personal communication, October 26, 2017) breaks down the ways that principals might use data in the context of school improvement. Principals responded to each statement on a Likert scale that included 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree). The results appear in Table 3. More than 90% of principals agreed or strongly agreed that student results were used to determine yearly goals for school improvement (97.1%) and that student results led to decisions about professional development (95.6%). More than 80% indicated that (a) they used data to show teachers the extent to which the school achieved goals (85.5%) and (b) student achievement results were used to identify curricular gaps (84%). Three fourths or more of the principals replied that detailed data analyses were essential in the improvement process (79.7%) and that data were used to determine effective teaching (75%); about two thirds indicated using external evaluation for improvement (66.6%). In two areas at least one third of principals were neutral or disagreed regarding data use: using external evaluations for improvement (33.3%) and division of teaching time is based on learning needs (38.2%); furthermore, nearly three fourths were neutral or negative in the use of student results to evaluate teachers (72.4%). The Data Use for School Development scale provided some insight into the way principals made use of data, but the majority of information collected to answer RQ2 came from the Phase 2 qualitative data collection.

Table 3. Data Use for School Development Scale (N=70)

	Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5	Mean	Std. Deviation
In my school we use student results to determine yearly goals for school improvement.		1.4%	1.4%	79.7%	17.4%	4.13	0.48
In my school student results lead to decisions with regard to professional development.		1.5%	2.9%	82.4%	13.2%	4.07	0.47
I show teachers based on data to what extent the school is achieving our goals.		2.9%	11.6%	73.9%	11.6%	3.94	0.62
Student achievement results are used to identified gaps in our curriculum.		2.9%	13.0%	71.0%	13.0%	3.94	0.59
Detailed data analyses are an essential part of improvement processes in my school.	2.9%	1.4%	15.9%	63.8%	15.9%	3.88	0.80
In my school we use data as a tool to determine effective teaching methods.		8.8%	16.2%	60.3%	14.7%	3.81	0.80
In our school we use external evaluations for our own improvement.	1.4%	18.8%	13.0%	53.6%	13.0%	3.58	0.99
The division of teaching time in my school is based on identified learning needs of students.	2.9%	13.2%	22.1%	57.4%	4.4%	3.47	0.89
Results of students are used to evaluate teachers.	8.7%	39.1%	24.6%	23.2%	4.3%	2.75	1.05

Organizational characteristics that included vision, leadership, and support related to data use were measured by 16 items on the School Organization Characteristics Scale. As shown in Table 4, this scale generated a trend of positive agreement in responses but with greater variation than the previous two scales. Not a single principal disagreed that they were strongly encouraged by the district to use data as a tool to support effective practice. Principals responded to the top three statements with high agreement (rating of 4 or 5), indicating a shared awareness of the need to develop data analysis skills (96%) and consistent encouragement from leadership to use data. Notable for the focus of this study, only slightly more than half the principals (52%) agreed that someone helped them change their practice based on data. Less than half agreed or strongly agreed that a specific time was set aside for data use (44.9%).

Table 4. School Organizational Characteristics Scale (N =70)

	Strongly Disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5	Mean	Std. deviation
My school is aware that we need to keep developing the skills of teachers to analyze data.			4.4%	63.2%	32.4%	4.28	0.54
Our district encourages data use as a tool to support effective teaching.			10.1%	60.9%	29.0%	4.19	0.60
My supervisor encourages data use as a tool to support effective practice.	1.4%		13.0%	62.3%	23.2%	4.06	0.70
In my school we use a structured method to analyze and interpret data to base actions on.	1.5%	5.9%	17.6%	58.8%	16.2%	3.82	0.83
Data use is a priority in my school.	1.4%	10.1%	17.4%	52.2%	18.8%	3.77	0.93
There is someone who answers my questions about using data.	1.4%	7.2%	24.6%	47.8%	18.8%	3.75	0.90
I am adequately supported in the effective use of data.	1.4%	7.2%	20.3%	58.0%	13.0%	3.74	0.83
Teachers in my school share a common understanding about what good teaching is.	1.4%	10.1%	15.9%	63.8%	8.7%	3.68	0.83
My supervisor creates many opportunities (e.g. time) for me to use data.	1.4%	4.3%	34.8%	44.9%	14.5%	3.67	0.83
My supervisor is a good example of an effective data user.	2.9%	5.8%	36.2%	37.7%	17.4%	3.61	0.94
Teachers in my school share a common understanding of what student learning is.	1.5%	13.4%	14.9%	64.2%	6.0%	3.60	0.85
My supervisor discusses data with me.	1.4%	8.7%	29.0%	50.7%	10.1%	3.59	0.85
My supervisor discusses the results of their data analyses.	1.5%	7.4%	35.3%	45.6%	10.3%	3.56	0.84
There is someone who helps me change my practice based on data.	1.5%	13.4%	32.8%	41.8%	10.4%	3.46	0.91
Teachers in my school share a common understanding about effective ways to evaluate student learning.	2.9%	23.5%	20.6%	47.1%	5.9%	3.29	0.99
There is specific time set aside for me to use data.	2.9%	23.2%	29.0%	43.5%	1.4%	3.17	0.91

User characteristics of principals that influenced data use including dispositions toward data use and levels of perceived knowledge and skill are shown in Table 5. More than 95% of principals agreed (rated 4 or 5) with all three items involving the benefits or importance of data use, indicating they believed students benefit when instruction is based on data (95.6%), that data is important in determining individual student needs (98.5%), and that data is important in changing their own practice (95.5%).

Table 5. User Characteristics Scale (N=70)

	Disagree = 2	Neutral = 3	Agree = 4	Strongly Agree = 5	Mean	Std. dev
Students benefit when instruction is based on data.		4.5%	46.3%	49.3%	4.45	0.58
It is important to use data in determining individual student needs.		1.5%	54.4%	44.1%	4.43	0.53
Data are important in changing my practice.		4.4%	52.9%	42.6%	4.38	0.57
I am comfortable in interpreting data that are presented in graphs.		7.4%	67.6%	25.0%	4.18	0.54
I know how to interpret the data and the reports I receive (exam results, student achievement results of previous years)		10.3%	66.2%	23.5%	4.13	0.57
I am able to adjust my practice based on data.		8.8%	70.6%	20.6%	4.12	0.53
I am able to use data to diagnose student-learning needs.	2.9%	2.9%	76.5%	17.6%	4.09	0.57
I understand the quality criteria and concepts for data use (e.g., correlation, validity, reliability).	4.5%	9.0%	65.7%	20.9%	4.03	0.70

Following User Characteristics, the next most positive responses were generated by the five items from the Computer System Characteristics Scale. Table 6 shows that two of the five items yielded means above 4.0 and the remaining three, above 3.5, indicating general agreement that the district's computer systems met their needs.

Table 6. Computer System Characteristics Scale (N=70)

	Strongly disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly agree = 5	Mean	Std. deviation
I have the proper technology to efficiently examine data.	1.5%	1.5%	7.4%	51.5%	38.2%	4.24	0.77
The computer systems in my district provide me access to lots of data.	2.9%	1.5%	7.4%	52.9%	35.3%	4.16	0.86
The computer systems in my district allow me to examine various types of data simultaneously (e.g., attendance, achievement, demographics).	2.9%	11.8%	10.3%	52.9%	22.1%	3.79	1.02
The computer systems in my district generate displays (e.g. reports, graphs, tables) that are useful to me.	2.9%	8.8%	20.6%	54.4%	13.2%	3.66	0.92
The computer systems (for data use) in my district are easy to use.	2.9%	13.2%	22.1%	44.1%	17.6%	3.60	1.02

The Data Characteristics Scale consisted of 10 items measuring principals' perceptions of data quality, such as access to timely, relevant, and accurate data. This scale had the lowest overall mean of the four scales on the survey (M = 3.33) and the most variation in responses as shown in Table 7. Most principals agreed or strongly agreed (rating of 4 or 5) that they had access to relevant student data (85.5%), which tracked progress (81.6%). Agreement surrounding descriptors of data accuracy (60%) and timeliness (63.8%) was slightly less with a third responding neutral (rating of 3) or disagreeing (rating of 1 or 2). When asked whether data was available within 3 weeks of the beginning of a school year, 20% disagreed and more when students started midyear (27.5%). The majority of principals disagreed (rating 1 or 2) that they could find all the data in one system (67%).

Table 7. Data Characteristics Scale (N=70)

	Strongly disagree = 1	Disagree = 2	Neutral = 3	Agree = 4	Strongly agree = 5	Mean	Std. deviation
I have access to relevant data on my students.	1.4%	7.2%	5.8%	66.7%	18.8%	3.94	0.82
I have data on the progress of my students.	1.5%	9.2%	7.7%	70.8%	10.8%	3.80	0.81
The data to which I have access to help me plan my support.	1.4%	7.2%	14.5%	63.8%	13.0%	3.80	0.81
With the data I have on my students, I can determine the growth of my students from year to year.	4.3%	10.0%	12.9%	65.7%	7.1%	3.61	0.92
The data I have on my students are up to date.	1.4%	8.7%	26.1%	58.0%	5.8%	3.58	0.79
The data I have on my students are accurate.	2.9%	5.7%	31.4%	54.3%	5.7%	3.54	0.81
Data on my current students are available at the beginning of each school year (within 3 weeks).	1.4%	18.6%	15.7%	58.6%	5.7%	3.49	0.91
When students start in the middle of the school year, their data becomes quickly available.	1.4%	26.1%	36.2%	34.8%	1.4%	3.09	0.85
I can find all the data on my students in one system.	17.1%	50.0%	14.3%	18.6%		2.34	0.98
I have too little data on my students.	18.8%	52.2%	21.7%	5.8%	1.4%	2.19	0.86

Finally, when principals were asked to describe the impact of data analytic tools on their work, a common trend emerged around principals saying that they felt data was generally underutilized. Similar to principals around the world (Schildkamp & Kuiper, 2010), the principals in this study talked about the use of data to inform decision as one of their greatest challenges (Principal 3). As in other studies, the mere availability of data and tools has not guarantee use or changes in practice (Wayman & Stringfield, 2006), and the factors impacting data use have remained complex and numerous. The researcher observed several ways that the tools were not as useful and usable as they could be. Large volumes of data were available, but the tools provided included mostly static and descriptive reports that failed to harness the analytic power of contemporary data processing and predictive analytics as seen in educational data mining trends. A gap was identified between the theory that educational leaders should be cross-analyzing different data types such as demographic, school process, perceptions, and student learning data (Bernhardt, 2018) and what the tools actually supported them to do. There was an underrepresentation of tools to measure and analyze perceptual and school process data and few tools integrated more than one type of data.

The qualitative data generated in Phase 2 confirmed many of the findings surrounding the factors influencing data use. A summary of the factors influencing data use were summarized and situated in the conceptual framework in Figure 3.

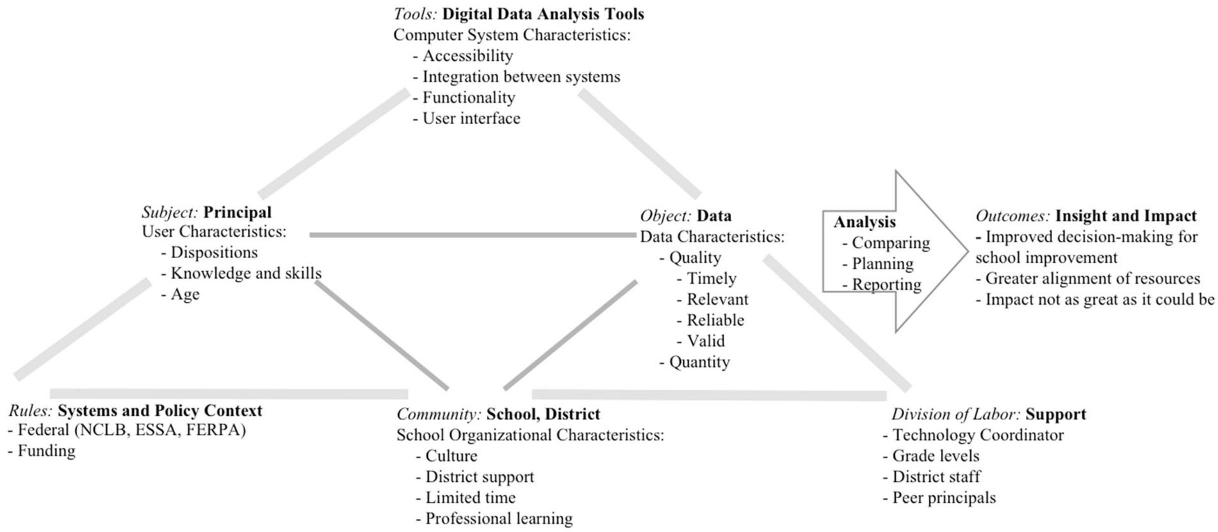

Figure 3. Factors influencing use situated in the conceptual framework

Study's Significance

The findings from this study can have implications for the development of theory as well as for stakeholders such as district leaders and tool designers. This study reaffirms the tremendous importance of user experience studies. A need exists for designers of data platforms to work with principals directly with an iterative design mindset so that the tools continue to be refined as data sources change, user needs evolved, research expands, and theories are updated. For each of the tensions identified in this study, designers can explore tool enhancements to support solutions. For example, users stated that they lacked access to training, so perhaps designers can address the need by embedding training modules in the tools. Principals often mentioned that they lacked dedicated time to engage in data analysis activities, so designers could enhance time-saving features, such as push notifications that would send principals data alerts when key thresholds are met instead of waiting for the principal to log in. One interviewee expressed his desire to have natural language processing (NLP) capabilities which could have profound implications. Novice data users often wish to explore data but are limited by their inability to formulate their questions in terms of tool operations (Setlur, Battersby, Tory, Gossweiler, & Chang 2016). An example can be found in the Tableau platform featured called Ask Data, which can interpret the intent behind vague questions to produce visual results. An application of such tools in education might empower a principal to ask for the "top students" or "highest performers" or "maximum score," and the system could be flexible enough to interpret a wide range of terms to query the data. The dream of having a natural conversation with data is being realized in other industries and would certainly benefit school leaders who are not trained analysts. In summary, user-centered products are enhanced by user research based on user narratives and observed experiences.

This study also contributed to theory by creating a pictorial representation of principals' data analysis conceptualized in activity theory to show the interplay of related factors while highlighting the important mediating role of the tools themselves (Figure 1). Other frameworks, such as Schildkamp's data use framework (2012), have considered the enablers and barriers of data use to include organization, data, and users but have not emphasized technology as a significant factor. The findings from this study confirmed technology as mediator influencing educational data use. This study adds to the growing body of research that confirms the usefulness of activity theory to guide the development of educational research questions, conceptualize relationships between factors, and identify tensions in a school setting. By simultaneously drawing from the field of UX, the researcher was able to use the activity theory framework in this study to organize factors that impacted users in a way that can be useful to others interested in linking these fields of study.

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Gamifying an Online Instructional Design Course: An Educational Design Research Study

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Keywords: gamification, educational design research

Abstract

This paper presents the results of a two-year educational design research (EDR) initiative focused on the challenge of increasing learners' motivation and engagement in an instructional design (ID) course. Class observations and student evaluations from prior semesters clearly showed the need to redesign a foundational graduate course at a large university in the southwestern US. Following the principles of EDR, a team of three faculty and two graduate assistants addressed this need through multiple cycles of analysis, development, testing, and refinement. The literature review conducted during the analysis and exploration phase of EDR indicated that gamification as a pedagogical technique could improve student interest and engagement. Gamification elements were introduced to the course design during the design and construction phase and were subsequently tested and refined during the evaluation and reflection phase. Data collected included notes and drawings created during the research team's brainstorming sessions and from the course archives on Blackboard. The archives included text from various course discussion forums, assignment content, messages from students, and feedback from students about their perceptions of the game elements. The redesigned course has been offered for two iterations, and 63 graduate students have completed the course. Five design principles that are relevant in real-world educational contexts emerged through the systematic introduction of various interventions and adjustment of the components of the educational content of the course. This EDR study demonstrates how technology-based gamification elements could be used to enhance student engagement and motivation and can serve as a model to inspire others who may consider gamifying their online and blended courses.

Introduction

Students' interest and active engagement in a course are critical for learner academic achievement (Soffer & Cohen, 2019). Through class observations and student evaluations from prior semesters, the course instructor of an instructional design (ID) course at a large university in the southwestern US found that some of her students perceived the course to be dry and uninteresting, struggling to stay engaged with the content in the first half of the course. Following the principles of educational design research (EDR), a team of three faculty and two graduate assistants worked through multiple cycles of analysis, development, testing, and refinement to redesign the course with the aim to improve students' interest, motivation, and early engagement in the content. This case study reports findings from this two-year educational EDR initiative and describes how game elements of fantasy storyline, avatars, gamified points structure, badges, leaderboard, and interactive multimedia supported immersive play experiences within the online course.

Background

Smith and Ragan (2004) define instructional design (ID) as a systematic and reflective process of translating learning principles into instructional content. Having a good understanding of the instructional design process can help educators create courses that are more likely to be effective and engaging. Research studies have shown the positive impacts of effective instructional design in many professional education settings, such as in medical training (Melo, Falbo, Muijtjens, Vleuten, & Merriënboer, 2016), librarian education (Mullins, 2014), and preservice teacher training (Kumar & Hamer, 2012).

Given the importance of instructional design for students pursuing a degree in instructional technology, a foundation ID course has been one of the core courses of our Learning, Design, and Technology graduate program since the program's inception in 1979. The course, entitled *CUIN 7390: Instructional Design*, introduces students to the theoretical, experiential, and critical components of the instructional design process. In addition to core knowledge, students gain practical experience by designing stand-alone instructional modules that can be used in real educational settings ("Course Descriptions," 2017). The design of the course adopts the systematic design of instruction model introduced by Dick, Carey, and Carey (2014) and uses the textbook written by these authors, *The Systematic Design of Instruction*.

The initial design of CUIN 7390 followed each phase of the Dick and Carey instructional design process and was structured such that each week's instruction corresponded to a step in the design process. The course began with the analysis phase of instructional design (e.g., needs assessment, learner analysis, and performance objectives) that would eventually lead to students developing instructional materials for their individual projects. At the end of the course, the students formatively evaluated the materials that they created with a sample of their target population (Figure 1).

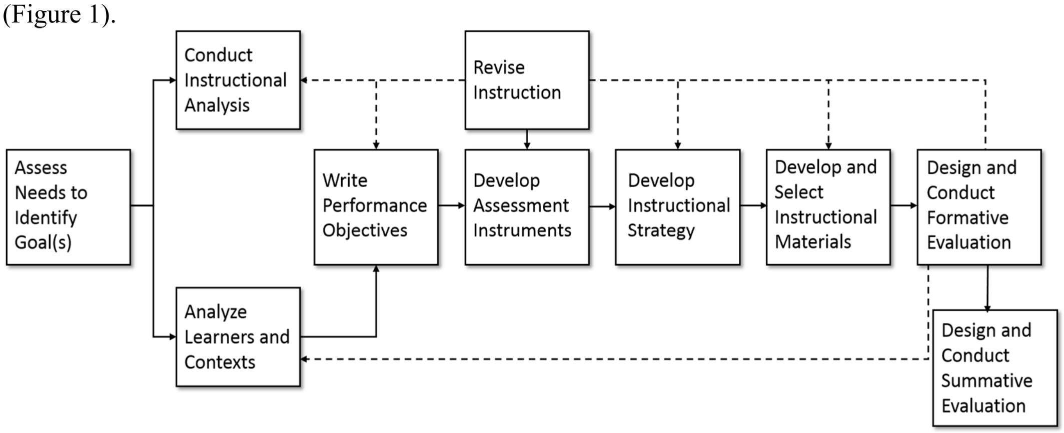


Figure 1. Dick and Carey's systems approach model. Adapted from *The Systematic Design of Instruction* (8th ed., p. 1) by W. Dick, L. Carey, L., J. O. Carey, J. O., 2018, New York, NY: Pearson. Copyright 2018 by Pearson.

Since this course relies heavily on information in the textbook, students often reported that the large amount of reading was challenging. Student evaluations for the past ten years indicated that while the students found the overall quality of the course high, they sometimes remarked comments about the content such as, "Overwhelming at first!" (Anonymous student response on an end-of-course evaluation). Some students over the years described discomfort and stress that they felt in the first part of the course before they understood the ID process as a whole. For example, one student commented, "In the beginning, there was no light at the end of the tunnel. It has, however, come full circle and made more sense" (anonymous student response on an end-of-course evaluation). In preliminary redesign discussions, the primary instructor shared that students who were organized, methodical, and self-regulated tended to engage with the course materials early in the semester and overall performed well in the course. However, she said that other students who were less detail-oriented, auditory, or visual learners appeared to find the systematic process dry and uninteresting and would often struggle in the first half of the course. Such students would typically have greater interest and engagement once they realized the *big picture* and how the planning phase of the ID process fit into the development phase as they started to put the pieces together about halfway through the course (Personal communication with the primary course instructor). Since this course is usually offered entirely online, we saw a strong need to redesign the course and apply innovative instructional strategies that could motivate students and engage them with the content earlier in the semester. We also felt that this course was a good candidate for applying gamification elements for three main reasons –

1) This course is an introductory course, but it is very important because students learn essential skills they will need in other courses in the program;
2) Because this is a theoretical course, the instructional design content did not change significantly from year to year; and
3) The course is taught every spring, enabling the research team to quickly evaluate what worked and what was needed to be revised for the next iteration the following year.

Educational Design Research

To address the need to enhance student motivation and engagement, we followed the principles of EDR to generate insights through multiple cycles of analysis, development, testing, and refinement (McKenney & Reeves, 2019). Central to EDR is the iterative testing and refinements on complex educational problems to derive evidence-based claims that may potentially impact naturalistic settings (McKenney & Reeves, 2019). When doing EDR (sometimes referred to as *design-based research* or *DBR*), researchers systematically introduce various interventions or adjust the components of their educational content to refine and produce practical knowledge or theories that are relevant in real-world educational contexts (Barab & Squire, 2004; Brown, 1992). DBR studies evaluate "what works; for whom; under what authentic, field-based conditions; and how/why this approach is effective" (Dede, Ketelhut, Whitehouse, Breit, & McCloskey, 2009, p.14).

Although it is not a linear step-by-step process, EDR typically involves three major phases. The initial *analysis and exploration phase* involves working closely with collaborators to acquire an understanding of a significant educational problem and investigate how others have addressed it. This phase gradually morphs into a *design and construction phase* that is focused on identifying or creating appropriate design principles and using these principles to develop a prototype intervention that addresses the problem. Finally, an *evaluation and reflection phase* of multiple iterations of data collection and analysis is conducted to test the prototype intervention and review the implications of the findings. Figure 2 depicts the EDR process.

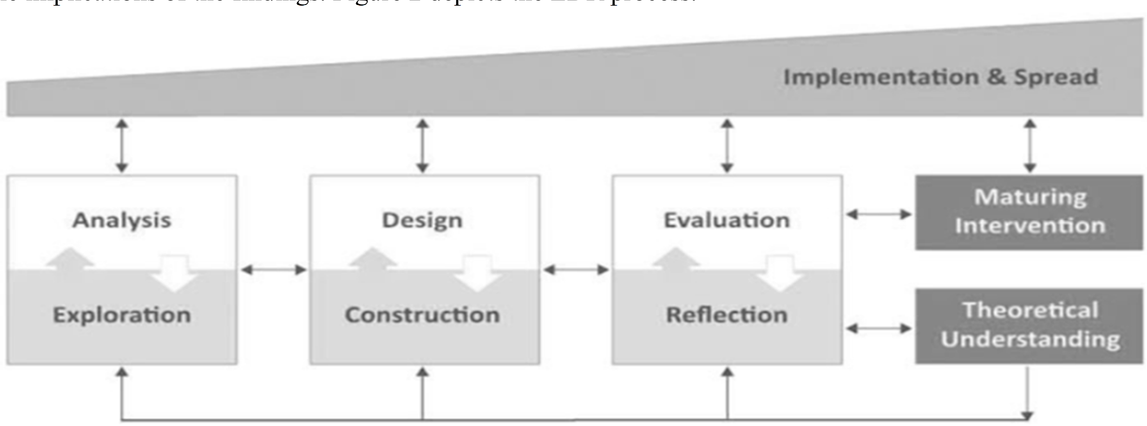


Figure 2. The process of conducting educational design research. From *Conducting Educational Design Research* (2nd ed., p. 83) by S. E. McKenney and T. C. Reeves, 2019, New York, NY: Routledge. Used with permission.

Gamification

The literature review conducted during the initial analysis and exploration phase suggested that gamification as a pedagogical technique could improve student interest and early engagement (Betts, Bal, & Betts, 2013; Gibson, Ostashewski, Flintoff, Grant, & Knight, 2015). The term *gamification* refers to the "use of game design elements within non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011, p. 1) and involves the use of "game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" (Kapp et al., 2014, p. 54). While the application of gamification in education is still an emerging trend, its proponents suggest that it can be employed to enhance student engagement and prompt learning (Dicheva et al., 2015).

There are some elements that are commonly found in a gamified course: Story, rules, challenge, curiosity, character, interactivity, feedback, and freedom to fail (Buckley, Doyle, & Doyle, 2017; Kapp et al., 2014). It is not necessary to add all of these elements when doing gamification on a course. However, Nicholson (2014) suggested the use of "narrative, freedom to choose paths to explore, playful activities, and opportunities to reflect" (p.14) for a gamified course to be engaging and meaningful for students.

Methodology

McKenney and Reeves (2019) suggest that EDR is not so much a specific research methodology as it is a genre of educational inquiry that seeks to maximize the practical impact of educational research while at the same time seeking to reveal new theoretical knowledge. For our study, we pursued EDR for two main reasons: (1) the parallel resemblances of its process with the ID process and (2) the naturalistic or real-life context emphasis of the method. Central to EDR is the iterative testing and refinements on complex educational problems to derive evidence-based claims that may potentially impact naturalistic settings (McKenney & Reeves, 2019). When using EDR, researchers systematically introduce various interventions to or adjust the components of their educational content to refine and produce practical knowledge or theories that are relevant in real-world educational contexts (Barab & Squire, 2004; Brown, 1992). EDR generates insights through its multiple cycles of analysis, development, testing, and refinement, from which new insights would be generated to improve the following cycles.

Research Questions

Our EDR initiative addressed two overarching research questions –

1. What is an optimal design for applying gamification elements in an online instructional design course to improve student motivation and increase their engagement as early as possible in the course?
2. What design principles can be identified that can be used to extend the application of gamification elements in other online or blended courses?

Data Sources

The data for this study included notes, drawings created during the research team's brainstorming sessions, and reflection notes taken during and after the end of each course. We also examined the course archives on the Blackboard learning management system (LMS). The archives included text from various course discussion forums, assignment content, messages from students, and post-course feedback from students about their perceptions of the game elements.

This paper reports findings from two iterations of the redesigned ID course. In Year One, 24 students completed the course, and 39 students completed in Year Two. The students' ages ranged from 23 to 54 (*M*=6.67, SD=8.94) with 20.6% identified as male and 79.4% female. At the beginning of the course, we asked students to complete an online survey that was modified from the student course engagement questionnaire (SCEQ) (Handelsmann, Briggs, Sullivan, & Towler, 2005). The survey was optional and not tied to their grades. The SCEQ is well-validated to measure student engagement and has been reported to have high-reliability scores (Ginns, Prosser, & Barrie, 2007; Handelsmann et al., 2005). The Cronbach alpha for this study was .832. The 23-item survey uses a 5-point scale ranging from 1 (not at all characteristic of me) to 5 (very characteristic of me). This survey measure student's perception of course engagement in four categories – skills, emotions, participation, and performance. Several of the items were slightly reworded to match the course settings (see Appendix 1). For example, item 3 – "Doing all of the homework problems" substituted "homework problems" with "assignments." Table 1 displays the SCEQ results for students who took the course in Years One and Two.

Table 1. Student course engagement questionnaire scores for the first and second years

Year		Skills	Emotional	Participation	Performance
first year	Mean	38.31	20.63	24.50	14.5
	N	16	16	16	16
	SD	3.790	2.604	3.688	1
second year	Mean	37.80	20.97	22.77	13.55
	N	30	31	30	31
	SD	3.478	3.114	3.748	1.36

Educational Design Phases

Phase 1: Analysis and Exploratory Phase

In the fall of 2016, our team began the redesign process by reading and discussing the book, *The Gamification of Learning and Instruction Fieldbook: Ideas into Practice* by Kapp et al. (2014), as well as research articles about educational gamification. We held weekly meetings to discuss our ideas and brainstormed ways of making the game more engaging and authentic. We discussed the design of games that we had experienced, including older immersive games, such as *Myst* (Miller & Miller, 1993).

Choosing a story for the game was a critical first step in the process. Kapp et al. (2014) suggest that stories could help improve learner's engagement, since they "evoke emotions, provide a context for placing information, and are the way humans have handed down information for centuries" (p. 236). Because of our proximity to Johnson Space Flight Center in Houston, Texas, we decided to use a space theme for the storyline. Throughout our brainstorming sessions, we discussed the script, characters, challenges, and possibilities for adding more interactivity to the course content. We also created sketches and flowcharts for ideas that could carry the content through the 15 weeks of the semester and still convey the essential ideas and skillset of the ID process (Figure 3). This spurred exploration into space terminology and content as we developed the prototype during the next EDR phase.

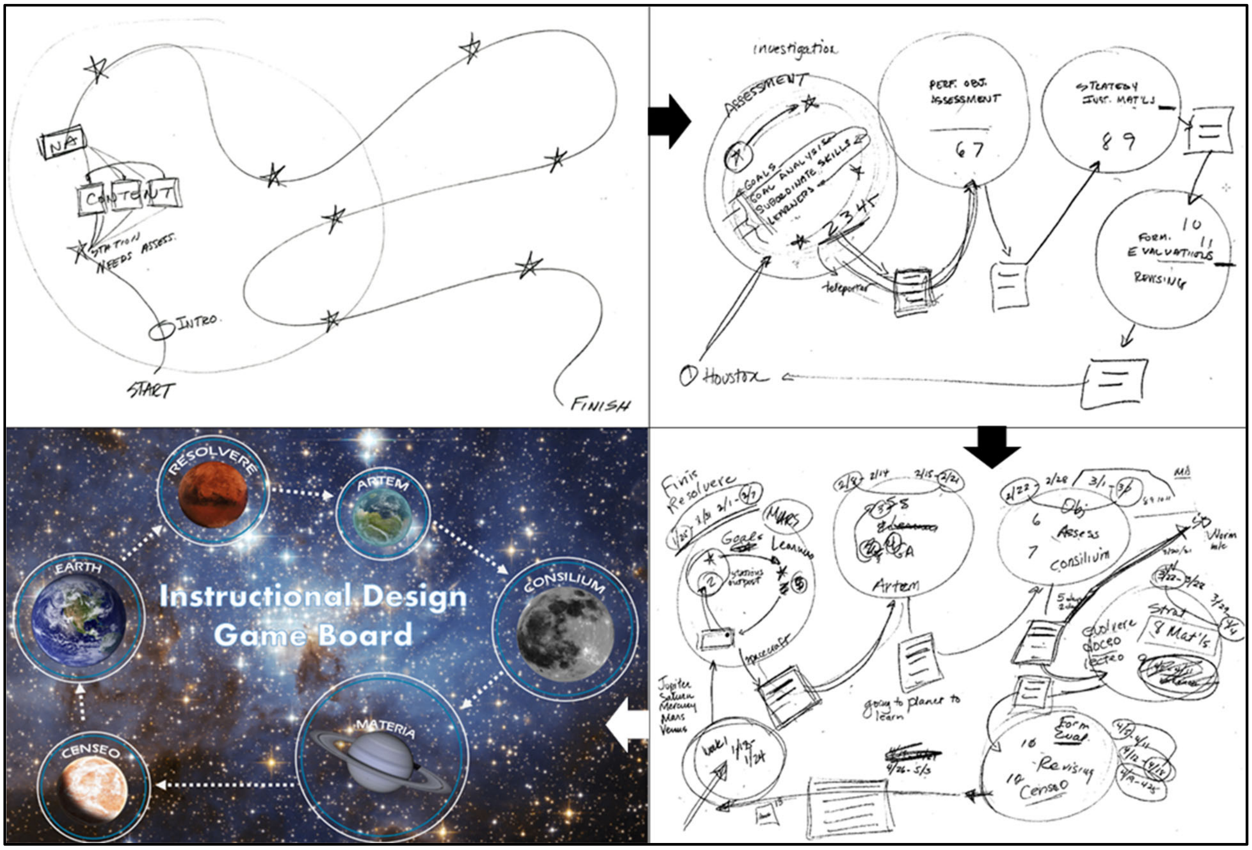


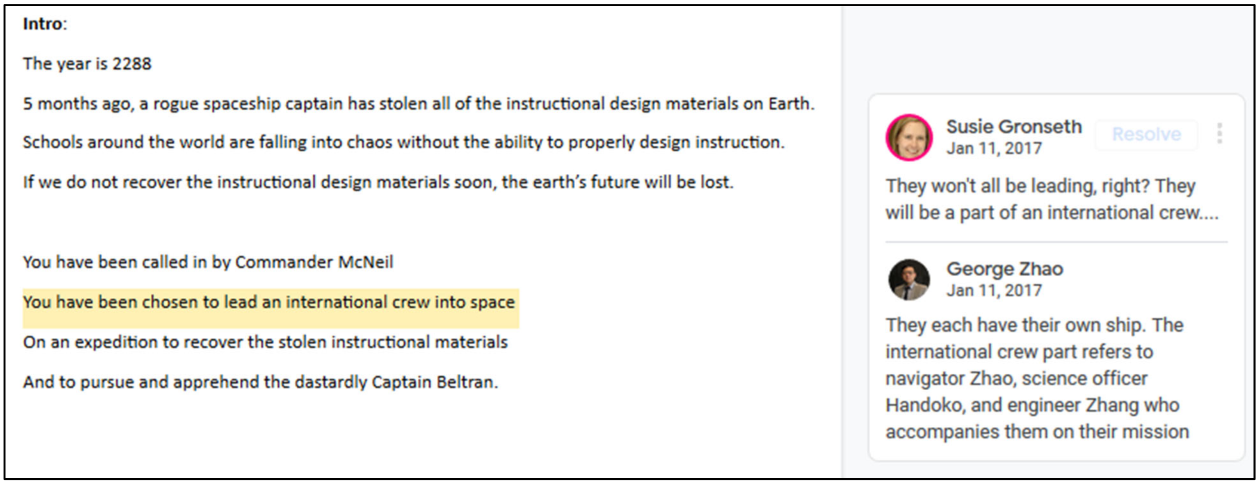
Figure 3. Drawings show the evolution of the Instructional Design Game Board from concept to reality.

As ID process can be easily divided into five components, the research team decided that the space "crew" (the students) could visit five planets on their quest to find an "evil villain" who stole important ID documents. Planet names were based on Latin words that describe the focus of ID process component. For example, the first planet was named *Resolvere* (meaning "to analyze"), since identifying instructional goals using front-end analysis and analyzing learners and context were covered in this section. Students would have *missions* to carry out on each planet that would culminate with their completing their own ID project, and they worked individually and in teams through the ID process to create design documents for their content area.

We explored the idea of using commercial software to create the game, and we researched companies who developed these tools. We contacted two companies who had received recent design awards for their game software and evaluated demos of their programs. Commercial software appealed to us at first, because it offered many features including built-in leaderboards, avatars, and badges. However, the more behavioral aspects of the game software, as well as the high cost, deterred us from using this software and resulted in our developing the game using a variety of tools including Adobe Captivate and Photoshop, Camtasia, and features already existing in Google Sheets and Blackboard.

Phase 2: Design and Construction Phase

We began the design and construction phase by chunking the course content and aligning it with the storyline using a Google Doc shared with the team. This allowed team members to interact continuously by leaving comments and editing the text (Figure 4).



Intro:

The year is 2288

5 months ago, a rogue spaceship captain has stolen all of the instructional design materials on Earth.

Schools around the world are falling into chaos without the ability to properly design instruction.

If we do not recover the instructional design materials soon, the earth's future will be lost.

You have been called in by Commander McNeil

You have been chosen to lead an international crew into space

On an expedition to recover the stolen instructional materials

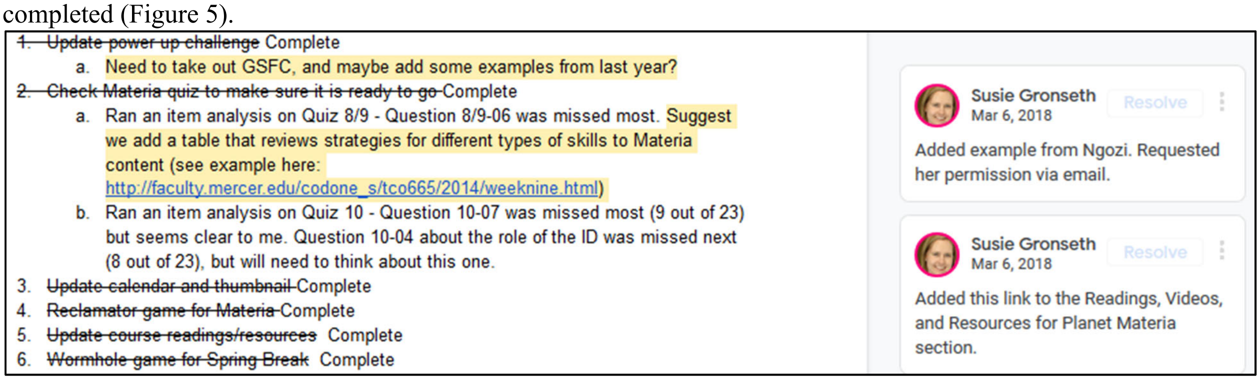
And to pursue and apprehend the dastardly Captain Beltran.

Susie Gronseth Resolve
Jan 11, 2017
They won't all be leading, right? They will be a part of an international crew....

George Zhao
Jan 11, 2017
They each have their own ship. The international crew part refers to navigator Zhao, science officer Handoko, and engineer Zhang who accompanies them on their mission

Figure 4. Google doc used to align, edit and revise the storyline, script, and story videos.

Music, ideas for graphics, and scripts for the audio were also added to this document as the design was finalized. As the construction of the course began, we also added a Google Doc to keep track of changes needed and completed (Figure 5).



1. ~~Update power up challenge~~ Complete
   a. Need to take out GSFC, and maybe add some examples from last year?
2. ~~Check Materia quiz to make sure it is ready to go~~ Complete
   a. Ran an item analysis on Quiz 8/9 - Question 8/9-06 was missed most. Suggest we add a table that reviews strategies for different types of skills to Materia content (see example here: http://faculty.mercer.edu/codone_s/tco665/2014/weeknine.html)
   b. Ran an item analysis on Quiz 10 - Question 10-07 was missed most (9 out of 23) but seems clear to me. Question 10-04 about the role of the ID was missed next (8 out of 23), but will need to think about this one.
3. ~~Update calendar and thumbnail~~ Complete
4. ~~Reclamator game for Materia~~ Complete
5. ~~Update course readings/resources~~ Complete
6. ~~Wormhole game for Spring Break~~ Complete

Susie Gronseth Resolve
Mar 6, 2018
Added example from Ngozi. Requested her permission via email.

Susie Gronseth Resolve
Mar 6, 2018
Added this link to the Readings, Videos, and Resources for Planet Materia section.

Figure 5. Tracking changes needed and completed in the course using a shared Google doc.

As we worked on the storyline and learned more about space exploration through conversations with space subject matter experts, we added elements such as a "wormhole" for "disappearing" during spring break, used a photo of the mission control room at NASA as the background for the Commander (instructor) videos, and created assignments for small groups to create educational materials for the actual eclipse that would take place the summer after the revised course was offered. On each planet, we planned interactive multimedia elements for the students that would reveal the next chapter in the "Captain Beltran" story and enable them to "unlock" the next section of course materials by locating passcodes and completing content-related tasks within the game. Course instructors became facilitators, and they would communicate through instructional videos, supportive handouts, and feedback to guide the students throughout the course.

When we began discussing how we would construct the game interface, we realized that we could not carry out the complete vision of our online course experience solely using the functions of Blackboard. This challenged our team to identify and bring in new tools, such as Voki for creating the student avatars and talking avatar "explainer" videos, Google Sheets for running a live class leaderboard with a linked "behind the scenes" instructor sheet, and Camtasia and Adobe Captivate for generating interactive multimedia game-play. We transformed our online discussions from a *post once, reply twice* expectation to a team-driven, goal-oriented discussion framework. We found that students were so invested in their teamwork that they posted more actively and initiated even further discussion through student-created Google Docs, Hangouts, and Slack channels.

Much of our design discussion centered on how to transform the previous points structure of the course into the game format. Students accumulated "flight hours" (points) for completing missions, quizzes, and bonus "Power Up" challenges and for actively participating in discussions. The "space crew" leaderboard showed students' current standings with regard to flight hours earned, game levels achieved, and badges earned. Students were represented by avatars and the game names they created, which were not their real names, enabling them to assess how they were performing against the other team members while maintaining their anonymity. The leaderboard was easily accessible to students through a link in the main menu of the Blackboard course, and we recognized the current leaders on each planet in course announcements. We also designed three different badges that were displayed on the leaderboard. One badge, *Patches Earned*, represented the student's current astronaut rank earned. Students began the course as *Junior Astronauts* and then rose to higher positions as they earned "flight hours" (points). Another badge that was incorporated into the leaderboard were wings that were also aligned to students' current rank. The third badge displayed any points earned from the "Power Up" challenges, which were bonus activities for each planet. Figure 6 shows a portion of the leaderboard with student-created avatars and names, as well as the three types of badges, "total hours in space" (accumulated points), level, and hours needed to move up to the next level.

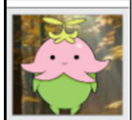
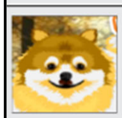
	Astronaut	Total Hours in Space	Level	Hours Needed to Reach Next Level	Patches Earned	Rank Earned	Wings Earned	Power Up Badges Earned
 Astria Rosebud	Astria Rosebud	207.56	Level 5	You are at the highest level		Master Astronaut		
 Hikari	Hikari	207.27	Level 5	You are at the highest level		Master Astronaut		
 Isa	Isa	199.76	Level 4	1.2		Senior Astronaut		

Figure 6. Course leaderboard.

Another complex task involved tracking the different points that students could earn while on each planet. Figure 7 shows a screenshot of the activities for one planet in the tracking system we used to assign points and bonus points for the challenges.

Item	Week	Points/Flight Hours
Planet Resolvere		
Chapter 2 Concepts Quiz	2	5
Week 2 Engagement • Planet Resolvere Game (game SCORM) (1 pt.) • Planet Resolvere Mission video (1 pt.) • Week 2 Discussion (3 pts.)	2	5
Chapter 5 Concepts Quiz	3	5
Week 3 Discussion (Weekly Engagement)	3	5
Planet Resolvere Mission • Goal Statement(s) (4) • Description of Learner Interview (2) • Learner Analysis (3) • Context Analysis (6)	3	15
Bonus: Power Up Challenge 1	*3*	*3*
	Planet Resolvere Total	**35 (+3 bonus)**

Figure 7. Screenshot of the online tracking system for possible points on Planet Resolvere.

Lastly, throughout the process, we also created short videos to provide an overview of each planet and introduce the "mission" (assignment) that they had to complete on the planets. We also created interactive activities on each planet.

The gamified course was first implemented in spring semester 2017. Figure 8 shows the course schedule for the first implementation of the course in spring 2017.

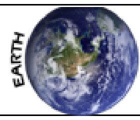
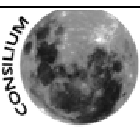
	Dates	Content
		Getting Ready: Space Camp!
	1/16 - 1/ 21	Ch. 1: Introduction to Instructional Design
	1/22 - 1/23	"Flying to Planet Resolvere" / Recharge
		Planet Resolvere ("Analyze")
	1/24 - 2/ 4	Ch. 2: Identifying Instructional Goals Ch. 5: Analyzing Learners and Contexts
	2/5 - 2/ 6	"Flying to Planet Artem" / Recharge
		Planet Artem ("Skills")
	2/7 - 2/18	Ch. 3: Conducting a Goal Analysis Ch. 4: Identifying Subordinate and Entry Skills
	2/19 - 2/20	"Flying to Planet Consilium" / Recharge
		Planet Consilium ("Design")
	2/21 - 3/4	Ch. 6: Writing Performance Objectives Ch. 7: Developing Assessment Instruments
	3/5 - 3/6	"Flying to Planet Materia" / Recharge

Figure 8. Screenshot of course schedule for 2017 spring semester showing the activities on each planet.

Phase 3: Evaluation and Reflection

After the first implementation of the course, the team met to reflect on the experience. We shared student comments we had gathered throughout the course. Overall, debriefing data centered on the learning of new technology skills. There was a feeling of accomplishment about how we had created a vision for the course and designed innovative ways to make it a reality. For example, since we did not use commercial software to create the game, we had to design our own leaderboard from scratch with Google Sheets and embedded graphics using formulas and displays that we learned how to use during the construction phase. We also used Blackboard's advanced features such as SCORM and adaptive release of content. In addition to technology skills, we also acquired new pedagogical skills, as we spent time in the design and construction phase trying to create activities that would challenge students, while, at the same time, allowing them to practice ID.

The team noted two areas that needed improvement after the first-year implementation. In Year 1, the students were divided into small groups; in these small groups, students followed a simplified ID process and created educational materials about the eclipse which would take place in August 2017. We felt this would give students a chance to support each other and learn how to use the ID process collaboratively. However, there were too many things happening at the same time; students were working on their own ID projects as well as their group project while they were also on a journey through space and learning about the ID process. In Year 2, we changed the assignments in the small groups so that students shared their progress on their own ID project with their group in order to give and receive peer feedback.

At the end of the course, we asked our students to provide voluntary feedback regarding the structure of the course and its game elements. We designed this survey to gather input about components of the course that they perceived helpful in motivating and keeping them engaged with the course content and components that they felt could be improved. The survey is composed of sixteen items, with fourteen Likert-type items, one rank-order item, and one open-ended item. Table 2 shows student post-course survey responses for the Likert-type items.

Table 2. Descriptive Statistics Results from the First and Second Iterations' Post-Course Survey.

		first iteration			second iteration		
	Item	N	Mean	SD	N	Mean	SD
1	The gamification elements in CUIN 7390 made it feel like a real game.	16	3.88	1.147	31	3.74	1.182
2	In general, how effective was the gamification approach used in CUIN 7390?	16	3.31	1.250	31	3.19	1.108
3	Your motivation in this gamified course	16	3.75	.931	31	3.90	.790
4	Your engagement in this gamified course	16	4.00	1.033	30	3.80	.805
5	The amount of work overall in this gamified course	16	3.88	.719	30	3.77	.728
6	The difficulty of this gamified course	16	3.31	.704	31	3.39	.715
7	The ease of navigating the course materials in this gamified course	16	3.31	1.138	31	3.42	.720
8	Time spent reading and viewing course materials in this gamified course	16	3.63	.957	31	3.71	.643
9	Time spent discussing course content with classmates in this gamified course	16	3.50	1.155	31	3.39	.667
10	Time spent completing the assignments in this gamified course	16	3.69	.704	31	3.84	.583
11	Overall, how useful were the course activities in helping you become more knowledgeable in instructional design?	16	4.00	.966	30	4.07	.980
12	The textbook and supplemental learning materials used in the course were:	16	4.13	1.258	31	4.06	.854
13	The instructions for the weekly course activities were:	16	4.44	.512	31	4.52	.508
14	This was a worthwhile learning experience.	16	4.37	1.025	31	4.77	.497

Design Principles for Gamifying an Online ID Course

The evaluation and reflection phase of this EDR project revealed design principles related to the integration of gamification elements into an online ID course.

Principle 1: Apply a Team Approach in Course Gamification

The redesign of CUIN 7390: Instructional Design was a collaborative effort of a team of three faculty and two graduate students in the Learning, Design, and Technology area. We began working on the project at the beginning of Fall 2016 and went through the iterative process of EDR to first clarify the problem, then create and test practical interventions, and finally engage in reflection to reveal theoretical insights to improve student interest and engagement. Once the literature review indicated that gamification might be a viable solution for increasing student motivation and engagement, the team members read about gamification in *The Gamification of Learning and Instruction Fieldbook: Ideas into Practice* (Kapp, Blair, & Mesch, 2014). We also studied published research on how gamification has been applied in online courses, and reviewed digital tools that could support various game elements. Analysis of our design notes made it evident that the team reexamined and redefined in each iteration the approach in which the course was delivered to better connect with the learners and explore the content more deeply.

Principle 2: Use Story to Reinvigorate and Provide Continuity in Online Course Content

Viewing the course through a new lens for teaching online using gamification provided inspiration for the designers to "play" with teaching ideas, providing a refreshed perspective on content that had been previously taught in much the same way for years prior. Story and role-play elements were incorporated in the redesigned course through the space exploration game segments and learner avatars and screen names. The "space crew" leaderboard showed students' current standings in regard to flight hours earned, game levels achieved, and badges earned. Students completed tasks individually, as well as worked in teams to design informal instruction for a simulated NASA project. Story became a powerful way to engage students in learning a potentially intimidating process of systematic ID.

Principle 3: Integrate Multimedia Tools to Support Gamification Application

The complete vision of the gamified online course experience could not be accomplished solely using the functions of the LMS. The team used Google Docs for online collaboration in the design process, identified image and video creation tools for creating avatars and talking avatar explainer videos, created cloud-based spreadsheets for the live class leaderboard, and used Adobe Captivate for generating interactive multimedia game-play. Online discussions were transformed to be team-driven and goal-oriented. It was found that students were so invested in their teamwork that they overall posted actively and initiated even further discussion through student-created documents, synchronous sessions, and asynchronous communications.

Principle 4: Integrate Interactivity in Gamification

A key outcome of this project has been maximized student academic learning time. We found that embedding interactive online multimedia throughout the course modules immersed learners in a powerful story and provided opportunities for them to acquire, practice, and apply ID concepts and skills. They increased their time exploring materials in the course site, often completing optional activities above and beyond the required assignments. The novel approach to grading through the accumulation of "flight hours" for successful completion of activities made it possible for students to extend their learning in directions that were meaningful and useful for them and served as a motivator to encourage them to reach increasingly higher levels in the course.

Principle 5: Provide Opportunities for Peer-to-Peer Interaction

Even though students were separated by physical distance, the team-based discussions relating to the development of the solar eclipse instructional units connected students to each other and the content through shared design work and contextualized their learning within a realistic ID case. The course content that may have felt at times complex and difficult to understand became more palatable, as our redesigned course offered an abundance of varied examples and practice with visual, auditory, and hands-on elements aimed at helping students grasp the essence of the ID process. The examples and practice experiences were tied together through the space adventure storyline, demonstrating to students that ID can be playful and creative.

Discussion

This study has demonstrated how technology can be used to enhance student engagement in online environments and to serve as a model to inspire others who consider applying gamification to their online and blended instruction. Some might ask why we used EDR to address the need to redesign the ID course instead of the systematic design of instruction model (Dick et al., 2014) taught in the course. ID models are adequate if the primary goal is to develop a more effective course alone, but we sought to accomplish the twofold mission of EDR, which is to solve a real-world problem (enhancing student motivation in online learning) and to identify new or refined theoretical knowledge (reusable design principles related to the use of gamification elements in online or blended courses).

The course discussed in the study incorporated game elements of a fantasy storyline, role-play, gamified points structure, badges, leaderboard, and interactive multimedia that support immersive play experience. It shows the variety of ways that content can be represented, organized, and presented to the learner through graphics, audio, video, text-based handouts, and hands-on explorations. Course designers may apply the design principles that emerged in this study as an inspiration for gamification of online and blended courses in other instructional contexts. Future research may focus on specific game elements that can be used to support an immersive play experience.

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Appendix 1.
Online Student Engagement (OSE) Scale (Handelsmann et al., 2005)

Within that course, how well do the following behaviors, thoughts, and feelings describe you? Please answer using the following scale:

1. not at all characteristic of me
2. not really characteristic of me
3. moderately characteristic of me
4. characteristic of me
5. very characteristic of me

Skills subscale:

1. Making sure to study on a regular basis.
2. Looking over class notes to make sure I understand the material.
3. Being organized.
4. Taking good notes.
5. Listening carefully.
6. Coming to every class (face-to-face or online).

Emotional subscale:

7. Putting forth effort.
8. Finding ways to make the course material relevant to my life.
9. Applying course material to my life.
10. Finding ways to make the course interesting to me.
11. Thinking about the course between class meetings or online class activities.
12. Really desiring to learn the material.

Performance subscale:

13. Doing all of the assignments.
14. Getting a good grade.
15. Doing well on different class assignments.
16. Being confident that I can learn and do well in the class.

Participation subscale:

17. Raising my hand in class or participating in online class activities.
18. Asking questions when I don’t understand the instructor
19. Having fun in class.
20. Participating actively in small-group discussions.
21. Using discussion forums or talking to the professor outside of class to review assignments or ask questions
22. Helping fellow students.

Evaluating the Effectiveness of Visual Thinking Strategies

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Abstract

This quantitative study investigated the use of Visual Thinking Strategies (VTS) in a higher education course for critical thinking. Participants (n=18) were exposed to VTS through weekly exercises. An instrument was developed to evaluate the participants' responses based on Abigail Housen's Stages of Aesthetic Thoughts (Housen 1999). Their written pre- and post-treatment responses were compared to measure growth in their critical thinking skills. Key findings support growth in both the quantity of basic and the inclusion of higher level observations. Previous research has found that training in VTS increases critical thinking skills which transfer to the individual's domain, or other areas of study (Housen 1999).

Introduction

Development of critical thinking skills is one of the tenets of higher education (Yenawine & Miller 2014). Visual thinking has developed as a field within psychology using aesthetic viewing as a strategy to increase critical thinking skills. This study investigates a higher education course where Visual Thinking Strategies (VTS) is used to develop critical thinking skills by viewing and analyzing artwork. As Arnheim puts it, "Identifying what we see is an act of cognition" (Visual Thinking Strategies 1997 p. 2).

Visual Thinking Strategies is an observational process with a facilitator asking three leading questions about a visual example. The facilitator summarizes responses without evaluation, and builds the conversation from thestatements. VTS has shown to be effective in evoking participation among learners (Housen 2001). It has been utilized in museums as well as in elementary classrooms to improve participants' critical thinking, visual understanding, and communication skills (Reilly, Ring, & Duke 2005).

Although VTS has been tested on elementary students (Housen 2001) and medical and nursing students (Reilly et al. 2005; Klugman, Peel, & Beckmann-Mendez 2011), there has been little research on the effectiveness of VTS on general college undergraduate students This study assessed the growth of visual critical thinking skills of undergraduate students (n=18) from the first week to the ninth week of the term. Students were in a semester-long course on visual and critical thinking at a major Midwestern university.

An instrument was developed for this study to measure the participant's critical thinking based on Housen's Five Stages of Aesthetic Viewing (Housen 1999). Participants completed a VTS Exercise, writing their thoughts regarding Hopper paintings on the first and the ninth weeks of class, which were evaluated with the VTS instrument. Weekly verbal exercises were presented in class between these evaluations to familiarize the participants with VTS. This study measures whether there was an observable increase of critical thinking skills between week 1 and week 9.

Motivation and Significance

VTS can be used in higher education to increase effective learning and student engagement (Yenawine & Miller 2014). VTS's structured, open-ended discussions emphasize that there may be multiple correct perspectives to support an argument. VTS is also a tactic used to approach unfamiliar topics with peer collaboration.

As Philip Yenawine and Alexa Miller put it, information in the 21st century is "complex, ambiguous, changing, and requiring synthesis across disciplines" (Yenawine & Miller 2014, p. 5). For students, it is critical for them to be able to deal with ambiguity, uncertainty, collaboration, and rapid changes. VTS better prepares students through the nature of its progression: observation, asking questions, presenting an argument with evidence, teamwork, and critical thinking. In addition, VTS has been observed to be helpful for English-second-language learners and students with learning challenges as it encourages oral communication and has a facilitating figure rephrase what the student had said, potentially clarifying what the student meant to say. (Yenawine & Miller 2014).

The use of art as the visual artifact for observational study in VTS is valuable to further critical thinking skills. "The nature of artwork is ... ambiguous in meaning, multilayered, intentionally open to interpretation, and often have symbolic and abstract elements; making sense of them offers great training for our minds" (Yenawine & Miller 2014). Visual Thinking Strategies can also be used to evaluate non-art based visual material.

Literature Review

The following section will go through the history of VTS, the Developmental Theory, the five Stages of Aesthetic Viewing (Housen 1999), prior K-12 student research on VTS, and prior Medical and Nursing student VTS Research. Through this section, the importance of this VTS research as well as the gaps in VTS that have not been studied are explained.

History of VTS

Beginning in the 1970's, Abigail Housen searched for methods to increase viewer engagement with aesthetic work, and her research demonstrated that students learn best through active learning (Housen, 2001). She collaborated with Philip Yenawine, who was a museum educator at New York's Museum of Modern Art, to find a way to effectively teach and measure viewing skills (Yenawine 2013).

Housen and Yenawine designed a method to view artwork in a group environment led by a facilitator. The facilitator asks simple, but thought-provoking questions to promote discussion, which are: a) "What is going on here?" b) "What do you see that makes you say that?" and c) "What more can you find?" (Housen 2001). The facilitator asks these questions, summarizes responses, points at the specific parts of the artwork that is mentioned and does not judge or evaluate the response (Housen 2001).

Developmental Theory

Learning is most effective when the learner actively participates and is given a chance to reflect on the material. Regardless of age, individuals feel motivated to overcome the challenges in their lives. Thus, the environment that one inhabits can influence how much, how well, and how quickly he or she learns. (DeSantis & Housen 2011). These findings are important bases for Housen's Aesthetic Stages. She used Vygotsky's and Piaget's theories as the motivation for her study. She uses verbal comments to understand individuals' stage of aesthetic thought. The Aesthetic Stages are progressive. Individuals of lower Stages of Aesthetic Viewing cannot understand the art at the same depth as upper stage viewers (DeSantis & Housen 2011).

Five Stages of Aesthetic Viewing

Abigail Housen developed the five stages of aesthetic viewing after interviewing and categorizing various individuals. She had noticed a pattern emerging from the interviewees' thought processes as they examined the artwork. The stages are summarized below. (DeSantis & Housen 2011; Housen 1999)

[1] Stage I: Accountive

Viewers in this stage tell a story of what they believe is occurring based on their personal experience and emotions. They connect the solid pieces that they see within the image and create a narrative out of this that makes sense to them.

[2] Stage II: Constructive

Viewers bring their past experiences and knowledge to understand the image. Viewers may dismiss an image if what is depicted is not an accurate representation of the natural world or if high-quality craft is not shown.

Viewers also begin to show signs of interests for the artist's intentions and the message that is attempted to be communicated.

[3] Stage III: Classifying

At this stage, the viewers begin to view the art from the perspective of an expert, being critical and attempting to understand the artwork's message by using the techniques and skills that they have learned.

[4] Stage IV: Interpretive

Viewers in this stage let the artwork express itself and tell its story. Viewers appreciate the small details of the work and use their critical skills to help understand the work. They are aware that their perception and the feelings that they get out of the work will differ depending on the situation.

[5] Stage V: Re-creative

By this stage, the viewer has spent a long time observing and analyzing works of art and may be a professional art historian or a professor in a related field. They are an expert in the work, knowing the details such as "its time, its history, its questions, its travels, its intricacies" (Housen 1999).

This clarification of the different Aesthetic Stages is important as this research also involves categorizing the participants (students) thoughts of this study into these stages. The participants are not expected to be above the third aesthetic stage as that the expertise of a professional. For example comments by individuals of each stage, see appendix A.

VTS Research

Housen conducted a five-year study of 2nd and 4th graders to measure growth in their ability to use their visual critical thinking skills, developed through VTS, to observe art and non-art objects (2001). While measuring the growth of these students from their first year to their fifth year using VTS, her team also assessed the difference of growth from students with and without VTS treatment. Housen's study found that students who had gone through VTS had more growth in their first as well as the fifth year than the students without VTS and improved standardized test scores.

Philip Yenawine's book, *Visual Thinking Strategies: Using Art to Deepen Learning Across School Disciplines*, provides a number of anecdotes and explores where VTS has been applied to other subjects, such as Social Studies, Science, and Language Arts. The practice of finding evidence of VTS helped students to naturally search for evidence to support their arguments as they complete assignments and exams. (Yenawine 2013)

Visual Thinking Strategies has also been tested in a medical school environment. In 2010, medical and nursing students at the University of Texas Health Science Center San Antonio were trained to "improve their physical observation skills, increased tolerance for ambiguity, and increase interest in learning communication skills" (Klugman et al. 2011, p. 1266). Results of post-training evaluation revealed an increase in observation time and descriptive word count in their examination for patient images. Also noted was an increase in tolerance level for ambiguity and interest in learning communication (Klugman et al. 2011). These results show the effectiveness of VTS in non-art related courses and for older students.

Abigail Housen and Philip Yenawine created VTS in order to increase aesthetic viewing. However, from research and anecdotal observations, there is evidence that VTS has been shown effective for problem-solving for other subjects outside of art. By implementing VTS into the undergraduate course curricula, it may be an opportunity for the students to improve in critical thinking skills that can be used in a variety of subjects, settings, and life-long learning. Thus, the study aimed to add to the knowledge base regarding VTS in relation to its effectiveness in undergraduate students' increasing their thinking skills. The aim of the study was to determine whether consistent exposure to VTS practices will increase the student's ability to utilize thinking skills. From the prior research conducted on K-12 and medical students, we expect an increase in observational and critical thinking skills.

Methods

Participants

Our research subjects were students in an honors Visual and Critical Thinking course (n=18) at a large midwestern university. Students varied in their year in college: 33% in were first year students, 39% second year students, 11% third year students, and the remainder, 17% were fourth year students. Of these students, 55% were from college of liberal arts, 33% from the college of science and engineering, 6% from the college of business, and

6% from the college of biological sciences. The following majors were represented: theater arts, history, linguistics, finance, electrical engineering, mechanical engineering, chemical engineering, economics, sociology, physiology, neuroscience, computer engineering, mathematics, and art. Due to the variety of colleges represented, the knowledge of these students at the beginning of the course in regards to a critical examination of art is a fair representation of the general student population.

Visual and Critical Thinking Course

The instructor of the Honors Visual and Critical Thinking course held weekly VTS exercises to familiarize the students with the process. The weekly exercises consisted of the instructor projecting an image worked collaboratively to figure out what is happening within the image. The instructor used standard questions to keep the conversation going, paraphrased student responses, and pointed to aspects of the image the student mentioned with minimal interference and judgment. The instructor is a trained expert in the VTS method..

Week 1 and week 9 VTS assessments were individually completed by writing about the provided artwork rather than discussing as a class. For both exercises, the instructor projected and printed photo copies of the paintings by Edward Hopper: *New York Movie* (See Figure 1) in week 1 and *Automat* (See Figure 2) in week 9. In addition, the exercises took place in the regular course classroom, with minimal external distraction.

Hopper's work *New York Movie* was used for the first assessment, and another Hopper piece, *Automat*, was used for the second assessment. Images were chosen for their similarity in content and mood. Similar paintings were used to lower the chance of extraneous factors influencing students' responses.

Fig. 1. Edward Hopper's New York Movie (1927)

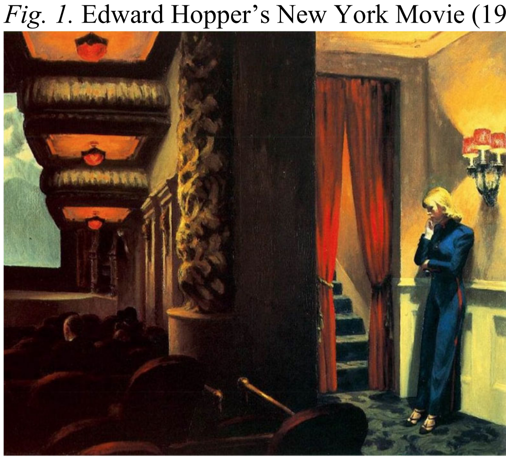
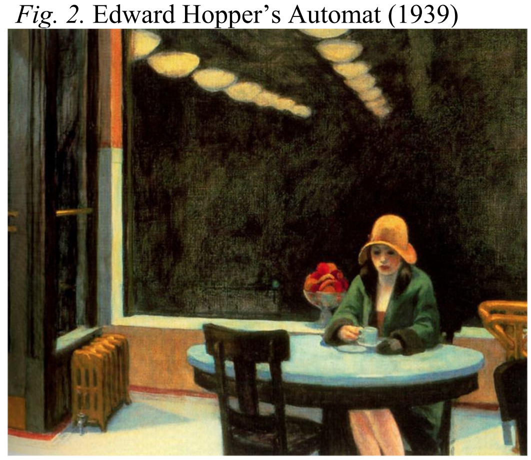


Fig. 2. Edward Hopper's Automat (1939)



Procedure

[1] Collected week 1 data: administered VTS Exercise to students in HSEM 2270V on the first week of the semester. Students were provided between 10 to 15 minutes to complete the exercise.

[2] Completed verbal, discussion-based VTS sessions with the entire class for about 10 to 20 minutes during class once a week until the 9th week.

[3] Collected week 9 data: administered VTS Exercise to students in HSEM 2270V on the 9th week of the semester. Students were provided between 10 to 15 minutes to complete the exercise.

[4] Anonymized (student name and VTS Exercise administered weeks) student responses by course professor, Dr. Hokanson, to prevent possible interference of bias.

[5] Measured students' week 1 and week 9 VTS Exercise using the VTS Instrument created to calculate VTS scores.

[5.1] Quantified the number of separate thoughts written in the VTS Exercise response by parsing student responses into separate thoughts, identifying if certain thoughts are supporting observations for a concluding thought.

[5.2] Categorized each thought into the respective stage in the VTS Instrument for each student.

[5.3] Calculate the mean count from each evaluators' scores for each stage.

[6] Each student's pretest versus posttest VTS scores were analyzed using a chi-square statistic that compares their number of responses at each of the Aesthetic Viewing Stages.

Research Participation

Since this is an analysis of existing educational data, the students had a choice of whether to have their classwork analyzed or not by signing a consent form after completing the week 9 exercise. The consenting student's data and demographics were anonymized for analysis to prevent possible bias and identification.

VTS Instrument

An instrument was created for use in this study by the authors to evaluate each student's observation of the artwork from the in-class exercise. Each thought-response was scored and categorized into one of the Aesthetic Stages.

Four levels were used to categorize responses by stage. Stage 1 responses are basic observations within the image that don't include context from the outside world. Stage 2 responses showed evidence of constructing a conclusion based on specific observations they had made. Stage 2 responses may also have brought in comments based on their interpretation of their social or moral world. Stage 3 comments show the viewer has started to step outside the world of the painting and wonder about the artist's intentions. Stage 4 starts to construct meaning through symbolism. Because the stage 5 response is reserved for one who has gotten to know the art over a long period of time, Stage 5 is not applicable to this study. Stage 5 respondents are typically professionals in the field of art history. Expressed thoughts that could reasonably fit in to two categories were entered in both. Thoughts derived or developed from lower level observations were categorized at the higher level.

Thoughts 1 and 3 are scored as stage 2 as they are observations that are supported by other observations. Thoughts 2, 4, and 5 are scored as stage 1 as they are observations that point that the factual and basic details.

Since there are various ways of measuring an increase in critical thinking skills, both the overall quantity of responses and the quality of responses (the Stages of Aesthetic Viewing (Housen 1999)) were analyzed.

Results

The mean score for the number of thoughts week 1 stage 1 was 4.86 thoughts per participant. By week 9, the mean number of stage 1 thoughts per person increased to 5.92 amounting to almost an extra thought per person. Stage 2 had an average of 1.44 thoughts per person in week 1 and 3.58 thoughts per person in week 9. Stage 3 increased by 0.31 thoughts per person, and stage 4 only had responses in week 9 with a mean of .08. (See Table 1 and Table 2 for complete descriptive statistics)

Table 1. Descriptive statistics of the week 1 scores

	n	$\bar{x}$	M	Mo	$\sum$	s	Minimum	Maximum
W1 S1	18	4.86	4.50	4.00	87.50	1.76	2.50	10.50
W1 S2	18	1.44	0.75	0.50	26.00	1.51	0.00	5.00
W1 S3	18	0.08	0.00	0.00	1.50	0.19	0.00	1.50
W1 S4	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2. Descriptive statistics of the Week 9 scores

	n	$\bar{x}$	M	Mo	∑	*s*	Minimum	Maximum
W9 S1	18	5.92	6.50	6.50	106.50	2.32	2.50	10.00
W9 S2	18	3.58	2.75	1.50	64.50	2.40	1.00	8.50
W9 S3	18	0.39	0.00	0.00	7.00	0.58	0.00	2.00
W9 S4	18	0.08	0.00	0.00	1.50	0.26	0.00	1.00

Figure 4 shows the growth of each stage for the mean scores of each week, with uncertainty bars that represent the confidence interval at 95% for each of the mean VTS scores. Figure 5 and 6 shows each student's change in their VTS scores from week 1 to week 9 for stage 1 and stage 2 respectively.

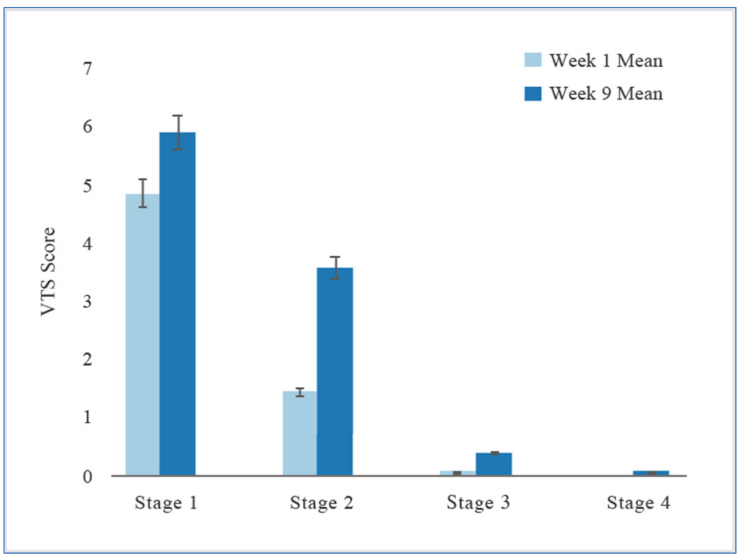


Fig. 3. Growth in Mean VTS Scores

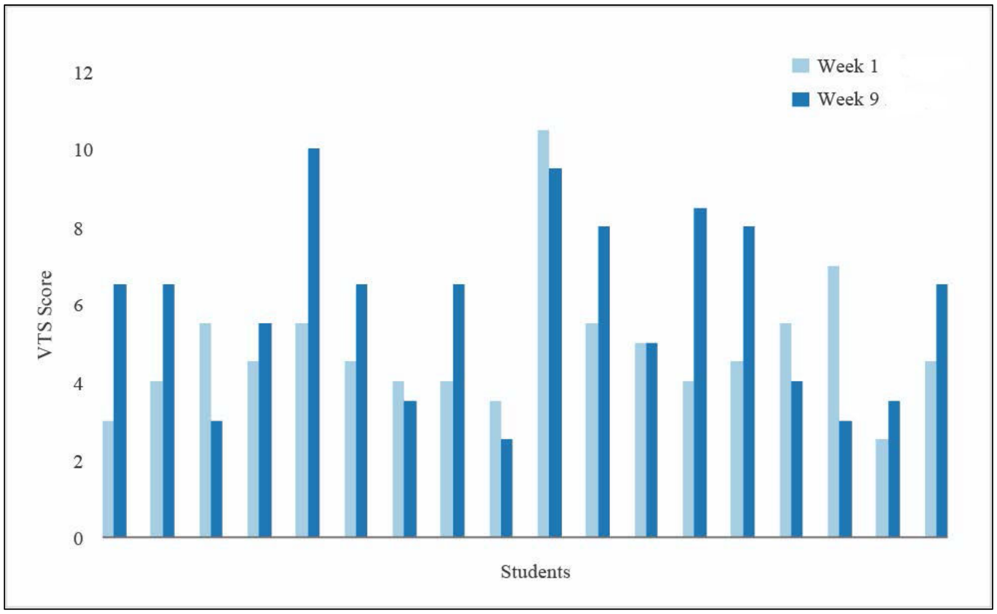


Figure 4. Stage 1 Individual Scores Comparing Week 1 and Week 9

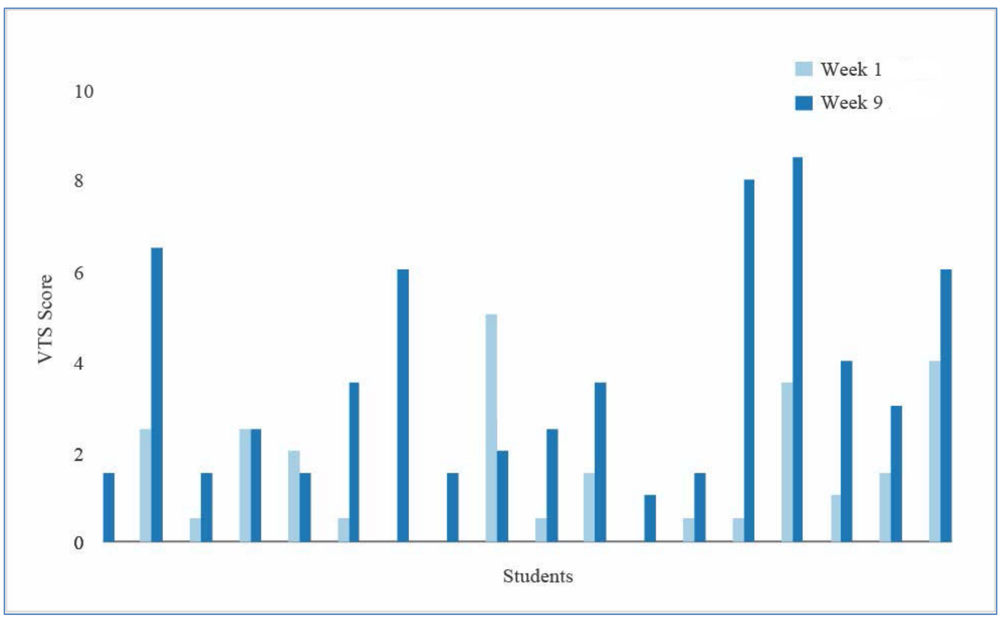


Figure 5. Stage 2 Individual Scores Comparing Week 1 and Week 9

Chi-Square Tests

Goodness of fit: In order to determine if our data showed a normal distribution, a chi-squared test for goodness of fit was performed. This test looked at the number of thoughts from a particular week and stage (i.e. week 1 stage 1) and compared that number across all 18 participants.

The results of our statistical analysis showed statistical significance in the improvement of scores from the VTS exercises from week 9 when compared with week 1. The scores were tallied and compiled into a matrix that allowed each participant to have an individual score that represented the number of thoughts they articulated in each of the stages, 1-4. (Developed from Abigail Housen's Stages of Aesthetic Thought (Housen 1999). Each student ended up with eight scores: week 1 stage 1, week 1 stage 2, …through week 9 stage 4.

An individual chi-squared test was performed for each week and stage (7 in all since there were no scores from week 1 stage 4). Then, results from stages 2, 3, and 4 were combined as a *higher level* category for both weeks

1 and 9. All tests resulted in an extremely low probability that our data is normally distributed; rather, the data seems to be strongly right skewed.

Test for independence:

It was determined that the next step should be to analyze the data using the chi-squared test for independence. In order to meet the minimum requirement of each cell of the chi-squared matrix, the data were combined for stages 2, 3, and 4. The results of the Chi-Squared test showed $p = 0.001499$

Discussion

The study showed an increase in overall and higher stage thoughts between week 1 and week 9. This implies a significant increase in critical thinking skills as evaluated by the VTS instrument ($p<.05$). This suggests that the students in week 9 understood that they were expected to imply higher stage thinking while participating in this exercise and had the capability to do so.

These results are similar to those of the study of medical school students. The Klugman et al. study resulted in an increase in the number of words used to describe the given image (2011). In both cases, participants that had been exposed to VTS had an increase in the number of observations made while examining an image. One would surmise that exposure to this type of exercises increases students' ability to look at a puzzling image and critically investigate details and context of an image.

Instrument Reliability

The VTS instrument was designed using the Stages of Aesthetic Thought (Housen 1999) outlined by one of the originators of VTS and a draft evaluation instrument created by the instructor, a VTS expert. Therefore, it was created for this study with the specific Edward Hopper paintings in mind. There are no reliability assessments for this instrument aside from the use of the instrument on past semester student responses.

In addition, the authors recognize the variability potential for using this instrument. For instance, the qualifications for what a thought-response entails and which category each thought-response belongs are subjective determinations with possible bias to which each individual who scores a VTS Exercise will have differing opinions.

Discussion of Errors

There is very little published research on Housen's Stages of Aesthetic Development. Our instrument has very little research to validate the content, which leaves chance for a systematic error. Participant's responses are a product of their individual mood, external stresses, etc. when they completed the VTS Exercise. We were not able to select participants but have used the largest available sample.

Our results concluded that there is a statistically significant change, the absence of a Type I error can't be proven. The study was designed to reduce its likelihood. The external validity of this study was controlled by measuring the entirety of the class who studied VTS (n=18). The participants were of a variety of discipliens within the university and from all four years of undergraduate study.

Summary and Conclusion

This study focused on VTS that was taught in an undergraduate classroom setting at a large, midwestern university and measured all the students taking a visual and critical thinking course during fall semester of 2018 (n=18). Although weekly VTS exercises were completed through week 1 and week 9, the class was exposed to other aspects of critical thinking activities within this course, which may have added to their increase in critical thinking skills. In addition, because the increase of knowledge and practical application of VTS was required, it can only be generalized to students who took or will take a similar critical thinking course that includes VTS-style learning. Future work in this area could involve a longitudinal study researching various years of this particular course, or comparing performances with other courses that do not employ VTS-style learning.

The potential of VTS outside of museum studies is still in the early stages of investigation. Although studies exist on measuring skills gained through VTS (Housen 2001; Klugman et al. 2011), there is no published instrument for quantitatively measuring VTS, which is why we have created our own instrument for this study. Therefore, there is the opportunity for future work to use this VTS instrument to quantify written or verbal VTS exercises. The use of this instrument is not limited to similar studies but could be used on studies of experts in the various fields. However, it may need some modifications as the instrument was created to measure students without specific knowledge of art history and the work that was chosen for both exercises was a realistic style with a single human figure and a recognizable context (See Figure 1 and 2). Non-subjective (abstract) art would likely give different responses and may not appropriately categorize in Housen's Stages of Aesthetic development (Housen 1999) in the same manner as the realistic paintings.

Visual Thinking Strategies is an attractive option for learning critical thinking skills because of its potential for transfer to other industries. Other studies regarding VTS have measured the transfer of knowledge from art viewing to a specific domain (Housen 2001, Klugman et al. 2011). The participants in this study had various majors so there is an opportunity to study the transferability to each participant's domain. Thus, future work in this field could involve a follow-up study that looks at the participant's transfer of gained critical thinking skills as a result of VTS.

This study showed a general increase from week 1 to week 9 in both the quantity and stage of thoughts. While week 1 results showed predominantly stage 1 thoughts without a notable count of stage 2, there was a great increase in the number of stage 2 thoughts while gaining a slight increase in stage 1 thoughts in week 9. Not only did the participants show that they are thinking more critically about the image in week 9, but their basic observation skills (Stage 1) have increased, as well. Between the two test sessions, participants' stage 1 scores increased, which suggests that they were still using their basic observation skills to build meaning for their higher level thoughts.

This study supports the notion that Visual Thinking Strategies is valuable as the results showed that there were significant improvement in visual critical thinking scores as measured by our instrument in as little as 8 weeks. This finding is important as we can infer an increase in critical thinking skills if they are engaged in a critical thinking course that integrates VTS.

Increasing critical thinking skills is critical for the success of modern students who are working with rapidly produced, evolving, and collected information. There are levels of ambiguity and unknowns in information found throughout the majority of disciplines and fields of study. In addition, undergraduate students are expected to dissect and process the knowledge that is given to them and are highly responsible for their own learning. Thus, other undergraduate institutions or programs may design critical thinking courses to include VTS exercises to develop their students' critical thinking skills. As Yenawine and Miller stated, "Visual Thinking Strategies does not teach what to think, but rather supports the discoveries students make when they are given opportunities to think in various ways" (2014).

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Appendix A Five Stages of Aesthetic Viewing

The following are comments made by individuals of each stage when viewing Picasso's *Girl Before the Mirror.* This data, collected by Abigail Housen, was used to construct the VTS instrument. The style of artwork used here is not of a realistic style, so modifications were made to categorize the data accordingly.

[1] Stage I: Accountive
"… I see… two women here… They… are looking at each other… looks like one of the women has a… misfortune…" (Housen, 1999, p. 9)

[2] Stage II: Constructive
"On that frame… or in that mirror there reflects some man's face but it's not a full face… One can see the lips the mouth, chin and half of the face… If you look at this man's face… it's the man from some other planet…" (Housen, 1999, p. 10)

[3] Stage III: Classifying
"it seems to have, the artist divides the painting into four, actually, you can also look at it in half, and it seems to be two different views of a woman of a female form…" (Housen, 1999, p. 10)

[4] Stage IV: Interpretive
"Well, the red color – is probably some aggression, and blue is, on the contrary, some feelings of rest… it's tensioned between these two colors… Here… changes, as she discovers something in herself… To my mind the point of this picture is some certain change…" (Housen, 1999, p. 11)

[5] Stage V: Re-creative
"I think it would be interesting to … sit and watch Picasso do that because… you have this fantasy that it was this… very continuous, easy, sure, spontaneous… creation of all these forms that one flows right to the other…" (Housen, 1999, p. 11).

Altruism as a Motivational Factor in Student Technology Adoption

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"Representation and communication are motivated by the social; its effects are outcomes of the economic and the political. To think or act otherwise is to follow phantoms." (Kress, 2005, p.6)

Inclusivity has become a cherished value within academia, as both cultural norms and legislation prod our educational system to improve access for marginalized communities. Interest in accessibility is on the rise, as recent studies estimate that 11 percent of our students have declared at least one disability (National Center for Education Statistics). In the United States, the rights of students with disabilities are guaranteed through Section 504 of the Rehabilitation Act of 1973 as well as a patchwork of state and federal statutes aimed at improving access to education.

Developing pedagogies that enhance access for all students requires that we examine our practices in the classroom. Many educators and instructional technologists are embracing the concept of Universal Design (Mace, 1988) by striving for texts and teaching environments that can be of use to all students, rather than demanding that students declare their disabled status in order to receive specialized accommodation. The texts through which we communicate the substance of our courses (e.g., syllabi, readings, lecture notes) are of particular interest to the current research, which focuses on the reaction of able-bodied students to the introduction of EPUB, a relatively new and highly accessible document format.

As Kress (2005) explained, this topic is both technological and political. Accessibility is not simply a state of being, it is a status that is given or denied by those who control the means of access. Printed books – for centuries, the primary platform for information transfer – are inaccessible to those without sight unless assistive technologies are made available to the affected audience. Whether such interventions are adopted easily or contentiously depends on the majority's interest in providing access. Universal Design advocates a single solution that works for all; as such, any successful effort to improve the accessibility of our documents must first win the approval of the majority. In the case of EPUB versus PDF, the choice of document format is more than semantics – this discussion pits our traditional fixed-layout designs (also known as *pages*) against a modern reflowable presentation style. To elaborate the fundamental importance of this issue, it will be necessary to clarify a number of concepts that typically go unexamined.

Our digital era compels us to leave behind notions of the book as a collection of printed paper rectangles bound between covers for a more essentialist idea: the book as a self-contained, portable collection of content that affords both presentation and navigation capabilities. The concepts of being self-contained and portable are key, because texts that do not satisfy those objectives (e.g., *webtexts*) require ubiquitous Internet access – a concept which disadvantages students without home Internet access, whose only off-campus connectivity may come from bandwidth-limited cellphone plans. Just as importantly, webtexts rely on the publisher to maintain uninterrupted online storage while self-contained portable documents may be downloaded and archived by the students themselves, guaranteeing access to key texts during future semesters. Digital documents exhibiting these properties are often called *e-books*, although their contents might amount to only a single page.

This study's participants interacted with two e-book formats: the ubiquitous *Portable Document Format* (PDF) and the less well-known *EPUB* (not an acronym). As such, it is important to explain the concerns over their use that inspired this research.

Prior to the arrival of Adobe's PDF technology, exchanging "native documents" was the status quo. This practice suffered from several disadvantages: the recipient needed to own the same software used by the author, graphics might fail to appear when the document was opened, and the recipient needed to install and activate the same fonts used by the author to avoid unwanted text re-wrap (due to the substituted font's differing character width). PDF resolved these issues by encoding fonts and images into a single file that could be viewed and printed using Adobe's free Acrobat Reader software. PDF's success in ameliorating the exigency created by the exchange of native file formats resulted in its rapid – and largely unexamined – adoption within academia. Soon after, the advent of *screen reader* software allowed the text within PDF files to be read aloud to visually impaired computer users. Interest in providing greater accessibility led Adobe to add an additional layer of structured data (including reading order instructions as well as alternate descriptions for images) to the PDF format. These accessibility features, however, are not required components and are separate from the PostScript-based object list that creates the PDF's visual representation. Additionally, the process of creating a fully accessible PDF is very complex, is typically only partially completed by authors, and requires the purchase of Adobe's full Acrobat Pro software application.

Due to these concerns, users of assistive technologies cannot be certain as to whether a newly encountered PDF document will be readable, or whether accessibility features will be properly implemented. As a result, assistive technology users may encounter difficulties accessing PDF content. As noted by academic journal editor Trude Eikebrokk (2014, para. 7), "PDF is a format that can cause many barriers, especially for users of screen readers (synthetic speech or Braille)."

The origins of the EPUB format preceded the introduction of Adobe's PDF. In 1993, the Swedish Library of Talking Books and Braille commissioned a commercial software company (Labyrinten Data AB) to develop the Digital Audio-based Information System (DAISY) "talking book" or DTBook, a forerunner of today's accessible EPUB format. This differs from PDF in numerous substantive ways; most notably in that they are easily parsed collections of XHTML, XML, and CSS files. The simplicity of these markup languages stands apart from PDF's mixture of ACSII and binary data (Lukan, 2012), which can only be displayed by applications that support the complex Adobe Imaging Model (Adobe, 2000).

DTBooks were specifically referenced by Rose et al. (2006) in their initial treatise of Universal Design for Learning (UDL) as a format for students with "print disabilities" (Wise, 2016), including dyslexia and other cognitive disorders in addition to various levels of visual impairment. DTBooks were intended to support UDL's requirement for *multiple means of presentation* to accommodate the various ways that students interact with and learn from courseware (Rose, 2006, p. 136). Unfortunately, DTBooks are not actually a good fit with the concept of Universal Design, as DTBooks (and the reading systems used to peruse them) are not intended for use by the sighted majority.

Recently, the DAISY Consortium and many other accessibility advocates have suggested the adoption of EPUB3, a recent iteration of the EPUB e-book format, as the universally accessible replacement for DTBooks (DAISY Consortium, 2011) but their voices are struggling to be heard in a world dominated by commercial purveyors of "accessible PDF." Progress is evident, however, in the growing number of academic databases that contain EPUBs (e.g., ABC-CLIO, ACLS Humanities, EBSCO E-Books, Proquest's Ebrary, Elsevier's ScienceDirect, Taylor & Francis), and the many sessions about EPUB found at academic conferences.

The current research responds to a gap in the literature on UDL, in that this heralded learning theory has not yet explicitly adopted DTBook's specified replacement, EPUB3 (DAISY Consortium, 2011). The need to research UDL practices that involve EPUB3 is clear, in that the EPUB3 format is more applicable than DTBook to the underlying premise of Universal Design: that we should avoid the provisioning of alternate accommodations for those who differ from the majority, but instead strive for universally acceptable formats "which, to the greatest extent possible, can be used by everyone" (Mace, 1988, p. 3).

By observing a small number of abled college undergraduates as they interact with EPUB documents and speaking to them at length about that experience, this qualitative research hopes to add to the discussion of whether "typical" college students can be successfully motivated to adopt this new technology. Specifically, my purpose was to better understand the potential for user resistance to EPUB as a replacement for "accessible PDFs" in academic settings, with a special interest in the role that altruism might play as a motivating factor in EPUB's adoption.

Review of Relevant Literature

Society's essentially unexamined embrace of PDF for document distribution is evidenced by the lack of journal articles on the ramifications of its adoption or its alternatives. In response, this study presents an examination of empirical literature that address motivation's role in technology adoption and the value of altruism as one facet of motivation, as well as the invisible nature of non-apparent disabilities, and what appears to be the only previous peer-reviewed research study on student preference for EPUBs.

Motivation and Altruism in Technology Adoption

Altruism was not considered to be an important component of motivation in the seminal work of Vroom (1964). In keeping with the behaviorist thinking of the period, Vroom's expectancy-theoretic model of "motivational force" depicted human behavior as a simplistic effort to gain pleasure while avoiding pain. In his oft-cited research on word-of-mouth communication, however, Sundaram et al. (1998) included altruism as a contributor to motivation, specifically defining it as "the act of doing something for others without anticipating any reward in return” (p. 529). This concept is key to understanding the inclination of abled readers to adopt the EPUB format in light of its greater accessibility for disabled users.

One established way to examine users’ willingness to transition to a new technology is the Technology Acceptance Model (TAM) developed by Davis (1989). Chen et al. (2017) extended Davis’ TAM to include the additional motivational factors of social interaction, enjoyment, and altruism. Chen et al. found altruism to be highly significant component of social interaction (p. 8) even though the nature of these interactions was virtual rather than face-to-face. Chen et al.’s research supports a key assertion of this study: that interest in helping others can be a motivational force for technology users.Hernandez et al. (2011) reported on the significance of altruism in determining attitude towards and usage of Information and Communication Technology (ICT) tools. Their research found that participants in online courses were significantly motivated by altruistic feelings toward their classmates, even though the virtual nature of these courses diminished the likelihood that their altruistic behavior would be reciprocated (p. 2228). Hernandez also determined that students were inherently interested in obtaining the approval of the course instructor (p. 2230).

The document formats examined in this research have been included in electronic knowledge repositories (e.g., university library portals, Blackboard’s eReserves feature). Kankanhalli et al. (2005) investigated the motivation of knowledge management practitioners and found that the intrinsic benefit of altruism was strongly correlated with the motivation to share knowledge (p. 131).

Disability Non-disclosure

The principal tenet of Universal Design (that the same version of a thing should be usable by everyone, regardless of their particular abilities) becomes even more important when we consider how difficult it can be to identify which students are in need of accommodation.

Kranke et al. (2013) found that “students with non-apparent disabilities encountered stigma from peers and professors” (p. 36), which creates pressure for students to maintain their undisclosed status whenever possible. Students identified a desire for autonomy and normality as additional reasons for avoiding disclosure (p. 43), as well as concern about maintaining compliance with their professor’s instructions so as to avoid undermining the professor’s view of their capabilities (p. 43).

Salzer et al. (2008) conducted a survey of students diagnosed with mental illness. A majority (56%) said they felt embarrassed when alerting professors to their disability and were fearful that these professors would stigmatize them (p. 373). Forty-two percent of students who had disclosed their condition characterized their professors as being unreceptive or even uncooperative (p. 373). These findings support the position that many non-apparent disabilities go unreported, strengthing the case for universally accessible texts as a way to obviate the need for student self-reporting.

Digital texts in the classroom

Literature on the use of self-contained, portable electronic document formats in the classroom (as opposed to HTML-based presentations) is in short supply; studies that compare multiple forms of electronic documents are rare. Standalone, archivable document formats, however, deserve in-depth analysis because the format that emerges as our final choice will become the accepted replacement for printed class texts.

In what may be the only peer-reviewed study of its kind, Mills (2016) conducted a quasi-experimental test of student preference between a course textbook distributed in one of three e-book formats: PDF, KF8 (Amazon Kindle documents), and EPUB. Some students received an EPUB containing interactive content, while others received either a PDF file or a KF8 (Kindle) file. Participants who received the EPUB file reported significantly higher levels of interaction and engagement with the course text, as well as greater perceptions of the text’s usefulness and value (p. 130). These findings support the current research’s recommendation of EPUB as a format well-suited for sighted readers as well as users of assistive technologies.

Reviewing this published literature provided an understanding of several relevant issues. Despite being overlooked in early work on the topic, altruism has been empirically shown to affect motivation and knowledge sharing; as a result, any modern investigations of technology acceptance should include altruism among their motivating factors. This review also lends credence to Universal Design for Learning’s recommendation of texts that are compatible with assistive technologies, since the non-disclosure of psychiatric and attentional disabilities is problematically low, contributing to a large number of students who avoid requesting accommodations despite awareness of their availability. We also see that while much more research needs to be done in the area of student digital textbook preference, at least one prior study has identified a student preference for EPUBs over PDFs or Kindle books. While each piece of literature reviewed offered some valuable contextualization of the issues at hand, none specifically addressed the practical question at the heart of this research: if we recommend EPUB3 in response to Rose's call for the use of highly accessible document formats in our classrooms, can abled students be motivated to adopt this new technology?

Methods

The purpose of this research is to investigate students' attitudes toward a new instructional technology (EPUB) as a replacement for "accessible PDFs" in academic settings. To further this goal, I conducted qualitative research to discover the actions and opinions generated when students without print disabilities were asked to interact with one document saved as both a PDF and an EPUB. These observed activities, as well as the semi-structured questions that both preceded and followed the hands-on portion of the interview, were designed to cast light on these research questions:

RQ1: What is participants' knowledge of the EPUB format?
RQ2: What challenges are reported or observed when students are learning to access EPUBs?
RQ3: How do participants perceive EPUB's constraints and affordances?
RQ4: According to participants, does a discussion of Universal Design principles increase their interest in the EPUB format?

Research setting

This research took place at a former teacher's college located in a small Midwestern city (population 43,849), located approximately one hour's drive west of Chicago. The university's Fall 2018 enrollment was comprised of 17,169 students (including 1,211 international students), 75% of whom are undergraduates. Males make up 50.8% of the undergraduates, while 49.2% are female. The average undergraduate student age is 22. Fifty-five percent of these undergraduates self-identified as White, 15.8% as Black, 17.9% as Hispanic/Latino, and 5.4% as Asian. As a university with a significant international enrollment located near America's third most populous city, it is considerably more diverse than the county in which it is located, i.e., 86.6% White, 11.4% Latino, 8.1% Black, 2.8% Asian (U.S. Census Bureau).

Participant demographics

Six undergraduate students (ages ranging from late teens through early 20s) from this Midwestern university were interviewed; the sample consisted of an even split between male and female participants; 50% were Black (one female, two male), and 50% were White (two females and one male). Each student was enrolled in a different major: Accounting, Communications, Kinesiology, Nursing, Psychology, and Special Education. The participants comprised a convenience sample drawn from my former students from an on-line class; 12 students were invited to participate via email, but only six responded affirmatively (50% response rate). Students' participation was incentivized through an offer of $15 cash, which was given to the interviewee at the start of each session.

Data collection and analysis

Data was gathered during individual face-to-face interviews; each interview lasted between 28 and 45 minutes. The interview site was a small conference room on campus. The participants were asked to examine the same document in two different formats (PDF and EPUB) on whatever computing platform they preferred; half of them (three) used a laptop, while the other half (three) used a smartphone. Among the laptop users, two were running Microsoft's Windows operating system while one was running Apple's MacOS. All three smartphone users interacted with an Apple iPhone. While using these devices, the participants were asked to interact with the two documents in various ways: scrolling, reading, searching, navigating to a specific section, and enlarging the document's text.

These interviews were recorded with a high-definition video camera placed behind the students' right shoulder in order to capture their hand movements as they interacted with an EPUB on their device of choice. These video recordings allowed me to replay and closely observe the students' interactions with the hardware and software used to access the documents, in order to note any challenges or general patterns that emerged from their use of these familiar and unfamiliar document formats.

Audio from these recordings was transcribed via F5 Transcription Pro software for open coding in Nvivo 12 for Mac. An initial pass through all six transcriptions produced 24 codes; a second pass caused me to merge two codes then organize thirteen others under six top-level codes. This resulted in a total of 16 top level codes from which to generate themes. Several of these were related to aspects of motivation (altruism, compliance, efficacy, convenience) while others applied to the hands-on tasks performed by participants during the interview (e.g., controlling text size, navigation, search/find) or their own statements on various related concepts (e.g., awareness of EPUB and Universal Design, general challenges with reading texts, preferred study locations).

Researcher role

The class during which I previously became acquainted with these students was conducted online rather than face-to-face, so our relationship remained relatively impersonal. My role as their former instructor and our substantial age differences made them likely to perceive me as an "outsider," although our shared experience of the online course might also have granted me a small measure of "insider" status. As Dmitriadis (2001) observed, the researcher is always some mix of insider and outsider, and so I endeavored to keep both attributes in the proper perspective. Acknowledging and accounting for such concerns is an essential task for researchers, according to Dmitriadis, since these multiple versions of our identities "often work at distinct cross purposes and can inextricably complicate and even derail our research as we originally conceive it" (p. 579).

Concerns

My "insider" role (garnered through my identification as a member of the study group) seemed unlikely to pose a substantial problem due to the impersonal nature of our prior distance-learning relationship, but a larger concern came from our previous shared experience with the topic of EPUBs. These students were selected specifically because I knew they had some small familiarity with the idea of an EPUB file as a self-contained portable document format. They gained this knowledge by participating in an extra-credit assignment as students in my online class; each had earned a small improvement to a previous assignment grade by downloading one short EPUB file from our class website (on Blackboard), then taking a short quiz about their interaction with the document.

Just as these participants came to their interviews with a small amount of pre-existing familiarity with this topic, I too brought my own prior knowledge to our sessions. Having interacted with more than a half-dozen sections of undergraduates during prior teaching experiences, I held some assumptions about their existing skill level when it came to digital technology. Upon reflection, I determined that the participation of these students in the current research was appropriate, as their past experience would reduce the initial strangeness of the EPUB format, thereby allowing for a more accurate appraisal of their abilities to interact with it. Additionally, it was undoubtedly clear to these participants that I am an advocate for the use of EPUBs within academia. However, at the point when this research occurred, they were no longer my students and had no compelling reason to modify their behavior in order to gain my favor. In addition, I feel that self-reflections on this subject have allowed me to approach this research impartially, as I have remained cognizant of the potential for bias. Such self-reflective writing on the basis for potential bias is one technique recommended by Lawrence-Lightfoot and Hoffmann Davis (1997), who noted that "making the anticipatory schema explicit (in the form of memos, journals, or self-reflective essays) allows for greater openness of mind" (p. 186).

Findings

The current research was conducted to collect student perspectives on the adoption of a new instructional technology, i.e., EPUB. My initial expectation was that participants might speak of altruism's connection to technology adoption, in addition to such classical motivations as learning goals and performance goals (Dweck & Leggett, 1988). The statements and observed actions of the participants in this study caused me to rethink those initial expectations, as EPUB's benefits for sighted users came to eclipse the moral advantages of accessibility. The findings that resulted from these interactions have been organized thematically as responses to my research questions. Pseudonyms have been used to protect the participants' identities.

EPUB remains largely unknown to students

Although these participants shared a past exposure to the existence of EPUB documents gained during an optional extra-credit assignment in the prior semester, they were unanimous in saying that they had not heard of the EPUB format prior to the extra-credit assignment, nor had they heard the term used since that initial exposure. However, two of the participants (Emma and Francine) stated that they were using Apple's iBooks software on their laptops, while Bernadette said that she sometimes used the iBooks app on her smartphone. This indicates an ongoing challenge for those who strive for greater awareness of the EPUB format within academia: software vendors have successfully branded the EPUB books sold on their e-book marketplaces with the name of their particular applications. EPUBs purchased through Apple's iBookstore are referred to as "iBooks," while EPUBs purchased through Barnes & Noble's marketplace for use with their Nook e-readers are called "NookBooks." Even some academic publishers contribute to this lack of name awareness – the University of Chicago Press sends out a monthly email offering a “free e-book,” but subscribers never see the term EPUB in either the initial email or the subsequent HTML landing page.

These branding issues result in a real problem for those who would encourage broader adoption of the EPUB format. Emma, owner of both an Apple laptop and an iPad, said, “I've used iBooks in the past, and I was aware that [the ability to change text size] was available.” Her ability to modify font size when reading on her devices (rather than zoom in and out, as with a PDF) indicates that she must have had prior experience reading EPUBs – yet when asked earlier in the interview whether she had ever heard of EPUBs after the prior semester’s extra-credit assignment, she said, “No.” It will be difficult to build consensus around the advantages of the EPUB format unless users are able to identify this format by name.

Users report minimal challenges during EPUB adoption

In order to participate in the extra-credit assignment previously mentioned, each of the participants had already gone through the process of assuring that they could open and read an EPUB file. For three of the participants, this required no additional effort as they were already using Apple devices that ship with the pre-installed EPUB reader iBooks. Another participant also used pre-installed software to read his EPUB: Dominick, whose recently purchased Windows laptop included Microsoft’s Edge browser, which can natively open EPUBs without a plug-in. The remaining Windows-using students reported that installation of the necessary free software to read EPUBs was unproblematic. When I asked Charles whether he thought that other students would find it too difficult to install an EPUB reader onto their preferred reading platform (e.g., laptop, desktop computer, tablet, smartphone), he responded: “I'm pretty sure students are used to being handed something new. Downloading it on their phone and getting used to it.” However, a note of caution on this topic was sounded by Anton, who said:

A lot of people are very lazy, don’t like to do work anymore. They like a lot of work done for them the easy way and stuff like that, so I feel like it would be a complaint if stuff were harder and they had to put in more work. They would definitely complain.

This indicates the need for students to be motivated to download and use EPUB readers as part of their coursework, a topic that will be explored next.

Motivation through perceived efficacy and convenience

Videotaped observations of users interacting with both PDFs and EPUBs supported their overwhelmingly positive statements regarding their experiences accessing EPUBs, but also yielded some unexpected results. It was surprising to discover these students’ minimal knowledge of methods for interacting with PDF documents. Each denied that they had ever used bookmarks to navigate their way through a PDF, or even used the search function to locate a specific term within a PDF; similarly, none were familiar with the highlighting tool built-in to most PDF readers. As a result, students were excited to experience what they perceived to be the greater efficacy of the EPUB format with regard to accomplishing several standard tasks associated with reading course texts: navigation, search/find, and adjusting text size for readability.

The following descriptions of user interactions with EPUB-reading software refer to the two types of Table of Contents (TOC) often found in an EPUB, which I will explain here. One of the ways in which EPUB accessibility is superior to that of PDF is the requirement for EPUBs to make their contents navigable through any reading system’s built-in Table of Contents menu (a feature not found in PDF reading systems, even when “accessible PDFs” are used). Often called the *hardware TOC*, this navigation system is immediately available in a consistent fashion from any page of any EPUB. Alternatively, EPUBs may (or may not) also contain an *in-book TOC*, analogous to the Table of Contents page in a printed book. As with a PDF file that contains an in-book TOC, the chapters and sections listed may (or may not) be shown as clickable hyperlinks. The example files provided for the hands-on component of these interviews reflected the typical “real world” state of these formats, in that the EPUB contained a hyperlinked in-book TOC while the PDF did not.

Navigation is made easier by consistent access to a Table of Contents. When asked to navigate to the "third section" of an EPUB viewed in Adobe Digital Editions (ADE) for Windows, Anton said he would scroll. Upon refamiliarizing himself with the fact that EPUBs change pages via a horizontal page-flipping convention rather than the vertical scrolling technique used by most PDF readers, he went to the EPUB’s third page. Once I pointed out that he was not at the third *section* but rather the third *page*, he moved backwards through the pages until he found the in-book Table of Contents then clicked on the appropriate hyperlink for the second section. Similarly, Dominick also used the in-book TOC hyperlinks to navigate to the third section when he viewed an EPUB with Microsoft’s Edge web browser. When asked to locate the third section of an EPUB within the iBooks app on an iPhone, Francine initially swiped her way through two pages before deciding (without any prompting) to instead click on the icon for iBook’s hardware TOC, allowing her to very quickly reach the third section. The remaining users (Bernadette, Charles, and Emma) all selected the hardware TOC immediately upon being requested to navigate to the third section. Francine's explanation of her behavior was typical of all the participants who accessed the hardware TOC: "If you want to find a page, you just use this scroll thing, but yeah, if I wanted to find a chapter, I would just go to the Contents thing." Suspecting that the simple interface of an EPUB reader made it easy for the participants to recognize standard icon conventions (such as a menu of contents), I engaged Charles in this dialog:

Interviewer: So show me how it was that you got to it. What was the method that you used? [Subject shows the built-in TOC menu.] Oh, so you went right into the navigation system!

Charles: Yeah.

Interviewer: And so even though you'd never touched this phone before, or used that software before, it was intuitive that you could kind of tell that that thing up in the corner was an Index.

Charles: Yeah, it provides like a dropdown list or something.

Interviewer: Yeah, nice. Now are you familiar with seeing something like that in PDFs, or is there any kind of Index that you use when you're going through PDFs?

Charles: Mmm, not that I can remember.

The interviewees' ability to easily locate the hardware TOC within two different EPUB readers (Adobe Digital Editions and Apple iBooks) on three different platforms (a Windows laptop, a Mac laptop, and an iPhone) shows the value of a streamlined user experience that follows consistent user interface conventions.

Search capabilities are underutilized by PDF readers. Surprisingly, all participants denied having knowledge of how to search for a specific term within a PDF file. Several knew the keyboard shortcut for search (control-F on a PC, command-F on a Mac), but only associated that process with web browsers. Each participant found it easy to search for a specified term with an EPUB. Dominick, the student who viewed his EPUB within the Microsoft Edge web browser, used the keyboard shortcut control-F to bring up the search function; the remaining interviewees were all able to quickly identify the magnifying glass icon that represented the EPUB reader's search function. As an example, when asked if she had any idea how to search for a term within an EPUB, Emma responded, "The magnifying glass at the upper right-hand corner."

Conducting a search within a typical PDF viewing application takes the reader to the first highlighted use of that term within the document; if that location is not the desired spot, the user clicks a forward-arrow icon or repeats the keyboard shortcut to be taken to the next highlighted instance of the term. All the EPUB readers used by these participants, however, follow a different convention: conducting a search pops open a floating list of all locations of the term, where each instance includes a snippet of the text surrounding the term (to provide context). The interviewees found that method to be more efficacious. When asked if the search procedure for EPUBs seemed to be the same as she was used to from using PDFs, she said: "No, I feel like this is different. Like you said, usually they just kind of give you the word and then where it is."

Search functions are a key capability for any researcher, but these undergraduates were unfamiliar with how to perform searches in PDFs. This may be a result of teachers' common practice of providing texts to students as unsearchable scanned images, rather than as searchable text. If course materials are not consistently searchable, it is understandable that students would not learn to associate such functionality with the PDF format.

Enlarging text for readability is the key to usability on smartphones. While the laptop users in this study were not overly concerned with text size, the subjects who used a smartphone to access the texts were immediately challenged by the tiny size of text within PDFs. Since the default behavior is for PDF readers to display the full width of the PDF, the text was rendered too small for students to read. Rotating the phone to landscape mode enlarged the PDF to fill the width of the screen; as Charles noted: "I could read it if I focused, but that's going to strain my eyes, so yeah, to turn it sideways would be better." However, the interviewees found it uncomfortable to navigate the PDF when only a small portion of the page was visible, causing them to flip the phone back and forth between portrait and landscape orientation during use.

When the smartphone users examined an EPUB on their mobile devices, they were immediately impressed by the difference in readability. EPUB readers feature reflowable text that is not bound by a particular page geometry, so the default text size was immediately readable. The participants also found it easy and intuitive to change the size of the displayed text by clicking the icon representing text size: two adjacent instances of a capital letter A, shown at different sizes. For the three participants who were using laptops, I demonstrated the default text size on my iPhone. All the interviewees then began to conjecture about how this capability would increase the likelihood that they would use their smartphones to occasionally read assigned texts, especially during short breaks between classes or while traveling. The convenience of being able to use a smartphone to read class texts was noted by all participants. As an example, Bernadette said: "With it being on your phone, you can change the font size to however large or small you need it. So, you can do the reading on the go, so you can get it done." Similarly, Dominick said: "I feel like EPUB on a cellphone would probably be a lot better than a PDF because once again, like

I said, it's all blocks, blocks of text." (Dominick had complained that the vertically scrolling display of PDFs on his cellphone made them appear as dense blocks of text rather than paragraphs.) Charles specifically called out the convenience of EPUB's usability on his mobile device: "I look for convenience. So I usually, if I can read it on my phone and get the job done, then I will." Emma noted that she's likely to have much more opportunity to read course texts on her phone when away from home when she said pointedly, "You never forget your phone!"

Universal Design as a motivational factor for EPUB adoption

The current research found that students were more likely to support EPUB adoption after learning that the format's accessibility is superior to that of PDF. In other words, the resistance of able-bodied students towards any additional effort needed to implement EPUB (i.e., to learn new procedures, and the potential need to download and install free software) could be minimized by an altruistic desire to participate in an accessible Universal Design pedagogy. It is important to note that none of the interviewees who participated in this research self-identified as having a learning disability, and that of these six undergraduates, only two were marginally familiar with the term Universal Design.

Altruism provides only limited motivation for technology adoption. Anton was among the majority who were unfamiliar with the concept, but he soon revealed that he was familiar with the inclusive practices enabled by Universal Design, noting that "We had, like, wheelchairs in our class, kids with disabilities in our class, so now it's like normal for us. Our generation, we're like used to it." He also saw the value of materials and practices that enabled inclusive learning and supported the idea that accessible materials would also be valued by his classmates: "It'd make everybody want to use it [EPUB] more, since they'd know like okay, this isn't just for me, it's for other people too with disabilities and stuff like that." However, when asked how much additional difficulty the typical college undergraduate might tolerate when being asked to adopt a new accessible technology, Anton once again turned skeptical. "If it's more work, yeah, people will complain," he said, "I know my generation, a lot of people are lazy."

The two students who were already familiar with Universal Design supported Anton's view that the majority's largesse could not be taken for granted. Francine, a Psychology student who said that she was broadly familiar with the term Universal Design but had no knowledge of its applications, noted, "I wouldn't be more motivated to use [the EPUB format], because I wouldn't need it, but for other reasons I would be, like the things I said earlier that attracted me to the EPUBs. [She enjoyed the ability to change font sizes or switch into Night Vision mode, as well as swiping through documents.] But unfortunately, that Universal Design thing wouldn't motivate me personally to use it more." Like Anton, she felt that touting the direct benefits to users would be key in easing the adoption path for EPUB. In contrast to Anton's skepticism, though, Francine thought that there would be little resistance if teachers mandated the use of EPUB. "Obviously it would be beneficial to people that need it, whether or not I need it; so, I wouldn't care, personally," she said. "It was a small hurdle. No difficulty for me at all."

When interviewees revealed a deeper personal connection to issues of accessibility, however, Universal Design was identified as being more motivational. Emma, a Special Education major who volunteered that she has "thought about this a lot," said that "The issue isn't whether or not it's fair, it's making sure everyone has the same learning abilities." Her responses were the most specific in this regard, but all the participants expressed some level of support for mainstreaming students with special needs into the general classroom population whenever possible.

Personal connection to disability strengthens motivation for Universal Design adoption. Given that all participants saw the Universal Design component of EPUB as an advantage, it's logical to presume that a personal connection to this topic would lead to a stronger connection and further reduce resistance to implementation. Bernadette, a second-year Nursing student, revealed that her familial relationship with disability has resulted in greater appreciation for the concept of Universal Design: "I think that helps make people more receptive to the idea [of using EPUB]. I come from a home with two brothers who are mentally impaired, so I know it sparks my interest," she revealed. "Because I know my brothers learn at different rates and one likes to read, the other doesn't like to read but likes to listen to things, so I think it would be, like, perfect." Bernadette's response validates an approach in which instructors first make the case for EPUB adoption as an accessible format that can benefit all students before pointing out the ways this new format can benefit the sighted, smartphone-wielding majority.

Compliance

One emergent finding that was not anticipated by this study's research questions is the strong role of compliance on student motivation. As noted by Kranke et al. (2013), students are highly concerned with maintaining a favorable relationship with their instructors – or as Vroom (1964) might have positioned it, to avoid the pain of low grades. Emma echoed a sentiment expressed in various degrees by all the other interviewees – that students would simply accept the transition to a new technology (EPUB) if instructed to do so by their teacher:

If I were to sit down, I came to NIU, I'm a freshman and my teacher – my professor – hands me an EPUB, well that's how I'm going to learn to read and I'm not going to question it. People are just going to get used to it and it's going to become the normal. Because it does have those features for people with special needs or learning disabilities and if they need them they can have them. So, I don't think it's inconveniencing anyone, and I don't think many students would question it.

Some scholars might challenge Emma's statement by citing Activity Theory (Engestrom, 2000); under that premise, students who had operationalized the use of PDF would suffer discomfort when their proximal zone of development was de-centered by the introduction of EPUB (Vygotsky, 2011, p. 203). This research, however, reveals that these twenty-first century scholars have become accustomed to constant change in their selection and use of technological tools. Anton expressed confidence in his classmates' ability to implement the new software needed to read EPUBs, saying that "Everybody's technology savvy these days; everybody knows technology, so it's not really that hard to figure out."

Emma extended Francine's "no big deal" assessment of EPUB adoption by positioning the introduction of new technologies and formats as the duty of the instructor: "I think it's important, especially with technology nowadays, that we're exposing students to that. Not to say textbooks aren't functional, but jobs nowadays will never hand you, 'Here's your [printed] manual.' They're gonna say, 'I'm going to e-mail you that manual.'"

From Emma's point of view, the medium is clearly as important as the message; content wrapped in the outmoded trappings of print culture is seen as having less real-world relevance to today's technology-driven students.

Conclusions and Implications

This study examined the role of student motivation in the adoption of a new instructional technology, EPUB. An analysis of participants' statements and actions during the adoption process led to the identification of four motivational factors: compliance, efficacy, convenience, and altruism.

One unexpected result was that participants placed the greatest emphasis on compliance, as they expressed the desire to use whatever tools were recommended by their professors. As initially assumed, they were also highly interested in the efficacy of EPUB; observation showed that they quickly learned to navigate and search an EPUB's contents as well as adjust its text for optimal viewing on a mobile device. Surprisingly, there was lower (albeit still positive) interest in the other two factors: convenience (i.e., smartphone compatibility) and altruism (*vis-à-vis* EPUB's enhanced accessibility). The altruistic response was more pronounced among students who possessed a personal connection to disability.

Participants expressed positive views of all four motivational factors, so this implies a low potential for resistance when EPUB is introduced into the classroom. These findings validate an approach in which instructors present EPUB as an accessible format that can benefit all students, especially users of assistive technologies. Since the EPUB format was developed by advocates for the visually impaired, it is highly compatible with assistive technologies, thereby reducing the need for students to seek special accommodation. Once instructors introduce the concept of accessibility, they should herald EPUB as a format that is easy to use and smartphone-friendly.

These results have significance for the growing community of educator who have restructured their curriculums around the concept of Universal Design for Learning, as the EPUB format enables a universal approach to the dissemination of course documents. Beyond practitioners of UDL, the EPUB format should be embraced by all educators desirous of truly inclusive pedagogies. The current research also has implications for the broader subject of student technology adoption, as it supports Chen et al.'s (2017) extension of Davis' (1989) Technology Acceptance Model to include altruism. Additionally, it supports Kranke et al.'s (2013) conclusion that compliance is a powerful motivator of student behavior. Such results can inform research into the adoption of other formats and technologies beyond EPUB.

While this small-scale study featured only a handful of participants in an interview setting, large-scale experimental studies should be conducted so that researchers can extrapolate their findings to a more generalized student population. Additional qualitative research on this subject is also needed to expand the pool of available data on student technology preferences.

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Preparing Teacher Candidates to Teach Digital Citizenship: An Online Synchronous Peer-Teaching Practice

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Abstract

The study examined the effect of a peer-teaching practice with synchronous technologies on preparing teacher candidates to teach digital citizenship. Candidates were required to work in small groups to 1) design, develop and deliver a 25-30 minute online workshop to their peers and 2) attend their peers' workshops. A mixed-method design was employed to collect data including a survey and a systematic examination of rubric responses and workshop video archives. The results showed that the practice helped prepare teacher candidates to teach digital citizenship. Candidates learned new knowledge, strategies, and resources from the practice and recognized its helpfulness to their learning about digital citizenship.

Introduction

Due to technology advances, younger generations tend to have more knowledge about digital technologies than many adults do (Kara, 2018). However, knowing more about technologies does not guarantee that they know how to use technologies in an appropriate way, which causes problems not in compliant with digital citizenship standards (e.g., violation of intellectual property rights). Digital citizenship is defined as "the practice of defining the norms of appropriate, responsible behavior with regard to technology use" (Dotterer, Hedges, & Parker, 2016, p.59). Ribble (2015) proposed nine elements of digital citizenship, including digital access, digital commerce, digital communication, digital literacy, digital etiquette, digital law, digital rights and responsibilities, digital health and wellness, and digital security. Teachers, administrators, and parents have the responsibility of training younger generations to become good digital citizens and ensure they receive comprehensive instruction in digital citizenship (Dotterer et al., 2016; Isman & Canan Gungoren, 2014).

How to prepare teacher candidates to achieve competency in digital citizenship so that they can better educate their own students in the classroom is a topic worthy of discussion. Faculty members in teacher preparation programs have to offer training opportunities to help teacher candidates transfer what they have learned within the programs to real classroom settings (Faulkner-Beitzel, 2008). As more and more universities are offering online programs related to instructional technology for teacher candidates, it is becoming more important to research best practices to help teacher candidates gain competency in digital citizenship in online learning environments.

Peer-teaching promotes active learning and requires teacher candidates to take ownership of their own learning (Stigmar, 2016). It allows candidates to play different roles in the teaching-learning conversation and offers opportunities to achieve meaningful conversations with their peers (Garbett, 2011). There are formal and informal forms of peer-teaching. Formal forms include peer-tutoring, presentation or group work; informal forms include peer collaboration outside the class (Priharjo & Hoy, 2011). According to Vygotsky's Zone of Proximal Development, candidates can learn better with the scaffolds from more knowledgeable others (Haider & Yasmin, 2015; Vygotsky, 1978).

In an online program, using synchronous technologies gives teacher candidates opportunities to interact with a faculty member or peers in real time, just as they would in the traditional classroom (Brown, Schroeder, & Eaton, 2016; Chen, Ko, & Kinshuk, 2005). Advantages of using synchronous technologies include 1) offering immediate two-way feedback (Grogan, 2015), 2) reducing the feeling of isolation (Elluminate, Inc., 2009), and 3) enhancing a sense of community (Elluminate, Inc., 2009; Parker & Martin, 2010). A synchronous communication tool can include features such as video, audio, text chat, instant polling, whiteboard, application/desktop sharing, emoticons, and breakout rooms that promote collaboration among instructor and learners (Brown et al., 2016; Martin & Parker, 2014). The commonly used synchronous tools include Adobe Connect, Blackboard Collaborate, Cisco WebEx, Google Hangouts, GoToMeeting, Saba Centra, and Skype.

The Current Study

The purpose of the current study was to examine the effect of an online synchronous peer-teaching practice on preparing teacher candidates to teach digital citizenship in their own classroom. The online synchronous peer-teaching practice here referred to an online professional development workshop using Blackboard Collaborate. These two terms were used interchangeably in this paper. The following research questions were used to guide the study:

1) How did teacher candidates perceive the effect of the online synchronous peer-teaching practice on preparing them to teach digital citizenship in their own classroom?

2) What did teacher candidates learn in the peer-teaching practice from acting as both a workshop instructor and a learner? Did they see things differently when playing these two different roles?

3) Were there any changes to teacher candidates' perceived knowledge of digital citizenship before and after the peer-teaching practice?

4) What strategies and resources did teacher candidates plan to adopt from the workshops for teaching digital citizenship in their own classroom?

Context of Study

This study was conducted in the introductory course of an online instructional technology program in South Georgia. The course included a one-month-long project that required teacher candidates to work closely together in small groups of 4-5 members to design, develop, and deliver a 25-30 minute synchronous online professional development workshop related to digital citizenship using Blackboard Collaborate. The project goal was to increase their knowledge of digital citizenship through the workshop development. Each group was instructed to choose a theme of Digital Citizenship focusing on either "Digital Law" or "Digital Rights and Responsibilities" as the workshop topic. Teacher candidates could select any topic specific to their teaching context under these two themes (e.g., "Plagiarism, Intellectual Property, & Copyright - Cite It, Don't Steal It!" or "Digital Footprint: What are you leaving behind?"). Peers in the same class acted as learners for the workshops. To prepare for the workshop delivery, each group needed to complete the tasks including 1) small group discussions, 2) a project plan, 3) weekly progress reports, 4) an online session with the faculty to practice using Blackboard Collaborate, and 5) workshop materials and assessments. Faculty and peer feedback were provided throughout the group work process (e.g., suggestions for improvement for a project plan). Candidates also needed to complete a rubric evaluating their peers' performance after attending the workshops.

Research Design and Instruments

A mixed method design was employed in the study, including survey investigation and examination of responses to the peer-evaluation rubric and workshop video archives. First, a 25-item anonymous survey was used to understand the candidates' perceived effect of online synchronous peer-teaching practice on preparing them to teach digital citizenship in their own classroom. The survey structure was presented in Table 1.

Table 1. Survey Structure

Section	Content	Questions	Question Type
1	Gender	Q1	Demographic question
2	Comfort level using Blackboard Collaborate, and comfort level with online synchronous peer-teaching	Q2-Q3	5-point Likert scale questions
3	Perceived effect of online synchronous peer-teaching practice	Q4-Q7	5-point Likert scale questions
4	Workshop instructor and learner roles	Q8-Q16	5-point Likert scale questions
5	Self-rating of the knowledge of digital citizenship	Q17-Q20	Q17-Q18: 4-point Likert scale questions; Q19: 5-point Likert scale question; Q20: Open-ended question

6	Best strategies and resources to teach digital citizenship	Q21-Q25	Open-ended questions

Second, candidates used a rubric to rate their peers' workshops based on the criteria including 1) organization & structure, 2) comprehensibility, 3) depth of thought, 4) design of workshop materials, and 5) preparation. They also had to explain what they learned from the each workshop. The responses to the rubric were examined using content analysis to understand what exact new concepts, strategies, or resources they have learned from the workshops. Third, the workshops were recorded and the archives were examined to understand what best strategies and resources had been utilized for teaching digital citizenship.

Participants

Twenty-eight teacher candidates who enrolled in the course were invited to participate in the study in the Spring 2019 semester. Candidates were assigned to six groups for workshop completion. Of 28 candidates, nine completed the survey voluntarily (including eight females and one male). For data analysis, each survey respondent was coded using an ID starting with S. Since the survey was anonymous, the researchers had no way to know who completed the survey. Therefore, the candidates who gave permissions for evaluation of rubric responses and workshop video archives were coded using different IDs starting with R. Groups were randomly named by color (e.g., Group Blue). Permission was received from nine candidates to examine their rubric responses (including eight females and one male) and five workshop video archives. The workshop topics and activities were presented in Table 2.

Table 2. Workshop Topics and Activities

Group	Topic	Theme of Digital Citizenship	Activities Included	Blackboard Collaborate Features and External Tools Used
Blue	How to maintain a positive, professional digital footprint as an educator	Digital Rights and Responsibilities	Pre- and Post-Assessments, Mini Lecture and Scenarios	Audio, Instant Polling, Text Chat, Upload PPT, and Whiteboard
Green	Copyright	Digital Law	Pre- and Post-Assessments, Mini Lecture, and Scenarios	Audio, Text Chat, Web Tour, and Google Slides
Purple	Cyberbullying	Digital Rights and Responsibilities	Pre- and Post-Assessments; Mini Lecture, Videos, and Statistics	Audio, Emoticons, Instant Polling, Text Chat, Web Tour, Upload PPT, and Google Form
Yellow	Digital Footprint: What are you leaving behind?	Digital Rights and Responsibilities	Mini Lecture, Videos, Reading Activity, Hands-On Activity, Lesson Examples, and Workshop Survey	Audio, Text Chat, Web Tour, Upload PPT, Google Form
Red	Plagiarism, Intellectual Property, & Copyright - Cite It, Don't Steal It!	Digital Law	Pre- and Post-Assessments, Mini Lecture, Videos, and Workshop Survey	Audio, Text Chat, Google Slides RQ Codes, and Google Form

Results

Among the nine survey respondents, two felt uncomfortable using Blackboard Collaborate and seven of them felt either comfortable or very comfortable using Blackboard Collaborate. S1 provided an explanation about why she felt uncomfortable with Blackboard Collaborate: “I was nervous at first because I am not comfortable using Blackboard Collaborate so I was worried I would have technical issues, but it went much better that I expected.” In addition, two of the candidates felt uncomfortable with online synchronous peer-teaching, and at the same time, seven of them felt either comfortable or very comfortable with online synchronous peer-teaching. Thus, overall, the majority of the participants had a high comfort level with using Blackboard Collaborate or online synchronous peer-teaching. The data from the survey responses, peer evaluation rubric responses and workshop archives were integrated together and presented by each research question.

Research Question One

The research question one was to understand teacher candidates’ perceived effect of the online synchronous peer-teaching practice on preparing them to teach digital citizenship in their own classroom. There were four survey questions (Q4-Q7) related to this research question. Q4 related to learn-instructor interaction (M = 4.44, SD = .53), which examined if candidates learned to engage their learners in dialogues or provide learners timely feedback during the workshop. Q5 covered learner-learner interaction (M = 4.44, SD = .53). It examined if candidates were able to facilitate interaction and collaboration among learners during the workshop. Q6 asked about learner-content interaction (M = 4.44, SD = .53). It examined if candidates were able to engage learners with workshop content and activities. Q7 concerned about learner-interface interaction (M = 4.44, SD = .53). It examined if candidates were able to assist learners in using Blackboard Collaborate effectively for learning during the workshop. The means for these four questions were all above 4, which indicated that students agreed with the helpfulness of the online synchronous peer-teaching practice to support them to teach digital citizenship.

Research Question Two

The research question two was to explore what teacher candidates had learned in the peer-teaching practice from acting as both a workshop instructor and a learner. There were six survey questions (Q8-Q13) related to the instructor role in the workshop. According to the descriptive statistics, the means for these six questions were all above 4, which indicated that candidates agreed acting as a workshop instructor enhanced their ability to 1) plan for clear instruction of digital citizenship to learners (M = 4.44, SD = .53), 2) handle unexpected instructional situations (M = 4.33, SD = .50), and 3) utilize technology effectively for teaching digital citizenship (M = 4.44, SD = .53). Acting as a workshop instructor also 1) allowed the candidates to practice their strategies to teaching digital citizenship (M = 4.44, SD = .53), 2) improved their strategies to teach digital citizenship through learners’ feedback (M = 4.33, SD = .71), and 3) increased their self-confidence in teaching digital citizenship (M = 4.44, SD = .53). For example, S6 confirmed that she did learn “how to collaborate online and take the role of an instructor in online platforms” from the workshop.

There were three survey questions (Q14-Q16) related to the learner role in the workshop. According to the descriptive statistics, the means for these three questions were all above 4, which indicated that candidates agreed acting as a workshop learner allowed them to learn new strategies to teach digital citizenship from their peers (M = 4.44, SD = .53) and affirm their own strategies to teach digital citizenship (M = 4.33, SD = .71). In addition, acting as a workshop learner also gave them a chance to reflect on their own strategies to teach digital citizenship (M = 4.44, SD = .53).

Research Question Three

The research question three was to explore if there were any changes to teacher candidates’ perceived knowledge of digital citizenship before and after the peer-teaching practice. There were four survey questions related to this research question. First, candidates were asked to rate their perceived knowledge of digital citizenship before and after the workshop using two 4-point Likert scale questions (Q17-Q18). According to descriptive statistics, the rating for the perceived knowledge of digital citizenship after the workshops (M = 3.56, SD = .53) was higher than the rating for the perceived knowledge of digital citizenship before the workshops (M = 2.33, SD = .50). Candidates perceived that they became either knowledgeable or very knowledgeable about digital citizenship after the workshops. In addition, according to the responses to Q19, candidates agreed that the workshops helped increase their knowledge of digital citizenship (M = 4.44, SD = .53).

Six survey respondents for Q20 indicated that they learned new knowledge of digital citizenship. For example, S1 mentioned, “I was familiar with many of the topics covered, but I did learn a lot from the workshops. I learned in depth information on several topics including the definitions of many new vocabulary words that I was not aware of before.” S2 also expressed that she gained knowledge of digital citizenship from the workshops. She said, “I learned some great information and statistics regarding cyberbullying, plagiarism, copyright, and digital footprints. The workshops were very informative and eye-opening.”

Candidates provided more details about the new knowledge they learned in their rubric responses. The concepts mentioned repeatedly included copyright, cyberbullying, digital footprint and plagiarism. For example, R5 said, “I did not know there were so many different types of cyberbullying. 47% of young people are cyberbullied. 1 in 4 young people have been bullied more than once.” Not only did the respondents learn new knowledge, they also learned resources they could possibly apply to their own classroom. Just as R3 mentioned, “I learned of different lessons that can be used to bring awareness of the digital footprint for middle and high school students.”

Research Question Four

The research question four was to understand if there were any useful strategies and resources that teacher candidates could adopt to teach digital citizenship in their own classroom. Concerning the useful strategies and resources used to teach digital citizenship, real-life examples/scenarios, videos, statistics, assessments, and hands-on activities were repeatedly mentioned in both the survey responses and rubric responses (see Table 3). For example, Group Blue shared the scenarios of professional digital footprint in the workshop, which helped their peers understand how to maintain a positive digital footprint. Another example was that Group Purple shared a video of Amanda Todd (https://www.youtube.com/watch?v=ni-Y3wU92iU) to raise learners’ attention to the serious consequences of cyberbullying.

Table 3. Useful Strategies Used to Teach Digital Citizenship

Strategy	Frequency of Occurrence	Quote
Real-life examples/scenarios	7	S2- “One effective strategy is to use real-life examples and make connections.” R8- “This group shared some great tips on maintaining a positive digital footprint. They shared some great scenarios to show how leaving digital footprints can be tricky depending on the situation.”
Videos	6	S2- “I believe links and videos are the most effective resources.” R3- “Providing videos and examples of how cyber bullying can have devastating effects in someone’s life and legal consequences, was an eye opening.” R7- “The ten types of cyberbullying were very helpful, and the video was very powerful.”
Statistics	5	R2- “Use statistics to bring the topics to life.” R8- “I learned about the statistics related to cyberbullying. There was a much lower report rate than I initially thought. 48 states actually have defined laws against cyberbullying except for Wisconsin and Alaska. We have a 13% report rate in the state of Georgia. There is only a 16% overall. The highest percentage comes from harassing/threatening comments while the lowest percent comes from cruel pictures.”
Assessments	5	S2- “Online quizzes are also great resources if they relate to the workshop topic. Polling and assessing throughout the workshop helps keep the audience engaged.” R3- “Pre and post assessments were done to engage the audience.”
Hands-on activities	3	R3- “It was interesting to learn how searches play such a big part of our daily lives.”

Discussion

There were several findings from the current study. First, students agreed with the helpfulness of the online synchronous peer-teaching practice to support them to teach digital citizenship. Second, the online synchronous peer-teaching practice allowed teacher candidates to play as both an instructor and a learner when learning digital citizenship. As acting as an instructor, they learned how to 1) plan for clear instruction of digital citizenship, 2) handle unexpected instructional situations during the practice, and 3) utilize technology effectively for teaching digital citizenship. In addition, through the online synchronous peer-teaching practice, they practiced their strategies to teach digital citizenship and improved their strategies through learners' feedback. The practice also helped increase their self-confidence in teaching digital citizenship. As acting as a learner, they learned new strategies to teach digital citizenship from their peers and affirm their own strategies. The practice also gave them a chance to reflect on their own strategies to teach digital citizenship. Third, candidates perceived that the practice helped increase their knowledge of digital citizenship. They agreed that they did learn new knowledge and resources they could possibly apply to their own classroom. Fourth, the use of real-life examples/scenarios, videos, statistics, assessments, and hands-on activities enhanced learning during the practice. Overall, the candidates' learning experiences through online synchronous peer-teaching practice were positive. Just as S6 said, "I think this class supported my learning in encaging, learning and teaching digital citizenship."

Conclusions

According to the results, the peer-teaching practice with synchronous technologies helped prepare teacher candidates to teach digital citizenship. They learned new knowledge, strategies, and resources from the practice and recognized its helpfulness to their learning about digital citizenship. The sample size of the current study was small, which made it difficult to generalize the findings to a large population. However, it could still provide insights into preparing teacher candidates to teach digital citizenship using an online synchronous peer-teaching practice. Directions for future research could include more samples, employing interview techniques to explore candidates' perception in detail and using a pre- and post- assessment to measure the actual changes to candidates' knowledge of digital citizenship.

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A Newcomer's Lens: A Look at K-12 Online and Blended Learning in the *Journal of Online Learning Research*

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Two descriptors: journal analysis, k-12 online and/or blended learning

Abstract

In this study, the authors analyzed 51 articles published between 2015 and 2018 inclusive in the *Journal of Online Learning Research* (*JOLR*). The purpose of this study was to examine the trends regarding article topics, geography, research methods and article types, authorship, and citation frequency. The results indicated that *JOLR* gave additional attention to K-12 blended learning; compared to the field overall. Another common topic was professional development, with one special issue and the majority of top-cited articles related to this topic. Most of the studies were conducted in the United States, by researchers also located in the US. Finally, more than half of the studies employed inferential and interpretive methods. Future research is needed to examine if the trends from this study continue over a more extended period and if these results reflect the development of and change in the field of K-12 online and blended learning.

Introduction

In 2011, Dr. Richard West introduced a new series called "Journal Analysis Series," which was published in the magazine *Educational Technology.* At the time, West (2011) wrote that to better understand the field of educational technology it was "helpful to review some of the journals that publish work in this area to see what conversations are being held, research being conducted, tools being developed, and theories being accepted" (p. 60). Later West (2016) reported that he and graduate students from his department had published 23 articles in *Educational Technology* over a period of five years, "each analyzing a decade of scholarship in that journal" (p. 41), with each analysis providing a meta-discourse of insights.

As a part of this series several distance/online learning journals were analyzed (e.g., *American Journal of Distance Education*; *Distance Education*; and *Journal of Distance Education*). However, as Barbour (2011) reported, only a small percentage of articles in these more general distance/online learning journals – such as those listed above – focused on the K-12 environment. In 2015 the *Journal of Online Learning Research* (*JOLR*) was established to publish articles related "to the theoretical, empirical, and pragmatic understanding of technologies and their impact on pedagogy and policy in primary and secondary (K-12) online and blended environments" (Association for the Advancement of Computing in Education, 2018, ¶ 1). Four years later, Arnesen, Hveem, Short, West, and Barbour (2019) confirmed that *JOLR* was responsible for approximately 7.0% of the 356 K-12 online learning journal articles they reviewed, and responsible for 41% of the articles published between 2015-17.

Given the growing importance of JOLR as a publication outlet for scholars of and research into K-12 online and blended learning, it is important to begin to understand the topics, types of articles, authors, and top-cited articles of this journal in an effort to provide insight into the larger context of the field. As such, the purpose of this study was to conduct an analysis of *JOLR* with respect to article topics, research methods and article types, authors, and citations using procedures similar to those used in the "Journal Analysis Series."

Literature Review

The practice of K-12 online learning traces its roots to around 1991 (Barbour, 2013; Clark, 2013). However, as Arnesen et al. (2019) reported, the first journal article focused on K-12 online learning was not published until 1996. Much of the literature and research that was initially published in the field came in the form of documents from private research centers and think tanks, individual program evaluation reports, and Master's theses and doctoral dissertations (Barbour & Reeves, 2009; Cavanaugh, Barbour, & Clark, 2009). In fact, it wasn't until 2006 that the number of journal articles related to K-12 online learning began to grow in larger numbers (Arnesen et al., 2019).

To date, there have been four comprehensive literature reviews that have been published in the field of K-12 online learning (Barbour & Reeves, 2009; Cavanaugh et al., 2009; Hasler Waters, Barbour, & Menchaca, 2014). Overall, the themes in each of these articles have been fairly consistent. For example, the dominant theme in each of the four literature reviews has been that the majority of research into K-12 online learning has been focused on comparing how students performed based on the delivery model of their learning (i.e., distance/online vs. brick-and-mortar). The remaining literature has tended to focus on: 1) components of teaching and learning online (Barbour & Reeves, 2009; Cavanaugh et al., 2009) or 2) online learning policy, particularly as it relates to full-time K-12 online learning (Barbour & Reeves, 2009; Hasler Waters et al., 2014).

In addition to these thematic literature reviews, there have also been several different analyses of the state of the field of K-12 online learning. For example, Barbour (2007) examined the backgrounds of various researchers who had published in the field and found that many of these early scholars in K-12 distance/online learning came from varied backgrounds, had very different professional training, and were working in a wide variety of disciplines. Lowes (2014) examined the research methods used in select journal articles from 2004 to 2014 in online teaching and learning. She reported that initial research in the field utilized experimental or quasi-experimental methods, and then transitioned to small scale case studies and survey-style research.

In their contribution to the second edition of the *Handbook on K-12 Online and Blended Learning*, Lokey-Vega, Jorrín-Abellán, and Pourreau (2018) studied the 'Research Clearinghouse for K-12 Blended and Online Learning' to determine if any learning theories were included in the title, abstract, or keywords of the research contributed to that database. Lokey-Vega and her colleagues concluded that while "the relatively young field of research in K-12 online learning has achieved much in establishing ourselves as a distinct and definable group" (p. 85), the body of research had just started to "stretch [the] field to seek and understand instances of success and test well-supported historically-important distance learning theories" (p. 85). Later in the same handbook, Lowes and Lin (2018) found that "much of the early research on online learning at the K-12 level focused on comparing online supplemental courses with their face-to-face counterparts… [while] the rest of the research falls under the broad heading of studies of particular cases" (p. 92).

As a complete volume, the second edition of the *Handbook on K-12 Online and Blended Learning* would suggest to readers that the field was largely atheoretical, focused on comparing student performance in online and brick-and-mortar environments or conducting case studies on a variety of aspects in K-12 online and blended learning, and primarily concerned with the United States. This is not inconsistent with the findings of Barbour (2018), who reported that to date researchers in the field of K-12 distance, online, and blended learning rarely used theoretical or conceptual frameworks to guide their research, did not use validated instruments as a part of the research tools, and – in many instances – failed to define the characteristics of what was being researched. This final point is important, as the nature of the distance, online, or blended learning contexts can vary significantly from one setting to another. Without adequately describing the characteristics of that setting, it renders meaningful comparisons with future research difficult to impossible.

It should be noted that all of the literature discussed thus far has focused on K-12 distance/online learning. However, the field is generally viewed in broader terms as the field of K-12 distance, online, and blended learning (Kennedy & Ferdig, 2018). Reasons for the lack of coverage of K-12 blended learning include the general lack of literature and, in particular, research on the topic.

There have even been some that have argued that the focus on K-12 blended learning by those in the larger field of K-12 distance, online, and blended learning is based on ideological or political motivations (Barbour, 2014); arguing that outside of the United States blended learning is seen as a form of technology integration at the K-12 level. However, the Association for the Advancement of Computing in Education, the organization that publishes *JOLR*, is based in the United States. Additionally, according to the founding editors, the purpose of *JOLR* was to "address online learning… [and] educators who have chosen to blend online learning tools and strategies in their face-to-face classroom" (Kennedy & Archambault, 2015, p. 6). As such, our analysis of JOLR will focus on the complete field of distance, online, and blended learning.

Methodology

To complete our analysis, we reviewed and analyzed all 51 articles published in *JOLR* between 2015 and 2018, excluding editorials and book reviews, for trends in topics, article types, authorship, geography, and citations, using procedures consistent with the Journal Analysis Series (West, 2011, 2016).

Article Topics and Geography Analysis

The website for *JOLR* (see https://www.aace.org/pubs/jolr/) provided abstracts for all of the articles that we analyzed. We entered the 51 abstracts into *Textalyser* (see http://textalyser.net/), an online text analysis tool, which extracted the top relevant two- and three-word phrases to determine the journal's central topics. Additionally, we reviewed the abstract and methodology portions of each article to determine whether they had a specific focus on school level, such as high school and elementary school, or had no focus. It should be noted that throughout JOLR's history there have been several special issues.

Table 1. JOLR Special Issues

Year	Volume	Issue	Special Issue Topic
2015	1	1	*
2016	2	2	Professional development
2016	2	4	Supporting students
2017	3	1	Bended learning
2018	4	1	Students with disabilities
2018	4	3	Online course design

* While not a special issue, the inaugural issue featured invited works from several of the scholars who helped to create the journal (Kennedy & Archambault, 2015).

We mention these special issues, as well as the invited inaugural issue, to allow readers to better understand some of the topical trends, as the inclusion of a special issue on a particular topic has the ability to skew the number of articles focused on that topic in the overall data.

We also examined each of the articles to determine either the geographic location of the study or the geographic focus of the article. Generally, the geographic focus was referenced in the abstract and/or methodology portions of the article, although the entire article was reviewed to determine the geographic focus.

Article Types and Methodologies Analysis

We used a similar coding methodology that West and his colleagues used in the Journal Analysis Series (see West, 2011, 2016). Each article was coded according to six possible categories to identify the methodological trends. We used the following coding definitions:

- Descriptive: The research primarily relies on data collected from surveys and reports where the statistics are descriptive in nature, such as means, averages, and percentages.
- Inferential: The research includes studies that are quasi-experimental, experimental, or correlational, or that validated a survey instrument using factor analysis or item response. They report inferential statistics that test hypotheses or report differences between groups.
- Interpretative: These studies include case studies, ethnographies, interview studies, observation studies, and document analysis studies. These articles often focus on interpreting data to develop theory and are more substantial than categorizing simple answers to a one- or two-question open-ended survey.
- Theoretical: The research is not data-based, but includes discussions of new theories, models, instructional approaches, designs, and reviews of literature.
- Content analysis: The research presents discrete categories and labels data according to deductively categorize data.
- Combined methods: The research uses any two combinations of methods, most commonly interpretive and inferential methods.

We assigned each article to a single category, and those articles with elements of more than one category were assigned according to their primary characteristics.

Authorship Analysis

We conducted the analysis of authorship by extracting the frequency of each author's contributions. We then employed a point scale, giving first authors three points; second authors, two points; and third authors and beyond, one point.

We also examined each of the articles to determine the geographic location of the author based on their institutional location. The *JOLR* website provides the authors' names, each author's institutional affiliation, and the country where each institutional affiliation is located. We reviewed this information and categorized the authors according to the country of their institutional affiliations.

Citation Analysis

We analyzed *Google Scholar*, using the *Publish or Perish* software (Harzing, 2010), to examine the number of citations for each article as of 31 December 2018. We analyzed all 51 articles published between 2015 and 2018 to identify the 11 top-cited articles, each of which was cited seven or more times.

Results

This study analyzed 51 articles published in *JOLR* from 2015 to 2018. The findings below will identify trends regarding article topics, article types and research methods, authors, and citations, using procedures like those used in the Journal Analysis Series (see West, 2011, 2016). In addition, this study will add two new domains: the article geography analysis and author geography analysis.

Article Topics and Geography

Table 2 indicates the most frequent three- and two-word phrases appearing in the article abstracts. Those phrases referenced fewer than three times for three-word phrases and fewer than 15 times for two-word phrases are not listed in this table.

Table 2. Frequency of phrases in abstracts

3-word phrases	Number of articles	Phrase count
Face-to-face	8	9
Online and blended	5	7
Online course design	5	6
Blended learning environment(s)	4	6
Online learning environment(s)	4	5
Students with disabilities	3	6
Community of engagement	2	4
2-word phrases	Number of articles	Phrase Count
Blended learning	14	29[1]
Online teacher(s)	13	29
Online courses(s)	12	25[2]
Professional development	12	23
High school	9	19
Online Learning	8	9[3]
Learning environment(s)	5	8

"Blended learning" and "online teacher(s)" were the most frequent topic phrases. Both had 29 instances within the abstracts, with 14 and 13 articles, respectively. The phrase "blended learning" was also found in "blended learning environment(s)," which added another six instances in four articles. Additionally, in many instances the phrase "blended learning" was preceded by "online and".

The other topics – "face to face," "online and blended," "students with disabilities," "communities of engagement," "professional development," and "high school" were all included in articles that focused on some aspect of online and/or blended learning. The four articles that did not contain direct references to online or blended learning in the abstracts did, nevertheless, discuss some aspect of online or blended learning.

Table 3 shows the specific focus on school level of each article. The number of articles that have no school level focus is also listed at the bottom of the table.

Table 3. Specific focus on school level

Specific levels	Number of articles
High school/secondary	23
K-12	17
Middle School	7
Elementary School	2
K-8	1
No focus on level	1

1 This number excludes incidences of the phrase used in "blended learning environment(s)."

2 This number excludes incidences of the phrase used in "online course design."

3 This number excludes incidences of the phrase used in "online learning environments."

Fifty of the 51 articles in this study discussed different aspects or levels of K-12 contexts. Twenty-three articles focused on high schools or secondary schools, 17 articles focused on K-12 generally, seven articles focused on middle schools, two articles focused on elementary schools, and one article focused on K-8. The one article that had no specific school level focus (Evmenova, 2018) focused on professional.

Table 4 reports the geographic location of the study or the geographic focus of the article itself. The number of articles that have no focus on geography is also listed at the bottom of the table.

Table 4. Location where the study took place or where the article was focused.

Geography	No. of Studies
United States	42
Turkey	1
Brazil	1
India	1
Multiple countries	1
No focus/Unable to determine	5

There were five articles that had no specific geographic focus or we were unable to determine the location. With the exception of these five articles, the vast majority (i.e., 91%) of articles with a geographic focus published by *JOLR* focused on the United States. There was one article focused on each of the following: Turkey, Brazil, and India. All but one of the studies were conducted in the country of the author's institution. However, it is worth mentioning that the one study that did not follow this trend involved authors from multiple countries.

Article Types and Methodologies

Table 5 lists the different research method categories and the number of articles for each category. Additionally, this table describes the overall proportion of each methodology.

Table 5. Categorization of all articles published

Method	Total Number	Total Percentage
Interpretive	16	31%
Inferential	15	29%
Combined	11	22%
Theoretical	6	12%
Content Analysis	2	4%
Descriptive	1	2%

The most common methodological category was interpretive. However, there was only one fewer inferential studies than interpretive studies. Content analysis and descriptive methods made up only a small proportion.

Table 6 indicates both the number of articles per methodological category for each year and the yearly average for each category. To ensure precision, the yearly average was rounded to two decimal places.

Table 6. Number of articles published each year according to category

Method	2015	2016	2017	2018	Yearly Average
Interpretive	4	7	2	3	4.99
Inferential	3	6	3	3	3.75
Combined	5	3	2	1	2.75
Theoretical	1	1	0	4	1.50
Content Analysis	0	0	1	1	0.50
Descriptive	0	0	1	0	0.25

Similar to Table 5, Table 6 shows that an interpretive approach was the most frequently used methodology, in terms of the yearly average. It is worth noting that the number of theoretical articles increased abruptly in 2018, increasing to four theoretical articles in 2018. Two of these four theoretical articles focused on the special issue topic of online course design, indicating that this topic may have been more aligned to this category. Additionally, the number of articles that applied combined methods tended to decrease gradually year by year.

Authorship

Table 7 lists all the authors who published two articles or more, ranked according to the medal system. Authors with three points or fewer were only listed according to the number of articles each published.

Table 7. Overall authorship by number of articles and point

Author name	**No. of articles**	**No. of points**
Jered Borup	4	9
Mark Stevens	3	7

Charles Graham	3	6
David Adelstein	2	6
Leanna Archambault	2	6
Annisa Loky-Vega	2	5
Michael Barbour	2	4
Mary Rice	2	4
43 authors	1	3
33 authors	1	2
39 authors	1	1

The 51 articles had a total of 123 authors. Jered Borup was a top author in this journal with the most number of publications and the highest author rank. Jered Borup, David Adelstein, and Leanna Archambault each published two articles as the first author. Of these listed authors, it should be noted that Jered Borup and Leanna Archambault are current editors of *JOLR*. Interestingly, although 86% of the articles had two or more authors, most of the authors, approximately 93% of the authors published only one article.

Table 8 shows the countries where the authors' institutional affiliation were located. It also counts the total number of authors from each country.

Table 8. Geographical location of authors

Geography	**No. of authors**
United States	115
United Kingdom	5
Turkey	3
Brazil	2
Canada	1
India	1

Similar to the results shown in Table 4 that the majority of the studies occurred in or were focused on the United States, 93% of authors' institutional affiliations were located in the United States, which indicated that the geographic focus of the study was almost always aligned with the geographic location of the authors' institutional affiliations. One of the exceptions to this pattern was when two authors from Brazil, together with one author from Canada, conducted a study set in Brazil.

Citations

Table 9 reports the top cited articles. Only articles with more than five citations are listed in this table.

Table 9. Frequency of article citation

Title **Authors**	**Type**	**Citations**	**Year**
Learning to learn online: Using locus of control to help students become successful online learners Susan Lowes, Peiyi Lin	Inferential	22	2015
Documenting and sharing the work of successful on-site mentors Joseph Freidhoff, Jered Borup, Rebecca Stimson, Kristen DeBruler	Interpretive	18	2015
Pioneering the digital age of instruction: Learning from and about K-12 online teachers Leanna Archambault, Jean Larson	Combined Methods	13	2015
Incremental progress: Re-examining field experiences in K-12 online learning contexts in the United States Leanna Archambault, Kathryn Kennedy, Catharyn Shelton, Medha Dalal, Laura McAllister, Sabrina Huyett	Combined Methods	11	2016
Building better courses: Examining the construct validity of the iNACOL national standards for quality online courses David Adelstein, Michael Barbour	Theoretical	10	2016
A call to action for research in digital learning: Learning without limits of time, place, path, pace…or evidence Cathy Cavanaugh, Christopher Sessums, Wendy Drexler	Theoretical	8	2015
Credit recovery in a virtual school: Affordances of online learning for the at-risk student Kevin Oliver, Shaun Kellogg	Inferential	8	2015
The status of middle and high school instruction: Examining professional development, social desirability, and teacher readiness for blended pedagogy in the southeastern United States Rebecca A. Parks, Wendy Oliver, Elaine Carson	Inferential	8	2016

Listening to the teachers: Using weekly online teacher logs for ROPD to identify teachers' persistent challenges when implementing a blended learning curriculum			
Jeremy Riel, Kimberly A. Lawless, Scott W. Brown	Interpretive	8	2016
Adapting the curriculum: How K-12 teachers perceive the role of open educational resources			
Beatriz de los Arcos, Robert Farrow, Rebecca Pitt, Martin Weller, Patrick McAndrew	Inferential	7	2016
An analysis of the curriculum requirements for K-12 online teaching endorsements in the U.S.			
Laura McAllister, Charles Graham	Content Analysis	7	2016
Fostering student success and engagement in a K-12 online school			
Heidi Curtis, Loredana Werth	Interpretive	7	2015

The citations listed in the table are reflective of those provided by *Google Scholar* as of December 31, 2018. As would be expected, the articles from 2017 and 2018 were too recent to have any meaningful citation counts, which was likely why there were no articles from those years in the table. Similarly, Jered Borup, who had published the most articles and received the highest author rank in Table 7, was also one of the most cited authors. In addition, David Adelstein, Leanna Archambault, Michael Barbour, and Charles Graham were among the most cited list. These top cited articles covered all methodological categories except the descriptive category. Finally, with the exception of Beatriz de los Arcos and her co-authors, whose institutional affiliation was in the United Kingdom, all other authors' geographic locations were the United States.

Discussion

The results of the topic analysis indicated that both online and blended learning were important topics in *JOLR*, with blended learning heading the list. The interest in blended learning is inconsistent with previous literature that primarily focused on K-12 distance/online learning (Molnar et al., 2017). The efforts *JOLR* has made to bring blended learning prominently into the discussion of distant and online learning reflects their stated purpose to publish articles about both online and blended contexts.

After blended learning, online teacher(s) was the other most frequent topic phrase. This phrase primarily appeared in the context of teacher preparation or professional development, which might indicate the critical role of the teacher, as well as the need for teacher preparation programs and professional development within K-12 online and blended learning environments. This result was consistent with Arnesen et al. (2019), which found teacher education was the most frequent two-word phrase and teacher education programs the most frequent three-word phrase. The results also revealed trends in course design for K-12 online and blended learning, as well as professional development for teachers in those same contexts.

As might be expected from a journal that focuses on K-12 online and blended learning, all but one of the 51 articles in this study discussed different aspects or levels of K-12 contexts. Of these articles 23 focused specifically on high schools or secondary schools, seven on middle schools, two on elementary schools, and one on K-8. In their review of the literature on virtual schools, Barbour and Reeves (2009) revealed a similar pattern. They cited specifics of large growth in virtual high schools and in high school students' participation in online learning, but cited elementary schools only in the larger context of K-12 learning. Similarly, 17 of the 51 articles do not focus on specific grade levels, but rather on the broader context of K-12 learning, suggesting that elementary and middle school contexts are still an important part of the overall concerns and interests of K-12 learning. It is also interesting to note that 12 (or 24%) of the articles focus on some aspect of online and/or blended teachers' training and experience.

The article geographic analysis showed that 82% (i.e., 42 of 51) studies occurred or were conducted in the United States, which was consistent with the literature in general. As might be expected, the results also indicated that the geographic focus of the study was almost always aligned with the geographic location of the authors' institutional affiliations. These results suggest that *JOLR* might benefit from a more global focus to achieve its commitment to being an international journal, and we note that the journal has recently added an "international section" to encourage these kinds of submissions (see http://www.aace.org/pubs/jolr/).

We found interpretive articles accounted for 31% of all methodological categories, followed by inferential articles (i.e., 29%). The results generally aligned with Lowes' (2014) study, in which she reported that the research in the field had transitioned from experimental or quasi-experimental methods to small-scale case studies and survey-style research. Further, according to Arnesen et al. (2019), theoretical methods were the most common type of K-12 online learning articles through 1994 to 2016, but the authors also reported that the number of interpretive and inferential articles was increasing. In fact, interpretive articles were found to be more common than theoretical articles between 2012 and 2016. Similarly, Barbour (2018) underscored the importance of interpretive and inferential methods, and suggested scholars should continue to focus on interpretive and inferential research in K-12 online and/or blended settings. However, Lokey-Vega, Jorrín-Abellán, and Pourreau (2018) claimed that theory played a pivotal role in the field of K-12 online and blended learning and advocated for an increase in the use of theory in the field.

Most of the top authors identified in this study, such as Michael Barbour, Charles Graham, Jered Borup, and Leanna Archambault, were also in the list of the top 20 authors in the recent study of Arnesen et al. (2019). This result supports the assessment by Arnesen and her colleagues that the field of K-12 online education is a 'small research community,' or at least those authors who were the most active represent a small field. Additionally, in accordance with Barbour's (2007) study, these results also displayed a shift in that most of the top authors were from post-secondary institutions, as opposed to non-profit research organizations. The results also suggested that more new scholars were beginning to join the field, given the fact that 113 of the authors contributed only a single article. The key for the future growth of the field will be to ensure that these authors continue to contribute to the field.

The top-cited articles focused on K-12 online and blended education, as did 92% of the entire body of articles as seen in the abstract analysis, both of which reflected the general aim and scope of *JOLR*. Specifically, the fact that six of 11 top-cited articles (i.e., 55%) were related to teacher education programs or teachers' professional development in online and/or blended settings indicated a field trend in professional development for online and blended teachers. This finding was also consistent with a trend in the broader distance education literature that recent studies put an increasing emphasis on the issue of professional development (Lee, Driscoll, & Nelson, 2007). Similar to the findings of Arnesen et al. (2019) that many top authors were also among those whose articles were cited more frequently, the top authors including Jered Borup, Charles Graham, David Adelstein, Leanna Archambault, and Michael Barbour were also the most cited authors. This result further supported the comment by Arnesen and her colleagues that the studies conducted by the most productive authors were also the most significant – at least from a citation perspective. Additionally, more than half of the most cited articles used inferential or interpretive methods, while only two of 12 articles were theoretical articles. This result was consistent with what was found in some of the articles produced from the Journal Analysis Series (West 2011, 2016). Interestingly, in his summary of the formal project, West (2016) remarked that "some journals seem to have discouraged or even disallowed theoretical work, including literature syntheses, in an effort to focus only on empirical work. However, we consistently found theoretical/literature-based articles to be among the most cited in a journal" (p. 44). This inconsistency might indicate that a shift has emerged from the early preference in theoretical methods – consistent with other educational technology disciplines – to data-based methods, especially inferential and interpretive, within the field of K-12 online and blended learning.

It should be noted that there are several limitations in this study. First, we excluded the keyword analysis because only 16 out of 51 articles (i.e., 31%) had keywords, which was not a large enough sample to generalize the primary topics for the whole journal. Second, since *JOLR* is a very young journal, there were only 51 articles over the four- year period that could be analyzed. In contrast, in the Journal Analysis Series, West (2011) indicated that the goal for the series was to examine a decade of scholarship from each of the selected journals. However, it is important to note that Lokey-Vega (2018) felt that the establishment of *JOLR* was one of several steps that "scholarly leaders [had undertaken to] establish critical community infrastructure for networking and knowledge building that would benefit any current or new scholar in the field" (p. 4).

Conclusions and Implications

In general, *JOLR* complies with its aims to publish articles related "to the theoretical, empirical, and pragmatic understanding of technologies and their impact on pedagogy and policy in primary and secondary (K-12) online and blended environments" (Association for the Advancement of Computing in Education, 2018, ¶ 1). Specifically, according to our analysis, the additional attention *JOLR* has given to blended contexts sets it apart from previous literature that focused primarily only on K-12 online learning. *JOLR* also raises awareness of the importance of teachers' professional development in online and blended environments. Second, we found that most of the studies on K-12 online and blended learning occurred or were conducted in the United States. Similarly, most of the researchers' institutional affiliations were in the United States. Third, the fact that 115 of 123 authors in our study had published only one article may indicate that the field is attracting new scholars or that scholars who have other research agendas are finding that their interests overlap with issues in the K-12 context. Finally, *JOLR* favored inferential and interpretive articles.

As the only journal that primarily publishes articles specializing in K-12 online and/or blended learning, *JOLR* provides a unique platform for researchers, especially new researchers to this field, to present their studies on K-12 online and/or blended learning in a journal focused on the subject rather than present them scattered among a variety of journals. However, given that the field is still a relatively new research area, future research can continue to examine the trend analysis over a more extended period to reflect the development of and change in the field of K-12 online and blended education. Further, researchers outside of the United States should be encouraged to conduct research that focuses on other countries in addition to the United States, thus facilitating comparisons between the implementation and use of online and blended approaches in different countries and cultures, as well as encouraging diversification of the field.

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A Comparison of Preservice and Inservice Teachers' Most-Valued Technology-Supported Activities for Teaching and Learning

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Abstract

We examined teachers' pedagogical reasoning for and the technological knowledge underlying their most-valued technology-supported activities for teaching and learning. Data from 140 preservice and 100 inservice teachers included open-ended, narrative responses to survey questions. Qualitative research methods guided analysis of the data that identified (a) the technology-supported activities and (b) the technical tools, target users, types of uses, rationales for use, and the technological pedagogical content knowledge (TPACK) underlying each activity. Preservice teachers described mostly teacher-focused and fewer student-focused techno-activities, and their reasoning for use focused on the technology's presentational and engagement effects. A majority of inservice teachers' techno-activities were student-focused, and their reasoning highlighted the technology's support for knowledge acquisition of higher-order cognitive skills and collaborative learning. The knowledge underlying all teachers' techno-activities was predominantly technological pedagogical knowledge (TPK), but inservice teachers also evidenced technological content knowledge (TCK). These results may reveal differences in the teachers' respective learning experiences or reflect a professional maturation process.

Introduction

Teachers are the decision-makers and the designers of whether and how they use technology in their classrooms (Ertmer, 2005; Tsai & Chai, 2012). Such decision-making and designing occurs within complex educational contexts. Teachers face a range of barriers and supports for technology use in classrooms (e.g., Authors, 2016; Ertmer, 1999, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Hew & Brush, 2007; Tsai & Chai, 2012). Increased clarity on barriers has guided shifts in teacher education and professional learning that have led to increased technology use by teachers over the last decade. Yet, research continues to show preservice and inservice teachers may not have a wide breadth of technology usage in subject areas, and technology integration has yet to be prevalent and equitable in PK-12 schools (e.g., Tondeur, Pareja Roblin, van Braak, Voogt, & Prestridge, 2017; Zyad, 2016).

Decades of research has focused on describing teachers' technology knowledge, often using the technological pedagogical content knowledge (TPACK) conceptual model (Angeli & Valanides, 2005; Mishra & Koehler, 2006). Recent studies find that teachers' perceived TPACK may not aptly reflect their behavioral intentions or smoothly translate into enacted actions in the classroom (e.g., Jen, Yeh, Hsu, Wu, & Chen, 2016). Thus, research must begin to unpack teachers' technology-mediated practices to better understand teachers' TPACK development and use in the PK-12 environment, such as by considering the role of pedagogical reasoning in the context of technology (e.g., Harris & Phillips, 2018; Hofer & Harris, 2019). There is a range of teachers' rationalizations underlying their choices of technology (Li, 2014; Voet & Wever, 2017). A teacher's reasoning for technology use may reveal how they value technology applied in their practice. Yet, the research that links teachers' technology use or planned use with their underlying reasoning for their technology choice(s) is sparse. Hence, our study examined teachers' reasoning for using technologies that they deemed valuable for teaching and learning.

Literature Review

Technology Use by Inservice and Preservice Teachers

Inservice teachers in PK-12 contexts use technology mainly for lesson preparation and professional development needs (Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Zyad, 2016). For instance, Zyad's (2016) study showed that technology was most frequently used by teachers for preparing lesson plans and keeping a database of various instructional materials. In recent years, more research has documented the increasing use of technology by inservice teachers during their classroom instructional time. The majority of these classroom-based technology uses were teacher-focused and transmissive in nature (Tondeur et al., 2016; Voet & De Wever, 2017). For example, Tondeur et al. found technology was integrated by most of the teacher participants to support structured learning approaches–most commonly the use of the data projector or interactive whiteboard to deliver instruction. Few opportunities were provided for student-centered applications. Similar findings were observed by Voet and De Wever. Their results showed that student use of technology remained scarce as teachers perceived technology as a resource for the learning task, rather than as a tool for supporting student inquiry learning.

In comparison to inservice teachers, there are fewer studies of preservice teachers' technology use. Among the studies of technology use, similar patterns, such as the domination of productivity software like Word and PowerPoint, were revealed in the cases of preservice teachers. Hu and Yelland (2017) found when integrating technology in instruction, preservice teachers, rather than their students, initiated and directed most of the activities. Understanding why teachers choose to use various technologies will advance more breadth in technology use.

TPACK in Relation to Teachers' Technology Use

Earlier literature has extensively examined teachers' perceived TPACK and its relationships with salient cognitive and affective aspects such as teachers' pedagogical beliefs, self-efficacy, and attitudes towards technology (e.g., Crompton, 2015; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). After recognizing that teachers' perceived TPACK may not aptly reflect their behavioral intention or smoothly translate into their enacted actions in the classroom (e.g., Jen et al., 2016), more researchers have begun to unpack teachers' technology-mediated practices to better understand teachers' TPACK development in the PK-12 environment (e.g., Gómez, 2015; Gonzalez & González-Ruiz, 2017). Gonzalez and González-Ruiz (2017) conducted multiple case studies to explore if the behavioral intention of six preservice teachers' technology-supported mathematical tasks for teaching was associated with the TPACK model. Findings showed that behavioral intentions revealed in the participants' explanations of technology-supported tasks was unrelated to the TPACK components. Research that involves more participants can expand exploration of teachers' knowledge when making educational technology planning decisions.

Pedagogical Reasoning and Action

Scholars have begun to also consider teachers' pedagogical reasoning and actions as a conceptual frame underlying the technology integration process (Harris & Phillips, 2018; Hofer & Harris, 2019). Developing and supporting teachers' pedagogical reasoning and critical decision-making regarding technology integration in classroom teaching is crucial because educational technology options are ever-expanding. Past investigations of how technological knowledge (i.e., TPACK) underlies teacher actions enacted in classrooms has begun to expand beyond the ‘what’ and ‘how’ of teachers’ technology use to also consider the ‘why.’ Loughran (2019) asserts “making sense of the ‘why’ comes with its own challenges because much of that thinking – the pedagogical reasoning – underpinning practice has long been recognized as tacit in nature” (Loughran, p. 4).

Some studies (Hofer & Harris, 2019; Niess & Gillow-Wiles, 2017) are specifically framed around Shulman’s (1987) theory of pedagogical reasoning and action, while others have explored reasoning processes from a TPACK conceptualization (Guzey & Roehrig, 2009; Janssen, Knoef, & Lazonder, 2019) or domain-specific (Sherman, 2014; Voet & De Wever, 2017) or both (Wilkerson, Andrews, Shaban, Laina, & Gravel, 2016). Of the handful of existing studies, most are situated in inservice contexts with a small number of participating teachers mostly at the secondary level (e.g., Guzey & Roehrig, 2009; Hofer & Harris, 2019; Niess & Gillow-Wiles, 2017; Sherman, 2014; Voet & De Wever, 2017). Two studies involve preservice teachers (Janssen et al., 2019; Wilkerson et al., 2016). These researchers contend that studies of pedagogical reasoning will enable better understandings of teachers’ knowledge, TPACK or otherwise, within instructional planning and decision-making.

Studies have identified that teachers’ pedagogical reasoning for technology integration mirrors their established pedagogy and knowledge (Guzey & Roehrig, 2009; Sherman, 2014). Sherman’s study of four mathematics teachers found that even when teachers had intentions to use technology for high-cognitive activities, most often lessons were implemented in low-cognitive ways, which revealed a mismatch between intentions and use.

The literature also suggests there is a wide range of teachers’ rationalizations underlying their choices of instructional technology (Heitink, Voogt, Verplanken, van Braak, & Fisser, 2016; Li, 2014; Voet & De Wever, 2017). Voet and De Wever found 22 secondary social studies teachers voiced four types of rationales for their adoption of technology tools: (a) increasing effectiveness of instruction, (b) connecting to students’ daily lives, (c) increasing work efficiency, and (d) complying with peer pressure to use technology. The teachers’ technological practices tended to be teacher-centric with little active technology use by students. In Li’s study, teachers articulated their use of technology for either attending to personal teaching needs (e.g., professional development or lesson preparation) or addressing student learning needs (e.g., enhancing engagement or facilitating understanding). Heitink et al. reported that most of teachers’ technology use was to strengthen teaching pedagogy and/or subject matter learning. Wilkerson et al. (2016), in a study with preservice teachers, found the teachers valued and used technology (a) as a modelling tool, (b) as a way to share student ideas, and (c) as a way to show student ideas.

These rationales have been identified in studies involving pedagogical reasoning and situated with teachers who were planning lessons within specific contexts, such as involving fewer than five pre-introduced technologies (Sherman, 2014; Wilkerson et al., 2016); for specific activities, such as inquiry (Guzey & Roehrig, 2009; Wilkerson et al., 2016), communication and collaboration (Niess & Gillow-Wiles, 2017), or high-level mathematics thinking (Sherman, 2014); or using specific supports or aids for lesson development (Hofer & Harris, 2019; Janssen et al., 2019, Wilkerson et al., 2016). Through very detailed case studies, past research has begun to identify a range of teachers’ reasoning underlying their choices of technology. We had the opportunity to use a larger teacher participant pool than past studies to examine teachers’ reasoning for using technologies that they deemed valuable.

Thus, our study examined a large participant pool of both preservice and inservice teachers, examined proposed/enacted techno-lessons, explored the reasoning for technology use in the lessons, and determined the requisite TPACK for designing the lessons. Our research questions included:

1. What technology-supported teaching and learning do preservice and inservice teachers value most?
   a. Who are the targeted users (students or teachers) in these valued technology-supported activities?
   b. What are the common technology tools involved in the technology supported activities?
   c. How are students or teachers using technology in these technology-supported activities?
   d. How do teachers reason about the value of technology-supported activities?
2. What TPACK knowledge is reflected in preservice and inservice teachers’ technology-supported activities?

Method

This qualitative research study is part of two larger research projects examining technology-related learning and integration in one teacher education program and in several middle schools.

Participants and Data Sources

Preservice teachers (n=140) enrolled in a university-based certification program for elementary certification at a large southwestern U.S. university answered the following questions in a survey administered within two weeks of their graduation and teacher certification:

- Describe the most valuable learning technology (a learning technology you could not imagine teaching without) that you or your students will use in the future, if available?
- Please explain why your chosen technology (listed above) is so valuable, such as its value to you and your students, how you or your students will use it, and what objectives it helps you reach?

Inservice teachers (n=100) were situated in four different middle schools in a southwestern U.S. state. Saguaro MS was located in a rural setting, served a Latinx-majority student population, and 72% of its population was economically disadvantaged. Porter MS was an urban school with 50% White student population and 40% economically disadvantaged. Walnut MS was suburban with 12% of students economically disadvantaged and 75% White. Verona MS was in a rural location and served a student population with 53% economically disadvantaged and 57% White. In the teacher survey, these teachers answered:

- Please list all the technologies (whether you have access to them or not) you feel are required for you to have available to assist your students in learning in the subject areas you teach.
- List the technology and the specific subject matter/content concept(s) it supports. You may be as broad or as specific as you like. You can discuss: its value to you and your students, how you or your students will use it, and what objectives it helps you reach.

We examined the inservice teachers as a whole group whose reported practices from the four schools contributed to a rich dataset. The open-ended, narrative data allowed deep examination of teachers' reasoning. A limitation exists: we did not observe teachers' practice and actions in a classroom setting.

Data Analysis

The open-ended data was analyzed in a spreadsheet. First, we listed, counted, and grouped each learning technology(ies) teachers mentioned into categories used in a common educational technology text. We then identified techno-idea chunks that expressed both a learning technology and a use and/or reasoning/value statement. For these chunks, we coded for (a) the type of activity (student vs. teacher uses) and (b) the reasoning/value(s). We used open-coding using emic and etic coding categories, subcategories, and definitions, while constantly comparing our generated codes and coded data to ensure consistency (DeCuir-Gunby, Marshall, & McCulloch, 2011; Miles, Huberman, & Saldana, 2014). We also employed multiple coders with code checking between researchers until 100% agreement on codes was achieved, which enhances trustworthiness (Miles et al., 2014). We then used a TPACK knowledge framework culled from the literature (Authors, 2018) to code the requisite knowledge we inferred as underlying each teacher's expressed techno-idea(s) (see Appendix). Finally, we created data displays (Miles et al., 2014) to explore and compare patterns in the findings from preservice and inservice teachers.

Results

Target Users and Types of Activities within Teachers' Valued Technology-Supported Lesson Activities

Preservice teachers' techno-activities involved more teacher focus (64.6%) versus inservice teachers' activities (44.6%). Conversely, inservice teachers' techno-activities involved more student focus (55.4%) (Table 1).

Depictions of teacher use and reasoning within teachers' valued technology-supported lesson activities. Considering the nature of tasks and different aspects of teaching responsibilities, we identified four categories of teacher-focused techno-activities (see Table 1):

- Designing and preparing for lessons–Teachers used technology to prepare for the class ahead of time, which included writing lesson plans, researching for course content, creating various instructional materials, transferring digital content from home to work.
- Teaching lessons–Teachers used technology to enhance their teaching when they executed a lesson, such as delivering information in multimedia formats, facilitating student-centered activities, showing students how to research online, and managing classrooms.
- Grading and assessment–Teachers used technology for formative and summative assessments and grading.
- Communicating with students and parents–Teachers used technology to communicate with students and parents.

Results showed that the majority of teacher-focused techno-activities that preservice and inservice teachers described involved teaching lessons (see Table 1). While preservice and inservice teachers used similar tools across all these teacher use categories, inservice teachers valued these activities for their potential to facilitate students' knowledge development and skills practice; preservice teachers valued the presentational effects that technology offered. In the following sections, we compare the common tech tools that preservice and inservice teachers used across these different categories of their teaching and the values they anticipated in adopting these techno-activities.

Table 1. Frequency of Teacher and Student Uses Mentioned in Techno-Activities

Target User and Activities	Frequency[a]: Preservice Teachers		Frequency: Inservice Teachers	
	n	%	*n*	%
TEACHER USES (total)	**135**	**64.6**	**137**	**44.6**
Designing and Preparing for Lessons	29	13.9	23	7.5
Teaching Lessons	93	44.5	95	30.9
Grading and Assessment	5	2.4	14	4.6
Communicating with Students and Parents	8	3.8	5	1.6
STUDENT USES (total)	**74**	**35.4**	**170**	**55.4**
Passive Hands-Off Learning (PHOFF)	26	12.4	21	6.8
Passive Hands-On Learning (PHON)	4	1.9	33	6.3
Active Hands-On Learning Participation (AHON-P)	30	19.4	70	22.8
Active Hands-On Learning Creation (AHON-C)	14	6.7	46	15.0
TOTAL STUDENT AND TEACHER ACTIVITIES	**209**	**100.0**	**307**	**100.0**

Note. [a]*n* represents the number of mentions within the teachers' techno-activities; % represents the proportion of each group's total, respectively.

Designing and preparing for lessons. The most common tools for both preservice and inservice teachers were computers, word processing software, and the Internet. Teachers, especially preservice teachers who had less classroom experience, valued the Internet because they described it could provide numerous resources for lesson planning and creation. Teachers also valued these tools for greater efficiency and flexibility. Several inservice teachers mentioned the use of class websites when they designed and prepared for lessons. Teachers usually built these sites themselves and added additional tutorials and materials on them, which they could efficiently reuse. They valued it as a chance to extend learning for students because students could access these teaching materials at home.

Teaching lessons. Both preservice and inservice teachers described commonly using the projector, presentation software, and computers for in-the-moment teaching. According to the teachers, these tools provided greatly enhanced visual effects in their teaching. Some teachers, especially preservice teachers, valued projection tools and used videos and other multimedia materials extensively because they felt it engaged student learning to a larger extent. Inservice teachers, on the other hand, valued these tools more because they facilitated knowledge-skill development and/or practice. Several inservice teachers also mentioned projectors and multimedia were great tools to tailor learning towards student needs.

Grading and assessment. Inservice teachers most commonly used the clicker, while preservice teachers most used the spreadsheet. Inservice teachers most valued grading and assessment tools for increasing efficiency and monitoring student progress. Preservice teachers, on the other hand, most valued these tools for supporting data interpretation and sense making.

Communicating with students and parents. Classroom websites and email were both the most often used communication tools for preservice and inservice teachers. Preservice teachers also applied media creation tools/software and word processing for communicating with students and parents. Both preservice and inservice teachers valued communication tools for supporting easy communication.

Depictions of student use and reasoning within teachers' valued technology-supported lesson activities. Our coding of the technology-supported activities teachers valued that targeted students' use yielded two categories, passive and active uses, and were further sub-categorized as follows:

- Passive hands-off learning (PHOFF)–Technological support for instructional moves and learning engagement with subject content, especially to attend to learner needs and variability.
- Passive hands-on learning (PHON)–Learner use of technology to learn subject content and/or revise/practice facts and procedures.
- Active hands-on learning for participation (AHON-P)–Authentic, learner-driven digital activities and learning environments that are typically content-centered and may recognize and accommodate learner variability, such as artificial intelligence-sensitive personalized learning.

- Active hands-on learning for creation (AHON-C)–Digital learning activities that maximize active, deep learning, such as cognitively complex tasks that necessitate creativity, critical thinking, problem solving, communication, or collaboration and involve learner agency.

Of the technology activities described by both preservice and inservice teachers, 26.1% and 37.8%, respectively, were coded as active types (see Table 1). While preservice and inservice teachers had nearly identical representation of AHON-P activities, preservice teachers described more PHOFF activities, and inservice teachers reported more AHON-C activities, in comparison to each other. A prominent pattern revealed that inservice teachers tended to value students' passive and active learning with technology because it led to knowledge acquisition and/or higher-order thinking; whereas preservice teachers valued it because they thought the technology supported modes of presentation and would engage students.

Passive hands-off learning involved learners who were hands-off the technology tools, such as when students sat in desks and watched, listened, or read digital information presented by teachers. Preservice teachers described these activities at three times the frequency of inservice teachers. Common tools described by both preservice and inservice teachers included projectors, video, multimodal content, and classroom websites. Yet, preservice teachers identified a wider variety of technology tools for PHOFF than inservice teachers, such as the Internet, presentation software, and other specific software like spreadsheets and word processors.

For passive hands-on learning, learners put their hands on technologies to play games to learn content or complete subject-related assignments via instructional software. Inservice teachers described PHON activities more often than preservice teachers. They also mentioned many more content-specific tech tools such as Compass Learning, digital textbook content, and Fastt Math software for PHON as compared to preservice teachers. These technology tools were adopted by inservice teachers to support students in developing or practicing their knowledge/skills because they thought that these would help to promote students' knowledge and/or skill acquisition. Preservice teachers generally valued students' passive use of technology to increase their engagement in learning activities.

A majority of the active uses were activities involving participation (AHON-P) for both preservice and inservice teachers. For AHON-P, teachers described students doing subject-specific, technology activities/projects such as using LoggerPro to collect science data, conducting online research, creating and showing presentations of their work using digital projection, engaging in assessments using clickers, and typing/taking notes. Both groups of teachers reasoned that the AHON-P activities enabled students' higher-order cognitive skills and supported their knowledge-skill development and/or practice. Inservice teachers commonly reported using computers and content-related software or hardware to promote students' knowledge acquisition and higher-order cognitive skills. Whereas, preservice teachers reasoned that these participatory activities supported students' use of content/multimedia representations, and they cited the internet and projectors as common tools for this. Even among these more hands-on, participatory activities, preservice teachers leaned toward showing or demonstrating activities for students.

Inservice teachers generated more active, creation uses than preservice teachers. Teachers described students creating multimodal expressions of learning, such as presentations, graphs, and graphics; publishing writing with word processing, blogs, or wikis; and organizing/mapping their thinking and ideas with storyboard or mindmapping software. These learning activities positioned students with agency in a range of creative, thinking, problem solving, communication, or collaboration decisions. Both preservice and inservice teachers mentioned similar technology tools (e.g., media creation software/tools, word processing and presentation software) that enabled student creation activities. Both groups of teachers also highly valued student use of technology for creating learning products. Not surprisingly, inservice teachers who mentioned AHON-C more often described many more additional reasons for creation activities such as supporting their content/multimedia representation, enabling higher-order cognitive skills, and fostering collaborative learning, when compared to preservice teachers.

Teachers' TPACK Knowledge Underlying the Valued Technology-Supported Lesson Activities

Overall, both preservice and inservice teachers relied most on TPK (90.5% and 72.3% respectively) to justify their reasoning for using certain technologies in their instructional decision-making. High percentages of TPK may indicate that both preservice and inservice teachers have a better understanding on how technology may be applied for general pedagogical purposes, in comparison to other TPACK knowledge categories. However, preservice teachers typically reflected their *knowing* of TPK while inservice teachers' rationales mostly on *enacting* their TPK. The difference implies that although preservice teachers had higher reference of TPK in their reasoning, they were anticipating what they might do in the future rather than enacted uses described by inservice teachers. We suspect preservice teachers' more limited technology and instructional implementation experiences reduce their abilities to have enacted TPK in practice.

Inservice and preservice teachers' rationales considered TCK 17.9% and 4.3%, respectively, considered TK 7.4% and 3.8%, respectively, and TPACK 2.4% and 1.1%, respectively. This may imply that the inservice teachers were given more exposure to technology and content-specific technologies and their possible uses in their school contexts than preservice teachers had in the teacher preparation programs.

Although TPACK represents a synthesized form of knowledge that some argue underlies well-reasoned technology integration in teaching, only 3.5% of preservice and inservice teachers included all aspects of TPACK knowledge in rationalizing their valued technology-supported instructional activities.

Discussion

This investigation is unique because it examined multiple layers related teachers' technological activities for teaching and learning: (a) the technology use activity, (b) the technological tools embedded within the activity, (c) the reasoning for use of the techno-activity, and (d) the underlying knowledge teachers used to design such activities. This study also was conducted with data from both preservice and inservice teachers, which allowed us to examine each as a professional group but also explore if similarities or differences existed based on professional experience.

The majority of preservice teachers' techno-activities were teacher-focused, reflecting these teachers' predominant use of technology for in-the-moment instructional use. Some past research trends show teachers moving away from using technology for instructional preparation or professional learning toward adopting it more often for classroom instructional use (Hu & Yelland, 2017; Ottenbreit-Leftwich et al., 2012). Technologies used within lessons, such as preservice teachers' commonly cited projectors, presentation software, computers, and video, provide students exposure to technology, albeit in the hands of the teachers. In fact, preservice teachers' reasoning for using these teacher-focused, techno-activities centered on aspects of presentation/showing, in that they valued showing multimedia content information, and felt presentations supported visual needs and enhanced students' engagement. Preservice teachers also generated student-focused techno-activities categorized as passive hands-off learning. These activities were almost identical in nature to their teacher-focused teaching lessons activities, tools, and rationales with the exception that the descriptions were student-forward and learning-forward (vs. teacher- and instructionally-focused). Using technologies for presenting information is common in the literature (Polly, 2014).

Preservice teachers showed some emergence of active, student-focused, hands-on learning activities, especially those for participation. Yet, their common tools, the internet and projectors, and their valuing these technologies for supporting students' representation of content trends again toward presenting/showing, albeit by active students. Thus, we did not find it surprising that in our analysis of their knowledge components, their descriptions heavily represented TPK, the knowledge of technologies for general pedagogical tasks. Their focus on presenting and showing digital information is likely the most common of all general pedagogical strategies. This prominent pattern among preservice teachers may reveal gaps in their teacher preparation, such as a lack of modelling of student-focused techno-activities and/or content-forward technological activities.

Inservice teachers in our sample generated more student-focused activities, a trend that differs from the extant literature (e.g., Polly, 2014; Pringle, Dawson, & Ritzhaupt, 2015; Tondeur et al., 2016). The inservice teachers' abilities to identify and value student-focused activities, especially those that actively put the technology in the hands of the students, aligns with similar emphasis in national plans (Office of Educational Technology, 2016) and efforts to increase student agency (Ito et al., 2013; Reich & Ito, 2017) and rebalance digital inequities in which students of color or of lower socioeconomic levels tend to have passive technological experiences (Hohlfeld, Ritzhaupt, Dawson, & Wilson, 2017). Yet, inservice teachers still described numerous examples of passive, hands-on learning, especially reasoning that it supported knowledge or skill practice with games or learning software, which are exactly the types of activities other researchers have found to be predominant techno-activities for students of color or with lower SES (Hohlfeld et al., 2017; Warschauer & Matuchniak, 2010). While this research shows the range of activities and rationales, further research is warranted to examine if teachers' reasoning for technology use changes when considering students with different characteristics.

Preservice and inservice teachers often expressed different reasoning for similar techno-activity categories. Inservice teachers tended to value technology's aptitude to support students' cognitive and knowledge development or practice, while preservice teachers valued instructional presentation or increasing students' engagement. This pattern of inservice teachers thinking more specifically about students' knowledge development accords with inservice teachers' inclusion of more content-specific tools or activities and, accordingly, a higher percentage of TCK they drew upon to think of their activities, as compared with preservice teachers. A range of possible explanations for these differences exist and warrant continued future research. For example, these results may reveal differences in the teachers' respective learning experiences: teacher education and professional development, respectively. On the other hand, a professional maturation process may explain the differences, in that it just takes teachers time in the field as professionals to broaden their techno-activity repertoires to prioritize student-focus. Indeed, Gurevich, Stein, and Gorev (2017) who conducted one of the few longitudinal studies of preservice to inservice teacher trajectories, found such an expansion of tools and activities among the novice teachers. Alternatively, inservice teachers' valuing of knowledge and skill development with techno-activities may stem from standards-based and high-stakes environments within U.S. schools in which they must ensure their lessons align with standards and lead to achievement. It is encouraging that inservice teachers claim to value active, hands-on activities for knowledge development because this stance aligns with the research base (National Academies of Sciences, Engineering, and Medicine, 2018).

While the teachers articulate a range of affordances, the teachers' emic reasoning and values that emerged from our analysis reflect teacher perspectives. Sharing these teachers' reasoning categories with preservice or inservice teachers in learning contexts may nudge teachers to consider the value(s) technology offers when designing techno-activities and adopting tools, such as during lesson planning design sessions (Janssen et al., 2019). Ultimately, teachers may develop deeper justifications for their technological work in the classroom.

In addition to the aforementioned research directions, we suggest continued examination of teachers' reasoning by subject area teachers to determine how content- or domain-specific technologies within disciplines affect reasoning and decision-making, such as studies conducted in music (Crawford, 2010), social history (Voet & De Wever, 2017), science (Wilkerson et al., 2016), and mathematics (Niess & Gillow-Wiles, 2017). Such studies might also distinguish the instructional lesson outcomes in terms of high or low-level uses (e.g., Sherman, 2014; Voet & De Wever, 2017) because categories of teacher reasoning and TPACK do not necessarily infer deeper cognitive learning activities in practice. We also suspect that the contexts in which teachers teach will impact their valuing of technology, as illustrated by Guzey and Roehrig (2009). Thus, studies can also closely account for a school's technological context as well as the student populations teachers serve while examining the teachers' technological reasoning and action.

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The Crust of the Matter: Lessons in Assessment Design from The Great British Bake Off (GBBO)

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Abstract

Popular culture has inspired diverse educational work and research (Guy, 2007, Fink & Foote, 2007, Wright & Sandlin, 2009, Johnson, 2018, Heffernan et al, 2018). This project examines how the Great British Bake Off (GBBO) might prompt us to rethink assessment design in higher education. Influenced by qualitative TV content analysis, we used directed content theory analysis (Hsieh & Shannon, 2015) to examine the 2018 series of the GBBO, which comprises of ten one-hour episodes. These GBBO episodes were broken down into their performance challenges and were analyzed using Boud and associates' (2010) Assessment 2020: Seven Propositions for Assessment Reform in Higher Education. The analysis reveals that the design of the GBBO is in line with of six out of the seven propositions that Boud et al. propose for assessment reform in higher education. In short, there is much we could apply to current assessment design, including making assessment central, modelling assessment and using open assessment feedback to produce sustainable learners and responsible partners in assessment.

Introduction

The type of assessments designed by instructors for productive learning is a subject of much debate. Despite advancements made in educational technologies, assessment strategies in higher education appear to largely focus on assessments as isolated events, measuring episodic learning. Instructors tend to deploy exams, quizzes, and traditional papers to provide some measure of student learning. At times, these assessments have been referred to as "disposable assessments"(Wiley, 2017), thrown away and forgotten soon after the assessments are completed. Perhaps we need to locate more sources of pedagogical inspiration for assessment design — possibly what Wiley refers to as renewable assessments that provide real-world relevance and productive learning.

Reality television (TV) shows have become a staple in popular culture. In spite of the bad rap they receive, we found the performance challenges in The Great British Bake Off (GBBO) Netflix series thought-provoking and deserving of a nuanced discussion, particularly on its implications for the design of assessments in higher education. In fact, popular culture has inspired diverse educational work and research (Guy, 2007, Fink & Foote, 2007, Wright & Sandlin, 2009, Johnson, 2018, Heffernan et al, 2018). So what can popular culture, in the form of the GBBO, teach us about adult learning and assessment?

About The Great British Bake Off

Despite assessment in education being contentious, watching others being tested makes for good viewing. In the past eight years, the world (Ensor, 2013) has been taken by storm by competitive culinary reality shows in which amateurs, professionals and even celebrities have their skills and knowledge continuously tested over a number of weeks with progressively difficult challenges. One show which has received a lot of media attention is The Great British Bake Off (GBBO) (Conlan, 2015).

The GBBO first aired in the UK in 2010 and is said to have been inspired by the idea of baking competitions at village fêtes (Higgins, 2015). In the hour-long show, twelve home bakers compete against each other by completing three different challenges: the Signature Challenge, the Technical Challenge, and the Showstopper.

The Signature bake tests the contestants' creativity and ability by requiring them to prepare one of their tried-and-tested favourite recipes. Bakers present their signature bakes to the judges and receive verbal feedback about the appearance and taste.

In the Technical Challenge, the bakers are put to the test by being given the same recipe on the spot. Here, the playing level is uneven, as some of the contestants might not even have heard of the bake they must prepare, while others may be well acquainted with either the technique required or the bake itself. The bake is blind tested by the judges, then compared against the others (in a think-aloud manner in front of all the contestants), and ranked from worst to best.

The final challenge is the Showstopper. This is where the participants are "able to showcase their depth of skill and talent" (Love Productions, 2019). Here, the judges are looking at the contestants' demonstration of a combination of creativity, technical skill, taste and aesthetics. Again, like the Signature bake, the judges give oral feedback to each contestant when judging the showstopper.

After the challenges are completed, the judges deliberate over all the contestants and what they have achieved throughout the three challenges. They decide which baker stand out as a star baker and who does not perform well enough and will need to be eliminated.

About Assessment

Are there insights that learning professionals could implement from this popular show into their educational practice? Initially, when watching the GBBO with current assessment trends in mind, e.g. collaborative problem-solving (Von Davier et al, 2017), peer assessment (Liu & Carless, 2006), self-assessment (Boud & Falchikov, 2007) and learning-oriented assessment (Carless, 2007), it may seem that the show's assessment design is behind the times: the contestants perform alone; the tidbits of feedback they receive while working come from the judges as they pass by; the focus seems to be on the end product, which only the judges evaluate; the contestants are judged against each other and ranked based on their end product in a type of norm-referencing test (Gipps, 2002). On further observation, there appears to be more to this initial view of the GBBO assessment design than meets the eye.

Methods

Inspired by qualitative TV content analysis, we used directed content theory analysis (Hsieh & Shannon, 2015) to examine the 2018 series of GBBO. This series comprised of ten one-hour episodes.

We used Boud et al's (2010) *Seven Propositions for Assessment Reform in Higher Education* to code the three different challenges in each episode. Although Boud et al's (ibid) call for assessment reform originates from the Australian higher education context, we argue that the underlying principles of his propositions are borderless.

Table 1. Qualitative Codes (based on Boud et al's Seven propositions for assessment reform in higher education)

#1 assessment used to engage students in learning that is productive
#2 feedback is used to actively improve student learning
#3 students and teachers become responsible partners in learning and assessment
#4 students are inducted into the assessment practices and cultures of higher education
#5 assessment for learning is placed at the center of subject and program design
#6 assessment for learning is a focus for staff and institutional development
#7 assessment provides inclusive and trustworthy representation of student

Findings

<table>
<tr><td colspan="3">Table 2. Summary of Findings
GBBO Overall Design
#5 Assessment for learning is placed at the center of subject and program. The program is centered around three challenges: the Signature Challenge, the Technical Challenge and the Showstopper Challenge. Feedback is given during and after each challenge to help the contestants learn and develop their knowledge and skills.

#1 Assessment is used to engage students in learning that is productive. This show is all about learning that is productive. Every challenge aims at contestants being able to produce something. This is an example of experiential learning.

#2 Feedback is used to actively improve student learning. Contestants are exposed to feedback about their own work but also to the strengths and weaknesses of other people's work.</td></tr>
<tr><th>Signature Challenge</th><th>Technical Challenge</th><th>Showstopper Challenge</th></tr>
<tr><td>#7 Assessment provides inclusive and trustworthy representations of student achievement. Contestants demonstrate the knowledge and abilities they bring with them in this competition. Assessment is based on totality of outcomes.

#2 Feedback is used to actively improve student learning. This challenge enables the judges to assess later performances ipsatively (Hughes, 2017): comparing the progress of contestants based on their initial contribution (this challenge) and the feedback they have received throughout to later challenges (the showstopper).</td><td>#4 Introduced into the assessment practice. This identical technical challenge is assessed blindly. Contestants are present during the assessment, where the judges openly discuss and evaluate each contestant's product. This can help develop contestants' evaluative judgement as the assessment process is modelled for them, thus helping them to become critical evaluators of their own work and the work of others. In this sense, the GBBO approach contributes to assessment for learning beyond a given course (sustainable assessment).</td><td>#3 Assessees and assessors become responsible partners in learning and assessment. Taking in feedback from the judges, contestants build their own critical thinking abilities and are able to independently judge their own work and the work of other contestants.</td></tr>
</table>

Six out of seven of Boud and associates' (2010) propositions for assessment reform in higher education could be inferred from qualitatively examining the structure and content of series 9 of the GBBO.

The GBBO is centered around three challenges (or assessments), namely the Signature Challenge, the Technical Challenge and the Showstopper Challenge (proposition #5: assessment for learning is placed at the center of …program design). The challenges are not 'add-ons' but are considered significant and embedded into the program from the very start.

Throughout the three challenges of the show, proposition #1 is evident: assessment is used to engage students in learning that is productive. The challenges are designed to focus on contestants' learning, which is not hampered by any conferment of grades. In addition, the assessed challenges are recognized as learning activities which require contestants to engage in appropriate tasks (i.e. baking products), all of which are significant learning activities in and of themselves. The baking challenges are organized in an interlinked sequence where challenges increase in difficulty (technical knowledge and skills).

Contestants are inducted into the assessment practice and culture (proposition #4) of culinary arts, not only through carefully structured assessments which aid them in making a successful transition, but also through the use of the Signature Challenge. This Challenge is an assessment practice which responds to the diverse expectations and experiences of those entering the competition. Contestants typically bring their existing unique backgrounds, experiences and prior research on the Challenge problem to connect with their new learning activities, in the process making new knowledge connections to existing schema. Through formative and summative feedback at this initial stage, rules and expectations around what is needed for success is made accessible to contestants.

In the Technical Challenge, the contestants are given a task from a professional baker. Identical, minimal instructions are provided on the spot. The completed product is assessed blindly and openly by expert judges in front of all, and ranked from worst to best. This could also be inferred as inducting participants into the assessment practice (proposition #4) of culinary arts. This feedback is used to actively improve "student" learning (proposition #2) by being clear and timely in helping them improve on the final task, with the hope of improving the quality of their learning and work.

In fact, it should be noted that proposition #2, where feedback is used to actively improve student learning, occurs at all three stages of each episode. During each challenge, students receive informal feedback during their baking – not in the form of marks or grades – about how to improve the quality of their work.

Throughout each episode, the viewer can clearly see how assessor and assessee become responsible partners in learning and assessment, as per proposition #3. Taking in feedback from the judges, contestants build their own critical thinking abilities and are able to independently judge their own work and the work of other contestants. This is particularly evident after the open judging during the Technical Challenge.

At the end of each episode, one contestant is awarded the "Star Baker" while another is eliminated. This is based on the totality of outcomes from the three challenges. Poor or good isolated performances do not determine the overall achievement of a contestant in both the single episodes and the whole series. This is in line with Boud and associates (2010) proposition #7: assessment provides inclusive and trustworthy representation of student achievement.

Implications of Study

A study of the GBBO series behooves us to consider the following questions as we design assessments for learning in our own practice:

- How will you challenge students technically as well as creatively?
- How will you evaluate student learning along different dimensions and as a whole?
- How will you integrate feedback into formative assessments at different junctures?
- What would a signature challenge for your learners look like? A technical challenge? Or a showstopper challenge?

Finally, is the following GBBO formula a recipe for meaningful and engaging assessment for learning?
Meaningful engaging assessment = productive learning + learning community + game-like components + connect with prior knowledge + open feedback

Conclusion

The focus of this discussion is to examine how the GBBO might inspire us to rethink how we design assessments in higher education. The GBBO analysis, using Boud et al's (2010) assessment reform propositions, reveals that there's much to learn from and apply to current assessment design, including the openness to learning with others, making assessments sustainable, and beating one's own personal best.

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Designing an Inspired Curated Learning Experience Using Immersive and Visual Open Access Resources

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Abstract

A curated learning experience is a method of organizing vast volumes of web and enterprise-based information and presenting it in a structured and significant layout. The study conducted allowed for an examination of how educators identify a diverse array of effective applications found in open-access educational resources using the Studio Thinking Framework (STF) and the Learning Objects Metadata (LOM) topology. The examination resulted in ascertaining ways to identify educational resources that provide student-centric knowledge construction and has the potential to inspire learning professionals to curate compelling learning experiences for their students.

Introduction

Differences exist between empowering learners to evolve and modernizing education (Hosseini, Kees, Manderscheid, Röglinger, & Rosemann, 2017). In the 21st century, the use of advanced technical solutions drives an increasingly visual culture in virtual applications, film, social media, and advertising (Brantley, 2015). Learners could benefit from modern teaching practices if the educational community embraces the curation of authentic learning experiences. Some define a curated learning experience as the method of organizing large volumes of web and enterprise-based information and presenting it in a structured and significant layout (Luna-Nevarez & McGovern, 2018).

Inspired content curation has the potential to enhance the student's learning experience, the teacher's teaching strategy, and to maximize learning outcomes. What is inspired content curation? By inspired, the research team contends that educators are capable of locating and incorporating open access resources of extraordinary quality in their curricula. With the application of two models for classifying learning experiences and learning resources, inspired curation is possible.

To transition to the disruptive 21st-century environment extensive learning could require more than traditional knowledge and skills (Dede, 2010). Also, 21st-century learners will need cognitive skills, and intra- and interpersonal skills (Dede, Grotzer, Kamarainen, & Metcalf, 2017). Learners will need to engage, understand, persist, apply, and express a response to rapidly changing contexts. More than that, the successful learner will reflect and assess solutions (Hetland, Winner, Veenema, & Sheridan, 2013). Learning of this kind reflects constructivist pedagogies along with immersive and multi-media learning experiences, which allows personal learning and student-centered cognition to occur.

Research Questions

The questions posed in this study are:

1. How could educators use multi-media and immersive resources to curate effective learning experiences?
2. To what extent may students learn cognitive, interpersonal, and intrapersonal skills using open-access educational resources from the Internet?

Theoretical Framework

The frameworks chosen for the study are the Studio Thinking Framework (STF) (Hetland, et al., 2013) and Learning Objects Metadata Topology (Solomou, Pierrakeas, & Kameas, 2015). The foundation of the STF consisted of two years of naturalistic observation in studio classes for a goal to develop a work of art. Discovery of a second covert or hidden curriculum arose that allowed educators to teach critical cognitive and creative skills (Sheridan, 2011). The STF skills encompass Observe, Envision, Express, Engage/Persist, Stretch/Explore, and Reflect/Evaluate. Researchers have demonstrated the value of the STF model through its application to virtual environments (Steele, Johnston, Lawlor, Smith, & Lamppa, 2018) and over a lifetime of living and working (Johnston & Lane, in press).

This framework gives educators a way to assess open educational resources for 21st-century learning experiences that stemmed from naturalistic observations initially with the intent to create meaningful works of art. Additionally, the STF aligns to visual education by employing virtual applications and solutions to stimulate new educational experiences. Every classroom, home, or office connected to the Internet can obtain a rich assortment of educational experiences through available open access to educational resources. Their availability and accessibility should inspire learning professionals to select/curate the most effective learning experiences for their students.

In conjunction with the STF, the researchers chose the Institute of Electrical and Electronics Engineers (IEEE) Learning Objects Metadata (LOM) Topology as a basis to assess the selected resources. Secondary and post-secondary education learning environments utilize multi-media and immersive resources (Frantiska, 2018). As a result, educators can execute this combination through open educational resources. Students can attain competencies via several learning objects. Learning objects metadata are neither intangible nor abstract applications but the design aims to construct and enhance the learning environment that could have numerous forms and purposes (Frantiska, 2018). Hence, learning objects metadata can direct what intangible or abstract applications will be required and must be associated with a learner's applicable educational level (Girvan, 2018). Like many frameworks, learning professionals and students alike may characterize learning objects differently. The STF model and LOM topology displayed in Figure 1 includes the description for each.

Studio Thinking Framework (STF)	***Institute of Electrical and Electronics Engineers (IEEE) Learning Objects Metadata (LOM) Framework***
Visual-based framework Focus on visual education by using virtual applications **Habits/Tenants** Observe Envision Express Engage/Persist Stretch/Explore Reflect/Evaluate **Structural Elements** Demonstration (Lecture) Students-at-work (students to spend in-class time working on an assignment, while keeping the classroom focused on specific goals) Critique (allows students to make connections with habits different from those that may have been taught in other stages of the class) Exhibition (described as an "overarching" structure that encompasses the original three) Transitions (the time spent transitioning between all other structures) (Sheridan, 2011)	Educators can use any entity, digital or non-digital, for learning, education, or training **Educational Metadata Contains** Information regarding the resource's learning type Exercise Simulation Questionnaire Diagram Figure Graph Index Slide Table Case Study Narrative text Exam Experiment Problem statement Self-assessment Lecture Intended end users Teacher Student Learner Instructional context Implies the actual context where the learning process takes place, and can accept values like "distance education," "face to face learning" and "blended learning **Educational Metadata Categories/Tenants** General (groups the general information that describes the LO as a whole) Technical (provides the technical requirements of the LO) Educational (provides the educational requirements or pedagogic elements of the LO) Annotation (provides educational information about when an LO was and by whom) Classification (provides information about what classification system and LO resides) (Solomou, et al., 2015)

Figure 1. STF Model and LOM Topology

Population and Sample

The population for this study consists of educational resources considered open access and readily available for use by the public as found on the Internet. The researchers intended to locate a wide variety of open access resources based on the following criteria: subject matter, learning resource type, and technology type. The researchers chose purposive sampling for this study because this method allowed for an examination of the content made available via online resources (Sheffer & Hunker, 2019). The samples selected for this study included examining a multitude of core subject-related content in the Language Arts, Social Sciences, Natural Sciences, Math, and Fine and Applied Arts. Additionally, the method allowed the research to appeal to a variety of demographic groups. The concept of prominence or recognition, such as nationally recognized TEDtalks, The New York Times feature, or validated by other expert testimonials, including most trusted, unique, innovative, or other recognition for quality, posited as a requirement for the population and the sample.

An online search aided in locating potential samples using a series of keywords developed in an earlier study (Johnston, Olivas, Steele, Smith, & Bailey, 2017) to locate websites that may feature an immersive and visual open access resource that includes a learning experience worthy of curation. The primary keywords used in the literature searches included video-based technology, applications, multimedia, and educational levels. Each contributor performed a close examination of the content and resources such as language arts, social sciences, natural sciences, and math.

Accessing webpages, such as Pinterest, YouTube, and PBS Learning helped during the search for the most technological materials instrumental in understanding the importance and usage of educational resources for curating a learning experience using immersive and visual open access resources, thereby allowing for triangulation. Accordingly, preferred applications involved those having visuals in the form of demonstrations, interactive videos, lectures, or narrative text. The research team did not purchase any examined technologies, because one of the criteria consisted of freely available curated resources. The analysis comprised solely of public information available online, and thus the team validated no claims in terms of any advertised distinction, subject matter, or age group appropriateness.

Methodology

Each member of the research team collaboratively documented specific details of at least five free open access educational technology applications in an Excel spreadsheet posted in Microsoft Teams resulting in the collection of 46 resources for examination, a summary of which is provided in Appendix A. The resulting cross-functional matrix displayed a header of columns consisting of:

- contributor’s name
- title of the application
- retrieval date
- URL of the open access technology
- description of the technology
- academic subject(s)
- educational level(s)
- LOM technology type
- LOM technical data type
- LOM learning resource type
- presence of advertising
- distinction
- contributor’s initial comments following the assessment of the resource
- six categories in the STF model
- rating value for the STF model
- additional comments after rater review

The cross-functional matrix also included dropdown menus allowing further categorization of the data in several columns. For example, the Subject column consisted of a dropdown menu to select the appropriate subjects impacted by a technology that included science, math, and the physical sciences. Each contributor completed the cross-functional matrix including the STF Habits of Mind (Winner, Goldstein, & Vincent-Lancrin, 2013). The contributors identified each Habit of Mind as either Student-Centric, Instructor-Centric, or Not Present in a specific application. Also, the contributing researchers included a justification of their decision to label them as such within the corresponding cell in the spreadsheet. The contributors added the Rating Value to the matrix later during the analysis phase.

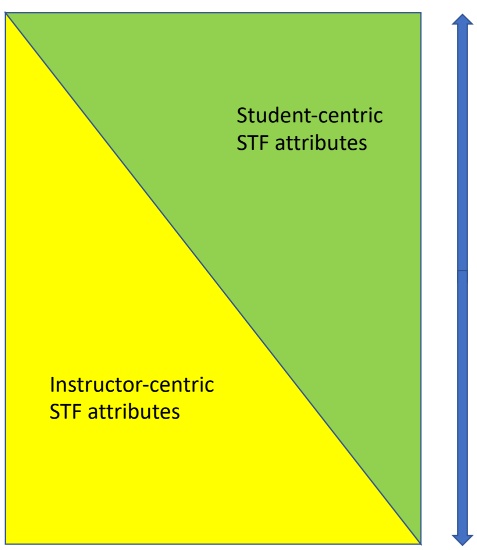
Data and Analysis

Using directed content analysis assisted with the interpretation of meaning from the content of textual data, hence, permitting adherence to the naturalistic paradigm. With a directed approach, data analysis begins with a theory or relevant research findings as guidance for initial codes (Hsieh & Shannon, 2005). Applying a directed content analysis on the sample of open educational resources allowed for a classification of the technology based on the Institute of Electrical and Electronics Engineers (IEEE) Learning Objects Metadata (LOM) Topology (Solomou, et al., 2015) and the Studio Thinking Framework (STF). The Excel document, as an efficient analysis tool, helped with tracking, organizing, and ranking resources based on various criteria established by the team aligning to attributes of the STF model, the IEEE's Learning Objects Metadata (LOM) topology, and descriptive information.

Macros within the Excel document enabled the team to use dropdown menus to categorize each resource rather than rely on free-form entry. With Microsoft Teams as the data hub, the team worked collaboratively on the Excel document by reviewing each contributed resource and coming to consensus on its fit for the curated collection as well as its STF and LOM categorization as a means for identifying emerging themes and trends. The research team developed a color legend for the STF model by assigning a specific color for each STF attribute. Student-centric attributes received green as the assigned color while teacher-centric attributes received an assigned color of yellow. For each open educational resource in the collection, those categories not present received red as the assigned color. After assigning a color to the STF attributes, the researchers applied a ranking on a scale between 0 and 2 based on the designated color. Red attributes received an assignment of zero, yellow received an assignment of one, and green received an assignment of two.

Totaling each resource's ranking provided a method to calculate an overall rating that represented the overall tendency for the technology to align to the STF model in terms of achievement of the attributes by students without guidance from the teacher, that is, distinguishing an inclination as a student-centric or an instructor-centric resource. Researchers found that 14 of the reviewed resources had a high STF rating (12, 11, or 10) that suggests a student-centric application, while seven had a medium STF rating, suggesting a mixture of student and instructor-centric STF attributes, while 26 of those had a low STF rating, suggesting a more instructor-centric attributed resource. Figure 2 includes information identifying the characteristics associated with the identified STF ratings and the compantion LOM attributes for the reviewed resources.

Representation of STF/LOM Reviewed Resources



Studio Arts Thinking Framework	Learning Objects Metadata Framework
Student-centric, student construction of knowledge occurs independently	Visual, interaction, application-oriented objects
Mixed, with some student-centric activity and some instructor-centric activity	Mixture of interactive objects and consumption-based objects
Instructor-centric, requires instructor intervention for student construction of knowledge	Mostly consumption-based objects such as presentation, text, streaming

Figure 2. Representation of Reviewed Resources based on STF and LOM Frameworks

Discussion and Results

Our first research question is, "How could educators use multi-media and immersive resources to curate effective learning experiences?" From our analysis and observations, we contend that by evaluating multimedia and immersive resources using the STF and LOM frameworks, educators can identify and apply student-centered, constructivist-oriented learning experiences for their students thereby aiding in the learning process (Muir, Knezek, & Christensen, 2004). Students could gain the opportunity to collaborate with peers and engage with the software, thereby increasing intrinsic motivation while supporting the needs of the kinesthetic and visual learner (Basaran, 2016). A profound learning experience could occur because appropriately curated multimedia and immersive resources will consist of streaming media, images, text, interactive applications, or include a self-paced activity that relies on critical thinking skills (Hosseini et.al., 2017). Multi-media and immersive resources could allow educators to shift the learning paradigm and shift a student's mode of cognition through a more dynamic experience (Girvan, 2018).

Presenting knowledge and skills in new ways may challenge students and add value to the learning process, perhaps appealing to a diverse learner population. Exposing learners to interactive and vibrant sources of information could help learners feel more empowered and increase their level of engagement by exploring such curated learning experiences (Solomou et.al., 2015). Additionally, learners could view, summarize, and deduce information at their own pace. Conversely, educators could deliver a comprehensive curated experience for learners who have learning challenges. The multimedia and immersive resources posited as intuitive, thereby reducing the need for assistance when interacting with the programs (Sheffer & Hunker, 2019).

Our second research question posed is, "To what extent may cognitive, interpersonal, and intrapersonal skills be learned using open-access educational resources from the Internet? From our analysis and observations, we contend that educators should select multimedia and immersive resources supporting student-centered interaction. Through such activity, students have a higher propensity to develop into independent learners who use higher-order thinking skills to solve problems and navigate through knowledge sources (Kopzhassarova, Akbayeva, Eskazinova, Belgibayeva, & Tazhikeyeva, 2016). Using open-access educational resources from the Internet could allow a learner to attain several skills including, but not limited to, synthesizing information, increasing independent learning, applying critical thinking and problem-solving skills, and offering more options for a versatile classroom learning experience (Wang & Wang, 2011).

Multimedia and immersive resources may afford learners the opportunity to demonstrate levels of understanding through the reflective and evaluative process. Learners could create their own experience if developers designed the selected resource for exploration. Using multimedia immersive resources could allow learners to acquire cognitive, interpersonal, and intrapersonal skills by selecting resources designed for student exploration of an academic topic. According to Clark and Gibb (2006), with the teacher guiding the learning experience, learners could acquire such skills by encountering problem-solving scenarios that rely on small group interaction. All open access educational resources analyzed included some form of cognitive skill development, with cognition described as the totality of mental activities and processes involved in thinking, perceiving, understanding, and remembering (Ashcraft, 2005).

The results of the study support the contention that an identification of multi-media and immersive resources on the Internet is achievable and includes information about how educators can locate and deploy them. Furthermore, the learning experiences consisting of cognitive, interpersonal, or intrapersonal skills resulting from the curated educational applications are shared, as well as the techniques used to identify relevant resources.

Conclusion

According to the findings of this research study, many free resources exist on the Internet for educators to use to enhance learning. The research team analyzed 46 resources based upon specific criteria and their potential usefulness in an educational environment. The standards used to determine the value of these resources included educational level, subject, technology type, distinction, presence of marketing advertisement, technical data type, learning resource type, and alignment of the technology to the Studio Thinking Framework (STF). Because researchers apply their judgment about the efficacy and reusability of digital learning objects (DLOs), using a technique to evaluate technology via several measures aids in avoiding bias during the evaluation process of technology and could reduce the amount of time required to assess the technology (Basaran, 2016).

The researchers of this study suggest that open access Internet resources are available for the student to interact and experience many of the STF attributes directly, and only require teacher involvement for reflection and assessment. These student-centered resources included interactivity and often incorporated multiple paths to the learning objective for the student to follow. The Internet resources that did not incorporate means for student independent learning required teacher interaction with the program to meet curricular goals. Analysis of the data collected incorporated a ranking scale to enable the researchers to rate the extent of student-centrism in relation to knowledge construction. The learning resource type on the highest ranked open access online educational programs were interactive. Technical data type paired with the STF framework could lead educators to believe that multi-media applications involving multiple forms of interaction receive high ratings for student-centeredness and could posit as a good choice for providing students with experiences leading to higher forms of critical thinking. Instructors who are inspired to select open educational resources which focus on independent learning and higher-ordering thinking provide students with outstanding opportunities to achieve learning objectives.

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Appendix A

Title	URL	Subject	Educational Level	Technology Type	Technical Data Type	Learning Resource Type	STF Rating
Answer Garden	https://answergarden.ch/	Fine & Applied Arts	Middle School, High School, Postsecondary	Application, Text, Image	Hypertext	Interactive	12
Echo360	https://echo360.com/higher-ed/	Math, Social Sciences, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School, Postsecondary	Text, Image, Streaming Media, Application	Photo, Document, Graph, Image, Presentation, Audio Recording, Video	Activity	12
Flash Card Machine	https://www.flashcardmachine.com/	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School, Postsecondary	Text, Image, Streaming Media, Application	Presentation, Hypermedia Application, Interactive Software	Interactive	12
Media Smarts	http://mediasmarts.ca/digital-media-literacy/educational-games	Language Arts	Elementary, Middle School	Text, Image, Streaming Media, Application	Hypertext, Presentation, Audio Recording, Interactive Software, Presentation	Activity	12
MIT Open Courseware	https://ocw.mit.edu	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Postsecondary	Application	Interactive Software	Interactive	12
Quizlet	https://quizlet.com/	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Math, Social Sciences, Elementary, Middle School, High School, Postsecondary	Text, Image, Streaming Media, Application	Presentation	Interactive	12
TutorPro	https://www.tutorpro.com/content- creation-tools/	Fine & Applied Arts, Math, Social Sciences, Biological & Physical Sciences, Language & Fine Arts	Middle School, High School, Postsecondary	Text, Streaming Media, Image, Application	Hypertext, Image, Audio Recording, Video	Interactive	12
Interactive Storytelling (Ex. Bublr)	https://elearningindustry.com/18- free-digital-storytelling-tools-for-teachers-and-students	Language Arts, Social Sciences	Elementary, Middle School, High School	Application	Hypermedia Application, Video, Animation, Presentation, Presentation, Interactive Software	Activity	11
Moodle	https://moodle.org/	Language Arts, Social Sciences, Math, Biological	Middle School, High School, Postsecondary	Application, Text	Interactive Software	Interactive	11

		& Physical Sciences, Fine & Applied Arts					
Padlet	https://padlet.com/	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School, Postsecondary	Text, Application	Presentation, Video	Demonstration	11
Prezi	https://prezi.com/	Fine & Applied Arts, Math, Social Sciences, Biological & Physical Sciences, Language Arts	Elementary, Middle School, High School, Postsecondary	Text, Image, Streaming Media, Application	Photo, Image, Presentation, Animation, Self-Running Presentation	Presentation	11
Scoop.it	https://www.scoop.it/	Fine & Applied Arts, Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	High School, Postsecondary, Middle School	Text, Image, Application	Document, Hypertext, Animation, Webcast, Video	Interactive	11
DOGO News	https://www.dogonews.com/	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School	Text, Streaming Media, Application		Case Study	10
History Animated	http://historyanimated.com/verynew historywaranimated/	Social Sciences	Elementary, Middle School, High School	Text, Image	Document	Simulation	9
Nova	https://www.pbs.org/wgbh/nova/	Math, Biological & Physical Sciences, Language Arts	Elementary, Middle School, High School, Postsecondary	Streaming Media	Video	Presentation	9
Reading Rockets	http://www.readingrockets.org/article/using-multimedia-support-reading-instruction	Language Arts	Elementary, Middle School, High School, Postsecondary	Text, Image, Application	Presentation, Document, Hypertext, Image, Hypermedia Application	Narrative Text	9
Wikis	http://www.clickonf5.org/internet/10- free-opensource-wiki-software-engine/7599	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School, Postsecondary	Application	Hypermedia Application	Interactive	9
Alison Courses	https://alison.com/	Math, Social Sciences, Biological & Physical Sciences, Language Arts,	Postsecondary	Application, Application, Application	Interactive Software	Presentation	8

		Fine& Applied Arts					
American Rhetoric	https://www.americanrhetoric.com/top100speechesall.html	Social Sciences, Language Arts	Elementary, Middle School, High School, Postsecondary	Streaming Media, Text	Video	Presentation	8
Audio Books, such as Lit2go	https://etc.usf.edu/lit2go/	Fine & Applied Arts, Language Arts	Elementary, Middle School, High School, Postsecondary	Application	Audio Recording	Narrative Text	8
David Bowie:Augmented Reality	https://www.nytimes.com/interactive/2018/03/20/arts/design/bowie-costumes-ar-3d-ul.html	Fine & Applied Arts	Middle School, High School, Postsecondary	Image, Streaming Media	Presentation	Presentation	7
Edgenuity	https://www.edgenuity.com/about- edgenuity/	Math, Math, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School	Text, Image, Streaming Media, Application	Photo, Presentation, Document	Guidelines	7
Khan Academy	https://www.khanacademy.org/	Math, Social Sciences	Elementary, Middle School, High School, Postsecondary	Streaming Media	Presentation	Demonstration	7
Listen to the world	https://www.nytimes.com/interactive/ 2018/09/21/magazine/voyages-travel-sounds-from-the-world.html	Biological & Physical Sciences	Middle School	Streaming Media	Self-Running Presentation	Presentation	7
Mars Landing	https://www.nytimes.com/2018/05/05/science/nasa-mars-insight-launch.html	Biological & Physical Sciences	Middle School, High School	Streaming Media	Presentation	Presentation	7
Pics 4 Learning	http://pics4learning.com/index.php	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School, Postsecondary	Text, Image	Image	Example	7
Pinterest recomended by Science &Nature	https://www.pinterest.com/search/pins/?q=slime%20mould&source_id= 7iGbTDXw&rs=srs	Biological & Physical Sciences	High School	Image	Photo		7
Rescuing the boys in the Thai Cave	https://www.nytimes.com/interactive/ 2018/07/21/world/asia/thai-cave- rescue-ar-ul.html	Biological & Physical Sciences	High School	Application	Presentation	Presentation	7

Science and Nature recommended by Jeffrey Bloom	https://www.atlasobscura.com/articl es/see-dazzling-botanical-imagery-through-the-ages	Biological & Physical Sciences	High School	Image	Photo		7
Sports news from the New York times, text plus video, perfect example of mixed media	https://www.nytimes.com/2018/11/13/sports/basketball/allonzo-trier-knicks.html?action=click&module=Editors%20Picks&pgtype=Homepage	Language Arts	Middle School, High School	Streaming Media	Presentation	Presentation	7
Ted Talks: Art and Mathematics	https://www.youtube.com/watch?time_continue=269&v=PMerSm2ToFY	Fine & Applied Arts	Postsecondary	Streaming Media	Video		7
Ted Talks: The Art of the Metaphor	https://www.youtube.com/watch?v=A0edKgL9EgM	Language Arts	High School	Streaming Media	Video		7
The statue of Liberty	https://www.nytimes.com/interactive/2018/11/13/nyregion/statue-of- liberty-torch-ar-ul.html?smid=nytcore-ios-share	Social Sciences	Middle School, High School	Application	Presentation	Presentation	7
Trolling the Monster in the heart of the Milky Way-	https://www.nytimes.com/2018/10/30/science/black-hole-milky-way.html?action=click&module=MoreInSection&pgtype=Article&region=Footer&contentCollection=Science	Biological & Physical Sciences	Middle School, High School	Streaming Media	Presentation	Presentation	7
WatchKnowLearn	http://www.watchknowlearn.org/defa ult.aspx	Language Arts, Math, Social Sciences, Biological & Physical Sciences	Elementary, Middle School, High School, Post secondary	Text, Image, Streaming Media, Application	Graph, Presentation, Image, Presentation, Audio Recording, Video, Interactive Software	Lecture	7
National Center for Case Study	http://sciencecases.lib.buffalo.edu/c	Biological & Physical Sciences	Middle School, High School, Postsecondary	Text, Image	Presentation	Case Study	6

Teaching in Science	s/about/awards .asp						
Digital Library for Earth System Education	http://www.dlese.org/lib/	Biological & Physical Sciences	Elementary, Middle School, High School, Postsecondary	Text, Image, Streaming Media, Application	Interactive Software	Problem Solving	6
Disney Youtube Education	https://www.youtube.com/user/DisneyEducation/videos	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School	Streaming Media	Video	Presentation	6
FutureLearn	https://www.futurelearn.com/course s	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	High School, Postsecondary	Streaming Media	Hypertext	Narrative Text	6
Open Stax	https://openstax.org/	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Postsecondary	Text	Document	Narrative Text	6
PBS Learning Media	https://www.pbslearningmedia.org/	Math, Biological & Physical Sciences, Social Sciences, Language Arts, Fine & Applied Arts	Middle School, Elementary, High School	Text, Image, Streaming Media, Application	Presentation, Audio Recording, Animation	Demonstration	6
Watch Know Learn	http://www.watchknowlearn.org/defa ult.aspx	Math, Social Sciences, Biological & Physical Sciences, Language Arts, Fine & Applied Arts	Elementary, Middle School, High School, Postsecondary	Streaming Media	Video	Presentation	6
Western Reserve Public Media	https://westernreservepublicmedia.org/education/classpro.htm	Biological & Physical Sciences, Math	Middle School, High School, Postsecondary	Application, Streaming Media, Image, Text	Interactive Software	Simulation	6
Creative Commons Search	https://search.creativecommons.org /	Math, Social Sciences, Biological & Physcial Sciences, Language Arts, Fine & Applied Arts	Middle School, High School, Elementary, Postsecondary	Image	Image	Non Interactive	1

Exploring Patterns and Challenges of Computational Thinking Practices

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Abstract

Although the process of thinking and learning in the computational practices are important, little research has been conducted. This study explored undergraduate students' patterns and challenges of computational thinking practices in an online environment. Qualitative data were collected from Scratch coding journals. The results revealed that undergraduates' reactions towards their successful programming experiences differed. No incremental and iterative computational process were identified when sequential directions were provided to complete unfinished tasks. Most students tested to see if their programming scripts were working and debugged errors by themselves. Few students programmed the tasks using other resources or without any references. The participants created their own codes for simpler tasks, whereas they reused and remixed other sources for complex concepts. When they mastered computational concepts, the codes associated with the concepts were easily reused and remixed. Practical implications were further discussed.

Introduction

Our constantly evolving world requires education to prepare students for success in school and life experience. Aa literacy is needed for everyone, 4 Cs–critical thinking, collaboration, communication, and creativity–have been identified as the core skills of 21st century learning for every student. Today's rapid advances in computing technology is calling for a new core skill to succeed in the digital age. The ability to expand the horizon of human thoughts and mind with computing power has become an integral part of our life and work. Accordingly, it has been argued across the globe that thinking computationally is another fundamental skill for everyone not just for computer scientists. Computational thinking (CT) has accordingly been gaining increasing attention from researchers, educators, and policy makers.

CT is one of the emerging problem-solving skills that must be acquired by the new generations of students to participate in our digital-based world (Barr, Harrison, & Conery, 2011). CT is defined as "the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent" (Wing, 2011, p.1). By using CT as a method for problem solving, students can actively participate in the computing world. CT is a broad topic that can be applied in various fields to meet the explosive demand for new problem-solving skills. CT can be fostered through the connection of existing standards, including the Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS). At the same time, we need to ensure that all students have the equal opportunity to learn a complete set of CT through a stand-alone course, as well as being applicable to other fields.

The rationale for teaching computer science (CS) to students is far beyond career development. CS education is about giving more thinking knowledge, skills, and attitudes which help students become active in the digital world as active creators rather than passive consumers. Research on embedding CT in K-12 subject areas have found that students exposed to CT showed significant improvements in their problem-solving and high-order thinking skills (Calao, Moreno-León, Correa, & Robles, 2015; Hambrusch, Hoffmann, Korb, Haugan, & Hosking, 2009). Although, to date, much effort has been devoted to teaching CT competencies in K-12 classrooms, stand-alone CS courses are implemented predominantly at the secondary education to teach the CT concepts and practices (Yadav, Gretter, Hambrusch, & Sands, 2016). Recent changes in the CS education system have led to college students who are currently not receiving such educational benefits. Similarly, most of past research studies have been conducted in the contexts of K-12 education, which necessitates research in a more diverse levels of educational settings.

CT has some similarities to other higher-order thinking such as critical thinking, mathematical thinking, and engineering thinking. However, the difference is that those thinking frameworks do not include a computational process that refer to the domain knowledge, skills, and dispositions in computer science and related fields. The CT framework has been built using several concepts of cognitive thinking such as analytical, logical, creative, or problem-solving process (Aho, 2012; Barr, Harrison, & Conery, 2011; CSTA & ISTE, 2011; NCR, 2010; Wing, 2011). Although there is little agreement about what CT encompasses, when it comes to defining CT, three-dimension framework has been widely accepted in recent years. According to Brennan and Resnick's new framework for constructing CT (2012), CT involves three key dimensions such as computational concepts (i.e., sequences, loops, events, parallelism, conditionals, operators, and data), computational practices (i.e., being incremental and iterating, testing and debugging, reusing and remixing, abstracting and modularizing), and computational perspectives (expressing, connecting, and questioning).

Several studies have examined the effectiveness of the CT instructions on student learning in K-12 classrooms (e.g., Chen, Shen, Barth-Cohen, Jiang, Huang, & Eltoukhy, 2017; Denner, Werner, Campe, & Oritiz, 2014; Doleck, Bazelais, Lemay, Saxena, & Basnet, 2017; Grover, Pea, & Cooper, 2015; Moreno-León, Robles, & Román-González, 2015; Román-González, Pérez-González, & Jiménez-Fernández, 2017). Many studies that used the Brenna and Resnick's framework evaluated learning in computational concepts only, while few included computational practice and perspectives of the CT constructs. Although the process of thinking and learning in the CT practices are important, little research has been carried out in accordance with the practice components presented in the framework–being incremental and iterating, testing and debugging, reusing and remixing, abstracting and modularizing. Also, Brenna and Resnick (2012) suggested the assessment approaches (e.g., artifact-based interviews and design scenarios) to CT practices, but the artifact-based interviews have limitations in terms of the time efficiency of collecting data and the dependency of participants' memory. The pre-determined design scenarios are also time consuming and may not be connect to a learners' interests. Thus, there remains a need for studies that further investigate the practical approach to assessing CT practices and provide data offering insight into understanding the development of CT practice in while creating a project to solve problems in online higher education course.

Purpose of the Study

We are still at an early stage regarding the understanding of computational practice development to prepare students for 21st century problem-solving. One way to advance in this area is to determine the current status of CT practices in block-based programming activities; there is a need to identify particular CT practice's patterns and challenges students have in online programming activities. The first purpose of the study was to explore the patterns undergraduate students had while creating their Scratch projects. The second purpose of the study was to investigate in which areas undergraduates was having difficulties with CT practice based on the framework proposed by Brennan and Resnick (2012). The following four research questions guided the study:

(a) What patterns and challenges do undergraduates have in the process of being incremental and iterative?,
(b) What patterns and challenges do undergraduates have in the process of testing and debugging?,
(c) What patterns and challenges do undergraduates have in the process of reusing and remixing?, and
(d) What patterns and challenges do undergraduates have in the process of abstraction and modularizing?

Theoretical Framework

Brennan and Resnick's (2012) CT involves three aspects: computational perspective, computational practice, and computational concepts. Among the three dimensions, this study focused on the computational practice to uncover the patterns and challenges undergraduate students have in their computational thinking process while creating their Scratch projects. The computational practices are defined as the practices a student develop as they program. Four main components of practices are being incremental and iterative (e.g., Developing solutions step by step), testing and debugging (e.g., Finding strategies for solving problems), reusing and remixing (e.g., Building new solutions on existing works or ideas), and abstracting and modularizing (e.g., Modeling complex systems with simple elements). The assessment for the computational practices should involve examining processes, which provide opportunities to evaluate how their thinking and learning develop over time.

Method

Given the nature of our research questions, the study adopted a qualitative research design to yield an in-depth and comprehensive analysis. The four research questions focused on exploring the patterns and challenges of CT practices from undergraduates. Therefore, through reflective coding journals, we intended to explore not only participants' processes of CT practice in developing their Scratch programming projects but also participants' perceptions of the challenges that novice learners encountered in a context of developing their computational practices.

Participants

Participants were 96 undergraduate students who were enrolled in the "Computing and Information Technology" course from a large public, southwestern university in the spring semester of 2019. The participants had enrolled from varied majors, were of various ages, and were both male and female. The students learned a set of the core knowledge and skills that shape the landscape of computer science, represent information digitally, and create block-based programs to solve problems.

Context

The course was completely online and delivered via a web-based learning management system for providing course instructions. It focused on a set of fundamental competencies in computer science. The course was also designed to provide students with programming experiences using Scratch 3.0 which is a block-based programming language developed by MIT Media Lab to makes it easier to create and share their programming projects. Scratch is intended to be used in an introductory programming course for people of all ages and across disciplines (Resnick et al. 2009), and it offers editors for both online and offline. The participants were asked to perform programming tasks using Scratch. Out of 14 modules, there was a total of eight modules related to Scratch programming, and the tasks were to complete pre-designed and partially-finished Scratch projects with a set of requirements.

Data collection and analysis

The coding journal helped capture learners' thinking process, task completion steps, or their feeling. The structural coding journal comprised four reflective questions about their programming process and experiences as they created each Scratch programming project. Scratch coding journals asked the participants to share their programming experiences with reflective writing in responses to four open-ended questionnaires: (a) Describe how you created the quiz show in detail, (b) Describe what worked well during programming, (c) Describe how you tested to see if the quiz show was working and how you fixed issues, and (d) Describe how did you adapt a sample project to make it your own quiz show. Inductive, thematic analysis was conducted with 85 responses of the participants (89% response rate) to the open-ended question in order to obtain deeper insights on the development of CT practice. The authors organized the data and then coded Scratch coding journals following the three-step guideline of Miles and Huberman (1994): data reduction, data display, and conclusion drawing and verification.

Findings

Researchers identified and coded significance statements pertaining to patterns and challenges in the coding journal responses. Codes were applied and revised as needed by combining and eliminating codes for parsimony. The final number of codes were counted for each category–*being incremental and iterating, testing and debugging,* *reusing and remixing, abstracting and modularizing*. According to Scratch coding journal responses, undergraduates' reaction towards their programming experience considerably differed. The results are presented in the order of the research questions.

RQ1. What patterns and challenges do undergraduates have in the process of being incremental and iterative?

In the process of being incremental and iterative, most of students followed the sequences of the task requirements in the module. Although no iteration or incremental programming process were identified, a third of students designed their own themes or plots before programming with Scratch. Another 30% of students started programming after reviewing the sample provided in the module or understanding the task requirements. Because CT involves a whole series of process of solving a problem through identifying the problem, designing the project, and then coding algorithms, it needs an instructional design where students can go through the thinking and learning process for each necessary step. Also, since most problems cannot be solved all at once, it is important to have an iterative process to develop solutions with new ideas and approaches. There were limitations in understanding this process the task analyzed in this study did not require such iterative process.

RQ2. What patterns and challenges do undergraduates have in the process of testing and debugging?

Next, students should deal with various errors that occur during programming. It is important to develop strategies for handling problems. In the coding journal, we analyzed various testing and debugging strategies developed by learners through trial and error. In the process of programming, parallelism was the most challenging concept for testing and debugging, followed by variable, conditional, and operators. 90% of the students tested to see if their programming codes were working and debugged errors by themselves. Only 10 % of them used other tutorials or consulted with other students. As testing and debugging strategies, instant testing (e.g., testing block by block, comparing after with before) and debugging (e.g., fixing an error instantly, comparing with the sample project) was the highest frequent approach, followed by persistent approach (e.g., keep testing and debugging until it is fixed). The other strategies were consulting with peers, referring other tutorials, and taking notes to fix.

RQ3. What patterns and challenges do undergraduates have in the process of reusing and remixing?

Programming based on the work of others is part of computational thinking. Students can improve problem-solving skills by make their own based on others' works, rather than creating something new from scratch. In terms of reusing and remixing, 70% of the students adapted the sample project provided in the module to make it their own project, and the others programmed the tasks using other resources or without any references. Half of them customized appearance changes only (i.e., sprites or backgrounds), and the other half adapted codes (i.e., variables, if/else, operators) as reference. Most students followed the overall guidance and direction sequences. Students created their own codes (e.g., texts, themes, characters, backgrounds), whereas they reused and remixed other sources for a starter or complex concepts. The codes for simple tasks (e.g., changing appearance, adding animation effects) is easily reused because they were already familiar with how to code in the previous lessons.

RQ4. What patterns and challenges do undergraduates have in the process of abstraction and modularizing?

Lastly, abstracting and modularizing is an important practice in computational thinking by identifying general principles and developing problem solutions with simple parts. Students can abstract and modularize their solutions by conceptualizing problems in simpler ways and converting the concepts into stacks of code or individual sprites. However, unfortunately, we were not able to obtain meaningful insights for the abstraction and modularization, from the coding journals because the programming projects in the study were pre-designed. To analyze responses for such unidentified practice, an ill-designed or open-ended programming project may be required, and also scratch programming artifacts should be analyzed. Further research is needed for a deeper understanding of abstraction and modularizing.

Discussion and Implications

The findings of the patterns and challenges undergraduates have in CT practice provide meaningful implications. One of the interesting findings is that the structure of programming assignments should be changed to multiple phases to make it an iterative and incremental process so that students can be more exposed to practice their iterative process. The tasks should require learners to build their solution in multiple phases.

For testing and debugging, it also should provide students with various debugging strategies and resources because self-testing and self-debugging would be limited as the difficulty of programming increases. Furthermore, the effective methods of testing and debugging should be provided especially for an online environment. Lastly, some detailed guides for customization will be necessary depending on the instructional purposes. For instance, in the early stages, students could be asked to make changes on only appearance and move to changes on codes or structure, and then to guide them through all changes to the final task.

For using and remixing, sufficient resources should be provided for learners to explore many resources, which could affect more creative and diverse learning outcomes. Reusing and remixing activities offer code reading opportunities, but also requires education in ownership and copyright. More importantly, while learning CT through programming is important to assess the results of programming, it is also important to provide an opportunity to think about why the codes need to be used. Such reasoning questions will ultimately help students improve their computational thinking for problem solving.

This study explored the patterns and challenges undergraduates had during their CT process while creating their Scratch projects. We discussed some practical suggestions to provide quality CT education. To improve the quality of CT education, all educators should be responsible for how to introduce and effectively teach CT skills in their teaching (CSTA & ISTE, 2011; Voogt, Fisser, Good, Mishra, & Yadav, 2015). This study provides educators with a better way to design computational thinking activities, especially in an online environment, and also shed new light on understanding CT practices.

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Listening to the Voices of An American and A Nigerian Woman in Education

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Abstract

There is an increasing awareness that women are not always given a voice in the halls of Higher Education. This has been a recognized problem in the USA for some time. But this problem goes way beyond just the USA. Today, 130 million girls are being denied an education. Women need to make their voices heard while men need to learn to listen. In the words of Melinda Gates: "A woman with a voice is, by definition, a strong woman." This article is viewed from both an American and a Nigerian perspective. Women and supportive men need to continue to share their stories and highlight both the successes and challenges faced.

Overview

There is an increasing awareness that women are not always given a voice in the halls of Higher Education. This has been a recognized problem in the USA for some time. "In a professional world that has a tradition of the 'good old boy' network, women have long fought for recognition in the field of educational technology" (Donaldson, 2016, p. vii). But this problem goes way beyond just the USA. Today, 130 million girls are being denied an education. One brave advocate for females is the courageous young girl, Malala Yousafzai, who risks her life to advocate for education for all girls (Malala Fund, 2019). As a winner of the 2014 Nobel Peace Prize, Malala is definitely a voice that is being heard.

In Nigeria, young girls continue to fight for their education. The most recently available adult literacy rate (2015) is only 59.6% in the most populated country in Africa (UNESCO, 2019). There is a Nigerian tradition of considering boys as the priority gender to receive education. Many women have shared how they have gone against their fathers, husbands, and communities to fight for their education and the goal of an academic place within the country. This paper will share from a diversity of perspectives individual women's stories of their personal journeys in the face of daunting obstacles.

Women need to make their voices heard while men need to learn to listen. In the words of Melinda Gates: "A woman with a voice is, by definition, a strong woman." Attendees at a recent Association for Digital Education Communications Technology (ADECT) conference in Abuja, Nigeria in May of 2019 shared many stories when asked to make known their experiences. Personal stories where shared from experiences in the USA, Namibia, and Nigeria. According to the Malala Fund website (2019) the following are some of the reasons and examples of why approximately 130 million girls and women are denied an education:

- Child labour: Zainab received less than one cent per day stitching footballs, but she knew she could achieve more for herself and her family by finishing school.
- Early marriage: When the day came for 14-year-old Najlaa to be married, she felt her dreams of finishing school slipping away. So she ran away from home — still in her wedding dress.
- Conflict: By age 17, Zaynab was a refugee of three wars — in Yemen, Somalia and Egypt — and had been out of school for two years.
- Cost: Like many girls in Nigeria, expensive school tuition fees put Amina's education and future at risk.

- Gender bias: In Pakistan, many girls like Nayab drop out after grade 5 because their parents believe it is a waste of money to send a daughter to secondary school.
- Health: In Ecuador, Daniela graduated secondary school, becoming one of seven girls in her class with a high school diploma — and a child.
- Natural disasters: When an earthquake struck Sydney's village and damaged her home in Oaxaca, Mexico, she worried about falling behind in her studies.
- Poor quality: Living in a refugee camp in Jordan, the only class available to 12-year-old Rehma is for five and six-year-olds.
- Poor quality: In Syria, Rehma was a promising student, but today in her one-tent school, she's repeating lessons she learned years ago - the alphabet, numbers, the names of colors and animals. Rehma says her dream is to graduate, but if no higher grades are available to her, she never will.
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Ana's Perspective: Voices Shared from the USA

The historical situation often was not as extreme as the above examples but did include many gender-based challenges. Women played an early and important role in the history of technology. Ada Lovelace, the daughter of English poet Lord Byron, expanded on Charles Babbage's theoretical device in the mid-1800s, creating the first computer program. During WWII, women took over computer programming while the majority of men served in military roles. The women behind the popular film, *Hidden Figures,* got the Apollo 11 to the moon and back during the 1960s. Admiral Grace Hopper was a computer scientist and trail blazed the transition to the sophisticated computer programming languages that we still use today. She also was the one to coin the term "bug" when a moth got into the computer hardware and caused a malfunction.

Dr. Jean Kilbourne was one of my earliest influences in realizing the inequality that surrounds women in our society through the advertising medium. There are now 4 editions of her award-winning documentary, *Killing US Softly*. She speaks very loudly about how Madison Avenue has perpetuated the myth that women are to be seen and not heard. Another advocate for females is the courageous young girl, Malala Yousafzai who was awarded a Nobel Peace Prize for her voice in advocating education for all girls.

To provide my own foundation on the subject of women in leadership positions, I will share a bit of my own story. I was raised in the Eisenhower beige world of the 1950s, As the first wave of the Baby Boomers our options as women were limited. The only future choices I was given included housewife, secretary, nurse, or elementary school teacher. I remember my mother insisting that I take a typing course instead of physics. She wanted to make sure that I had the necessary clerical skills while insisting I was not smart enough for advanced science classes.

While in college, I was required to take a course on the History of American Education. I rebelled when I discovered that the only women mentioned in the text book included the wife of the first president of Harvard and Maria Montessori who was Italian. Women did play a very important role in the early American education though they were required to be single, church going, and of high moral standards.

Prior to returning to college to finish my degrees in my mid-40s, I was a computer programmer. I always was uneasy with the very masculine terms that described problems: *programs crashing, killing a program, or dealing with a virus.* The accepted terms for what I did in designing early web pages also were not comfortable, I was neither a *Web Master or Mistress*. My final chosen label was *Cyber Goddess*. It was not always easy being the only women in an office of men who were surprised when I refused to fetch them their morning coffee.

Because I believe that the voices of women in our field are not always heard, I edited the book, *Women's Voices in the Field of Educational Technology, Our Journeys* (2016). I asked leaders in our profession, men and women, from a total of 5 countries to share their stories. Through this effort I learned that women have to fight for their voices while men's voices are simply a birthright.

Today many women have just begun to raise their voices to share hidden experiences of sexual harassment and assault. One of 4 or 5 college women have been sexually assaulted per a recent RAINN report (2019). While 21% of transgender, genderqueer, nonconforming college students have been sexually assaulted, A third of rape victims contemplate suicide and 13% succeed. The fact that women and nonconforming students are coming forward to share what many consider their ugly secrets is bringing a major problem to light.

There exists a gender imbalance in attendance at higher educational institutions in the US. The male dominance started to shift downward during the 1970s and the 1990s saw the number of women (71%) increase substantially to outpace the 20-year static figure for men (61%), Other countries have other representations (Lopez & Gonzalez-Barrera, 2014).

Women in the USA are less likely than men to achieve tenure**.** "While women held nearly half (48.9%) of all tenure-track positions in 2015, they held just 38.4% of tenured positions (Catalyst, 2017). The Catalyst report goes on to state:

- While women represent over half (51.5%) of Assistant Professors and are near parity (44.9%) among Associate Professors, they accounted for less than a third (32.4%) of Professors in 2015.
- Women held over half (57.0%) of all instructor positions, among the lowest ranking positions in academia
- 22.1% of women faculty are in non-tenure-track positions, compared to 16.8% of men faculty.
- At all categories of institutions, full professors who are women earned on average $98,524 a year compared to $104,493 for their male colleagues in 2016–2017: only 94.3% of what men earned. (Catalyst, 2017, p. 1)

Within our own International organization, AECT, there have been some interesting trends. Women in the US did not get the vote until 1920, just 3 years before AECT was birthed. Since that time only 17 women have served as an AECT President. There was even a gap of 32 years with only male presidents. With the current membership ratio of 54% women the hope is that this trend is being reversed. In fact, the 2019 slate of members running for the next president contained only women (Doyle, 2016).

Felicia's Perspective: A Voice Shared from Nigeria

I have my higher education degree from Auchi Polytechnic, University of Portharcourt, and University of Nigeria, Nsuka, Nigeria. I am currently a lecturer, a researcher, a passionate educationist, with a specialty in educational administrator, educational management, and educational technology.

Illiteracy can be equated to sickness of the body and blindness was what my mother always told me as a child. She informed me that an educated woman is an empowered woman. She also told me to ensure that I worked hard as a woman. These wise words were always ringing in my heart and made me work even harder. I went through school as a shining star even though there was no money to support my education. I was considered to be a brilliant student in my secondary school and every other student ran to me to help them with their academic difficulties. In those days in school, most times l did not have the required text books. My fellow students who had the textbooks were always bringing their books to me for coaching and more explanations. I taught them and afterwards used the books myself. My exam performances were always outstanding and far better than the students with the books I borrowed and taught. I eventually became the talk of the town and was popularly called *SP* as l was the Senior Prefect. As a child I also went by the nickname *Doctor* since that is what I wanted in my future. As a teenager I returned to our rural village from the city of Lagos. The culture questioned education for daughters and I was pulled out of school to work the farm. My teachers influenced my father into continuing my education. Around me individuals kept telling me to marry instead of furthering my education. With the support of my father, I came to realize that I was blessed with an inner drive and courage

When I was ready for higher education. I was first admitted to study Agricultural economy at the University of Ibadan but was denied going because my father was wrongly advised. My father took me to a lecturer from my village who then admitted me to study secretarial studies at Auchi Polytechnic. Surviving school was not easy. I graduated and started working. I knew within me that I wanted to get to the top academically but for financial reasons I had to first find a Job.

In time I got married after a few years. Faced with married life, I saw my academic dream slipping away. I had my first child and then with a great deal of courage and a supportive husband, I went back to school. Eventually I graduated, and then went back to school for my Masters. Today, I am happy to have earned the title of doctor of philosophy with a specialization in Educational Administration and Planning. Our culture did not encourage me in my desired medical degree but I have achieved my dream with my PhD transitioning from medical to academic doctor

Even though I did not receive by PhD until 2017, I have accomplished many milestones along the way. I established a private primary school in a country where literacy is not always the focus for young girls. My research has been presented at international conferences at Harvard and Indiana University. I was the founder of the Association of Digital Education Communication Technology and organized the initial AECT – ADECT professional conference. Through this affiliation, I have created lasting collegial relations with key AECT scholars. At this point in my journey I'm excitedly waiting to see what the future holds.

Nigerian Past and Present Voices

Nigeria is currently the largest African nation in terms of population and within a few years will be third in the world behind China and India. The latest available figures show 59.4% female literacy and 74.4% male literacy. As of 2018, the illiteracy rate for 15-24-years-old was 9,364,626 with males at 3,509,338 and females at 5,855,288. Among those 15 years and older (41,763,792), 15,904,134 were male and 25,859,658 were female (UNESCO Institute for Statistics: Nigeria, 2019).

The culture continues to encourage males in education while women and young girls are given limited options. In 1920, only 7.7 % of Nigeria's college students were female By 2009, number was increased to 45 %. In spite of the high percentage pursuing higher education, females constitute just 20.3% of lecturers in Nigerian universities. This is a country where the terrorist Boko Haram continues to thrive while using kidnapping and suppression to discourage education or equality for girls.

When researching the noted women of Nigeria, the list included the following names:

- Prof. Adetoun Ogunseye – 1st female professor
- Grace Alele-Williams – 1st female Vice- Chancellor and 1st female PhD
- Funmilayo Ransom-Kuti – teacher, activist, founder of the Nigerian Women's Union
- Kuforiji-Olubi – Headmistress at 19 who became the first female graduate from the male-only Chartered Accountant of England and Wales. She was the also the first female graduate of ICAN

There are many identified societal benefits in educating women. These include a direct correlation with improved health and increased quality of life. Educated women are more likely to seek proper medical care both for themselves — especially maternal care — and their children. Higher rates of female education correspond with lower HIV and STD rates. Educated Nigerian women are less likely to get married or give birth as teenagers which improves society as a whole. These women are also more likely to hold stable jobs, less likely to be in poverty, and more likely to contribute to the overall economy (King & Hill, 1993).

Discussion on Future Opportunities

Women's voices are starting to be heard. More women are assuming prominent leadership roles in higher ed, the corporate world, and politics. Programs and professional organizations are in place at many universities to nurture future women leaders. And the generation entering college appear to not support the mantra: well we've always done it that way.

As many of us have been mentored, we have learned how important it is to support emerging scholars and colleagues. We value the act of reaching a hand back to those who follow. Leadership is taught by example, not by words. So how do we take this forward? Women need to make our voices heard while men and administrators need to learn to listen. A proven approach to support and to encourage emerging scholars and leaders is to:

- Be an intentional mentor
- Actively *invest* in a mentee's success
- Purposefully build mentees' confidence
- Assure early successes
- Promote mentees' strengths to others
- Treat mentees as your colleagues
- Invite mentees to work alongside you (co-teaching, co-writing, co-serving)
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The quote that begins the *Women's Voices* book is by Alan Rickman: "We need to tell stories to each other about who we are, why we are, where we come from, and what might be possible" (Donaldson, 2016. p. vii). Women and supportive men need to continue to share their stories and highlight both the successes and challenges faced. As our voices are heard, let us be the chorus that supports all those whom blaze their own future paths at all international levels.

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Building A Virtual Multidisciplinary Team

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Abstract

This study introduces an effort in the direction of an effective dynamic mini-courseware design during the practice of learners from multidisciplinary in higher education including several areas of professions such as learning science, computing, information science, artistic design, curriculum development, management, marketing, and law. The nature of a heterogeneity in a multidisciplinary team contributes pecific mental cognition and expertise when achieving socio-emotion and task over a social representation in a common representational space (Gloor, 2006; Vlad - Petre Glăveanu; 2014). The finding suggests heterogeneity of teamwork is not limited to a boundary of location, enriched by a virtual multidisciplinary members in a Design Thinking process encompassing; Diverse inspiration, Sharing empathy, Generate idea, Competing prototype/solutions, and Pilot-testing via a widespread of geography and time differences. A promising result empowering the VR multidisciplinary team for a "power of thinking" through a communication technology that nurturing an iterative process of thinking with social-ethical practices with the end-users' empathy sharing.

Introduction

Aside from a professional skill, a demanding of non-routine analytical skills including problem-solving, communication, teamwork, creativity, and entrepreneurship are acquired to be the essential skillsets for all careers that ensure the employability during the disruptive change of the 21st century. In parallel with the country goal that aimed for uniting diverse individuals into a productive quality citizen of the country; Digital Education, a promising path that empower college students and life-long learners, intertwines content with technology encompassing approaches of technical perspective, learning perspective, collaboration in a social-ethical perspective. Such the digital education system falls under the lead of Educational Technology profession that aimed at facilitating a learning capacity by the process of creating, using, and managing technological enhanced environments. Digital Education system in a technical term means a system for teaching, learning and evaluation with some basic automatic features such as attendance monitoring, media audio visual lesson editing, online practice/exams, individual assessments, centralized data storage, etc. The system in a holistic approach allows an involvement of practitioner/professions in a broad range of disciplines and members from schools, colleges, universities, non-formal institutes, and private sectors. The Digital Education system includes a total management; a plan for a quality assurance, strategic teaching, learning engagement, monitoring, evaluation, financial and benefit control. The digital education system urge an effective team to work for the success; integrating knowledge and methods from different disciplines, using real synthesis of approaches. Several researches addressed issues of the content in the courseware product that focused on value for the learners and the development methods with multi-disciplinary team. A few concerns on a courseware development disciplines cooperate for the best of the quality of interactive product for learners. A courseware design are usually text, graphics, animations, video, and audio wherever it is functional or otherwise suitable. The level of interactivity is usually restricted to interactive forms available through technical aspects. A simple technical function somehow could reach an effective learning outcome when applying with a decent design of instruction/presentation. In the digital learning system from teaching/learning perspectives; content, technology, and delivering are holistically in concerns, as the fast speed of technological change disrupt shortening the life-cycle of knowledge, delivering mode, and how people learn. Multi-disciplinary team in a courseware development disciplines is likely to result in a dynamic and raise the level of learners' awareness in all aspects, especially when employing users' centered approach of Design Thinking.

Mini-courseware

Contemporary learning has been enriched by state of the art technology namely mobile Learning (m-Learning) and ubiquitous Learning (u-Learning). The learning via mobile is attracting considerable interest in the fields of professional learning and work-based education, as its capacity of just-in-time and on the job upskilling people at work. Some design approaches are inclined to merely adjust the content to fit the screens of mobile devices, still employing behavioural and cognitive paradigms. Numbers of research enrich mobile learning strategies that accommodate creation and sharing of content; learning across formal, non-formal settings and at work. Psychological implications are broaden to situated, socio-cognitive, cultural, multimodal and constructivist educational paradigms (Pimmer, C. & Pachler, N., 2008). The new generation of learning system via mobile device is precise, brief, effective, and can dynamically interact with learners' individual profiles, the term is coined "mini-courseware" (Li, Y., Guo, H., Gao, G., Huang, R., & Cheng, X., 2009) . Largely known as "micro-learning", skilled based learning approach, a courseware appears in relatively small learning units and short-term-focused strategies. The instructional strategy highlights a microlearning process which is the design to gain learners' interaction on the micro-content, learning time and cost effective, specific topic/unit, small part of curriculum, knowledge/skill elements, integrate/situated process, multi and mediated media form, active/pragmatist approach. For more example, Uptodate (known in a medical care) an evidence-based learning resource, a contemporary learning ground that has been enriched by state of the art technology of Big Data, Micro learning, Mini-courseware and mobile Learning. This type of courseware design has been integrated into the mainstream of education and training. This design direction has caused the field of Educational Technologist from scope of integrating media and learning to face an evolutionary challenge since this new demand of learning must effectively correspond to an individual learner's needs in an appropriate manner and at the right time, within a disruptive but short life-cycle of demanding knowledge and technology. The scope is broadened to other professions as Information Technologist, Computer Engineering, Business, Law, etc. For the teaching and learning part, a quality content/courseware is gained not only from technical or pedagogical part, but other areas of the contribution and precaution to the issues that will encounter along the development and implementing the learning courseware. A Multidisciplinary team, individuals from different disciplines work together contribute their disciplinary knowledge for success. Team, independent individuals effort collectively to achieve a common goal or task with an effective process, is beneficial to problem solving that brought various perspectives as claimed to meet effective possible solutions with components of combination of team, communication, coordination, motivation, and relationships of the team (Paulus, P, 2000; Hoegl, Martin & Hans Georg Gemuenden, 2001; Ilgen, D. & Hollenbeck, J., 2004). Team member could offer their unique knowledge and ability for team output and motivated individuals' ambitious to improve their performance (Katzenbach, J.&; Douglas, S., 2015). Recent research on teamwork enriched by various expertises could gain a group wisdom through a process of conceptualizing knowledge, virtue and emotional feelings, and operating in a practical action with the group judgment and ethical decision (Akgün, A.E, 2019).

Virtual Multidisciplinary Team

Team consists of a group of people with needed skills to accomplish a particular task. Working as a team may require a process to implement a team training to promote a shared goal, strategies, and resources, and participation as well. Not only a requirement in a workforce, some research propose several approaches for in higher education students training programs; for example, using an authentic context such as a simulation game development to enhance teamwork skills. The study employed a game-based software development to be an activity in enhancing a teamwork skill found an issue of a lack of acceptable group assessment (Sereti, et.al., 2019; Iacob & Faily, 2019). Researchers propose an evaluation providing immediate feedback allowing a transfer of learning which the skills will eventually be modified to a similar one.

Team, a group of individuals together working from different geographic locations synchronized and relay, could effectively perform in a geographically dispersion relying on communication technology, as known a virtual team (Nader, A., Shamsuddin, A.& Zahari, T, 2009; Zahari, T Nevogt, D., 2013).

A few process of virtual team is found; Lipnack, J. & Stamps, J. (1999) a virtual team, consisting of three major components; people, process and connection, promotes a dynamic and diverse group and a common team structure might not be a favor of the team. Nevogt, D. (2013) proposes a practical process and technological tools for virtual team. The guidelines of the virtual team are 1) Goal settings and valid explanation 2) clear and precise notification for tasks and its priority with deadlines and publish for member to be follow and monitor the progress 3) Follow-up based on the agreement tasks and timeline as a group not individual communication 4)Allow for reasonable iterative process to develop the solutions 5) Technology mediates the process such as an online project blueprint--flowcharts, text-written, mind-maps, video; group and task internal communication; expert connections.

Research review on a virtual team consists of 4 major components: members, social-emotion, process, and technology. The heterogeneous group of cognitive specific from multi-discipline joined a virtual team could bring an exceptional solution. Socio-emotion issues take a major part in this diverse cognitive sharing. Some research supports the face-to-face meeting could empower virtual team to share a mental model and lessen the diverse cultural difference that could obstacle an effective communication. (Suchan; Hayzak, 2001). Take process via Computer-Mediated Communication (CMC) is highlighted as a success factor of virtual team. Technology takes roles in keeping members in following up task process even more crucial than a face-to-face teamwork. Members could be in a silence without noticing the progress to the group and that cause an ambiguity and eventually become problematic. Group coordination and task-technology-structure fit could keep up the virtual team forward the work. Finally, collaborative technical aspect takes an essential effects on team 's performance in following the taks and the process and that contributing to the work and the satisfaction of belonging to the team. Technology could provide a nurturing climate of which members could build a trust and cohesion of the team using a dialog or conversation in small group to share positive or release a doubtful sharing mental models during a virtual team norm building. An extensive reliance on communication technology anyhow could reduce effective of virtual team. Some research and practices apply a reward system, creating trust, and communication culture for team cooperation, also periodical face-to-face meetings to form relationships and being a vehicle to coordinate activities. In addition, teamwork needs an ongoing practice to maintain and promote the development of a shared mental model of multidisciplinary participation with team resources and goals. In addition, immediate feedback on learning outcomes could facilitate the transfer of learning during the practices.

A social hierarchical structure appears in an organization or group that a top position or senior tends to become authoritative and individualism causing trouble in engaging collaborative work. Also, some task could be appropriate for individual work that also could lead to a conflict and damage to the teamwork. Using teamwork in a curriculum, senior project of software engineering team exposed students as complex learning in a professional work environment, and that students are well aware of the commitment before commencing the group project. However, unequal amount of individual's work was in cautious that could create conflict and lead to lower levels of performance (Iacob, C. & Faily, S. 2019).

Design Thinking

Learning design, is a practice of matching learning with constructive instruction enhanced by technology. Several research studies found Design Thinking to be a powerful method providing a solution-based approach to complex problem solving that addresses ill-defined teaching and learning problems. Design Thinking is a technique originated in 1960's in Engineering field for an innovative production. Later, 1970's the design became a subject in replace to traditional arts and crafts for secondary school in the U.K., and gradually link to technology study. Design Thinking, in 2003 has been introduced at the university programs in business and innovation areas (Lockwood, T., 2010).

The process of Design Think is to understand the learners needs, re-framing the problem in a learners-centric way, through brainstorming techniques, prototyping and testing (d.school at Stanford University, 2010; Adams, C., & Nash, J. B., 2016; Brenner, W., Uebernickel, F., & Abrell, T., 2016). Typically, the process primarily includes a technique to gain an empathic understanding of the problem from the learners' insight by engaging and empathizing with learners' based on their experiences and motivations in the learners' physical environment. A wide and open view, aside from courseware designer's personal assumption, will clearly give insight to the learners' status of the problems. The next stage, the gathered insightful information is analyzed and synthesized to define a core problem, and through teamwork will validate a defining task of a problem statement. Eventually, the solutions come through supported by a teaching/learning mechanism that is well enhanced by technological features and functions. Later, in a prototype phrase, the design team scales down versions to investigate the problem solutions from the ideate stage. The team will perform a validity of the test with a variety of small group sampling techniques. Thorough this stage of the testing, the details of the prototype are investigated based on learners' reaction whether to improve, accept, or reject on the basis of learners' reactions. The best solutions will tune in this pre-experimental stage. The design thinking process with a teamwork should give an innovative solution resulted from a multiple loops and in different angles.

Design Thinking is represented with three iterative stages: inspiration, ideation and implementation (Brown, 2008). Inspiration, motivating the search for solution, generated through interactions with target clients. Ideation is the process of generating, developing and testing various ideas leading to solutions. Finally, the

Implementation stage of design thinking plans a path to develop and run the selected concept. Review the development process of Design Thinking found common cores accordingly (Brown, 2009; Brown, T. & Wyatt, J. , 2010; Stickdorn & Schneider, 2010; Coakley, Roberto, & Segovis, 2014; Glen, Suciu, Baughn & Anson, 2015; Gachago, Morkel, Hitge, van Zyl & Ivala, 2017): 1) Inspiration, understanding the problems and opportunities; 2)Empathy, Users' center deep analysis from users' physical and emotional experiences; 3) Ideation, alternate between divergent and convergent thinking through a brainstorming and think outside the box 4) prototyping & implementation, the idea turn into a concrete product/process and iteratively evaluate and refine.

Design thinking is found its largely used in software development organizations as a tool to follow a human-centered approach. Design Thinking also is claimed as a tool for undergraduate students' creative skills,problem solving, communication, as well as collaborative work, as known social and cognitive skills. Much more than that, Design Thinking, empowers students to train acquiring empathy towards others. (Valentim, N. M. C., Silva, W., & Conte, T., 2017) Brown (2008) uses a "persona", a character of users, to be an action to describe detail clients' characteristics, typically, represented in a textual form and photo, to motivate teams into thinking about users during the design process, making efficient design decisions. During the stage of Empathy; four areas accessing the users 1) Think and Feel: what users' perceive the issues/things 2) Hear: how the environment influences the users 3) See: what the users see in their environment 4) Say and Do: what the user says and how users behave in public. (Jahnke, I., Lee, Y., Pham, M., He, H., & Austin, L., 2019)

This research is aimed to provide guidelines of building up a virtual multidisciplinary team based on a design thinking process to achieve the target of a dynamic mini-courseware application. The study is conducted by a systematic review of research and best practices of design thinking process with the use of communication technology

Purposes

This empirical study aimed at outlining the process of building up a virtual multidisciplinary teamwork within a Design Thinking process. The study also explore tools and process in bridging communication among the multidisciplinary team while performing dynamic mini-courseware design. The main research questions are:

- What are the process and communication tools in the Design Thinking for a virtual multidisciplinary team?
- How the multidisciplinary team performed in the process of Design Thinking?

Methods

Building a virtual multidisciplinary team with Design Thinking process is a qualitative method in its nature.

1. the study employs a qualitative data collection using research and best practices review, analyze, and synthesize the process of Design thinking. In a matrix format, the synthesize process of Design Thinking is crossed analysis with a multidisciplinary team practice.
2. The result of the analysis of a virtual multidisciplinary teamwork with Design Thinking process is matched with a categorized technology, derived from a short-listed expert reviews, literature, and a software survey.
3. The study apply an empathy technique interview to understand the underlying opinions of some potential members that diving deeper into possible problems while making a team to complete the mini-courseware design. The data is gathered to identify the solutions with three experts' opinions. The process of Design Thinking in a virtual multi-disciplinary team was adjusted.
4. Eventually, the process of Design Thinking of the virtual multidisciplinary team via the technology toolkits was piloted. The researchers' participated and observed, followed by a semi-structured interview.

Results

Design Thinking with Multidisciplinary teamwork process consists of five stages namely: Diverse inspiration, Sharing Empathy, Generate Idea, Compete Prototype, and Pilot/Testing.

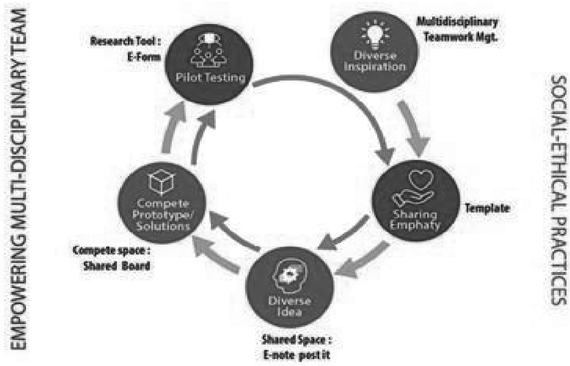

Figure 1. Model of building a virtual multidisciplinary team with design thinking

1. Diverse inspiration:

The Diverse group inspire: This stage emphasizes an awareness of the diversity of the group, welcome and persuade the group to the ultimate outcome. A clear and precise goal is announced on the homepage of the team. The group task is analyzed and along with the sub-teams' responsibility and timeline must be a group communication. This stage consists of 3 steps 1) Represents heterogeneous of the team via their work & profiles. 2) Selection to the sub-groups. 3) Group task analysis based on individual's expertise: Time & Task management.

Technological tools: Web GroupBlog VS Individual

2. Sharing empathy:

Team have a conversation with the end-users for collecting even richer and more provocative ideas. Team with different thoughts will take away the mindset, observe the world to find what end-users' problems and how they are thinking, what they desire to do, and what they wish for. They collect insights by looking at the major problems as an insider, as if they were the users.

Technological tools: Research Template

3. Generate Idea:

Members of the team virtually propose their ideas via online canvas based on information received from the users' empathy stage. Members act as a team researcher and that resulting to different data from accessing end - users' opinions. A structured brainstorming process. Taking one provocative question at a time via an online canvas, coding by color. Members freely generate ideas via an online Post-It note which allow for visual image and other media to be linked. Eventually, members categorize those ideas in the same shade of color, and naturally the ideas are ranked. This lets the group move into a process of grouping and sorting ideas.

Technological tools: E-note Post-IT

4. Competing prototype/solutions:

At the core of the implementation process is prototyping: turning ideas into actual products and services that are then tested, evaluated, iterated, and refined. A prototype, or even a rough mock-up helps to gather feedback and improve the idea. Prototypes can speed up the process of innovation because they allow quick identification of strengths and weaknesses of proposed solutions and can prompt new ideas.

5. Pilot-testing: will take their roles in filtering the ideas, an iteratively improve through the implementation for its ultimate solutions.

Technological tools: E-research (form)

Table 1. Design Thinking process with a multidisciplinary Team

	Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
	Brown (2009)	Inspiration	Ideation			Implementation
	Stickdorn& Schneider (2010)		Exploration	Creation	Reflection	Implementation
	Standford d.school (2010)		Empathy	Define /Ideate	Prototype	Test
	Coakley, Roberto, & Segovis (2014)	Inspiration		Ideation		Implementation
	Glen, Suciu, Baughn and Anson (2015)		Problem Finding, Observation	Visualization and Sense Making, Ideation	Prototype and Test	Viability Testing
	Gachago, Morkel, Hitge, van Zyl and Ivala (2017)	Collaboration and Generosity	Learner Empathy, Problem Orientation	Exploration and play		Reflection and Resilience, Focus on practice, Change Agents
	Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
Synthesize team	Kirkman et al. (2002)					
Context		confidence and trust				
Team Structure			-common goals -member roles - roles - relationship			
Process				- virtual team performance - member training -evaluation		
Synthesize team	Powell et al. (2004)					
Context		-cultural difference -expertise				
Team Structure			-relationship skills -choesion			
Process				-communication -coordination -task- technology structure fit		
Synthesize team	Shaw (2012)					
Context		rewards routines resources				
Team Structure			- purpose - cleat roles - relationship skills			
Process						
Synthesize team	Zimmer, Christina. (2015)					
Context						
Team Structure			-leadership - working according to the specified structure			
Process				-communication - community		
Synthesize team	Ghiringhelli & Lazazzara (2016)					
Context		- training - locations				
Team Structure			- team selection - Positioning - Set team goals -motivation - team leader - member team performance			
Process				- meeting structure - performance evaluation - electronic communication - working with technology - facilitating the team - Security		

Table 2. Design Thinking process in a Team mediated by communication technology

Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
Synthesized tools of Design thinking					
Kayla Kurin (2015)		-Innovation Flowchart - Google ventures design sprint - Design thinking mix tapes - IDEO design kit	-WeTHINQ - Question Ladder	- Design thinking tool kit	-WeTHINQ
Robert Cserti (2019)		-Typeform -Zoom -Creatlr	-Smaply, -Userforge, -MakeMy Persona, -SessionLab, -Stormboard, IdeaFlip	Boords, Mockingbird, POP	UserTesting, HotJar, PingPong
Emily Esposito (2018)		-Join.me	-Boards - Free hand - Coggle - Focus Booster	- InVision Studio - Craft	- Ethnio - Lookback
Chloe (2018)		- Smaply - Usability tools	- Visual collaborative work platform: Morally - Mind map tools: Mind Manager, Coggle	- Mockplus - Pop app	- Silveback
Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**
Synthesized tools of virtual team					
Hu (2015)	YouTube, Yammer, Wiki, Google Apps: Sites, Docs, Video, Maps, Calendar, gadget World Clock, g-mail	Wiki, Google sites	Yammer, Elluminate Live (Blackboard Collaborate), Skyp, Google talk, chat	Google sites, YouTube	Blackboard, Google Apps
Chastain & Nathan-Roberts (2016)	Sharing calenders, Web-based training, e-mail, datbases	Blog, Application sharing	- Web conferenceing, Video & Audio conferenceing	Streaming Audio/video, Narrated slideshow	
Aritz, Waler, Cardon, & Li (2017)	g-mail, messenger	Google Docs, Dropbox	phone calls, Facebook, instant messaging, Skyp, Google Hangouts, Coference a call		LMS**,** Google Docs
Larson, Leung, & Mullane. (2017)	Slack	Dropbox, Google drive/Docs,	Face Time, Google Hangouts, Skype, Slack, Teleconference application, WhatsApp, Google Hangouts,		LMS, Google drive/Docs, Slack
Edwards & Wilson (2017)	e-mail		Electronic display tools, Electronic meeting systems, Video & Audio onferenceing		
Mukherjee & Natrajan (2017)	Blog, Yammer	Facebook, Google drive/Docs,	Disscusion Boards, Google Hangouts, Yammer		Google drive/Docs,
Ritika Tiwari (2018)	Asana, Basecamp		Trello, Slack		Trello, Slack
Orta-Castañon et al. (2018)		Dropbox, Onedrive, Google Drive/Docs, Facebook	Skype, Webex, Snapchat, Chat, Google Hangouts, Facebook live		LMS, Google Drive/Docs
Overview Features	**-Personal storage -Resources -Task & time Management**	**Template**	**Shared space**	**Compete area**	**Research Tool**
Synthesized process	**Diverse Inspiration**	**Sharing Empathy**	**Generate Idea**	**Compete Prototype/ Solutions**	**Pilot /Testing**

RQ 2. How the multidisciplinary team performed in the process of Design Thinking?

The observation and interview are based on the framework of the Process, (People) Team, and Technology in the Design Thinking for the mini-courseware of the Multidisciplinary team which are explored in the dimensions of Context, Team structure, in the process of Design Thinking (Kirkman et al., 2002; Powell et al., 2004; Shaw, 2012; Zimmer, 2015; Ghiringhelli & Lazazzara, 2016)

Context & Team Structure: Twenty three participants, Master degree program from different background; Psychology, Information Technology, Instructors, Business, Computer scientist, Trainer, and Marketing. They enrolled in the Class of 2019, Educational Technology. The objectives of the class are to design a mini-courseware incorporating to a Learning Center to serve various kinds of targeted learners such as Primary school students, Undergraduate students, and Life-Long Learners. In the orientation session, the Design Thinking process was explained and Communication tools were suggested for members to review and agree upon.

Communication Technology: Toolkits were introduced. Main features are Web Blog of the project consisting of: Individual and sub-group profiles; Project Management, "Persona" Template, Online Sticky Note, Whiteboard (JamBoard), Survey tools.

Table 3 Members, design task in the Virtual Multidisciplinary Team

Sessions	Total of 21 members	Disciplines
Identy: what's a matter!	3	Psychology, Information Technology, Instructor
Open thinking for creativity	3	Teacher, Sciencetist, Business
Digital Teachers	3	Teacher, Computer Science, Management
Inter-generation in a Co-learning space	3	Business, Trainer, Information Technology
Language Market	3	Teacher, Computer Science, Business
Go Gamification	3	Teacher, Marketing, Computer Science
ICT Integration	3	Teacher, Trainer, Information Technology

Process

Diverse inspiration: participants put their profiles on the web projects and expressed their inspirations and their opinions on the mini-courseware design project. Later, members decided to join the sub-group themselves into 7 groups in a total of 21. Two could not decide to be members of any teams due to their feelings of lacking a proper knowledge to join the project.

Team structure: The leaders form themselves for each sub-group and the whole project. The timeline and task was proposed and leave a week for members to agree, add opinions, or adjusted.

Communication: Communication among themselves were not often, unless the deadline was approaching.

Sharing Empathy: Members were trained and provided resources for the end-users interview. They worked as a group, making a decision on the questions to explore. Then, they worked in a pair and switch, using video conference to interview with the end-users. Individually, the team member wrote the data onto the template. As a group, they interpreted the data together and share with other groups.

Team structure: Members whose expertises are not in the area of Information Technology and Computer Science/Engineering take the lead with a support from members from Social Sciences interpreting and synthesize the insights of users' feelings leading to solutions or opportunities for change.

Communication: Sharing online Template “persona”; individuals in the team wrote the data very similar. Few data were slightly different from others.

Generate idea: A structured brainstorming process occurred over an asynchronous mode of communication. Taking one provocative question at a time via an online canvas, coding by color. Members freely generate ideas via an online Post-It note which allow for visual image and other media to be linked. Eventually, members categorize those ideas in the same shade of color, and naturally the ideas are ranked. This lets the group move into a process of grouping and sorting ideas.

Members put their own idea on the sub-group and share to the other group members. Using an online sticky note, others came to comments, clarify and adding more resources.

Team structure: Members voluntary expressed and disseminate their ideas; while responded to other comments.

Compete Prototyping/ solutions: A blog of team project displayed 5 learning activities and 2 wireframes; open

Team structure: As a team, members in a sub-group responded to the comments and suggestions of other teams. Meanwhile, working as a commentator, individual member accessed other group works and contributed their opinions.

Communication: There are some problems when an individual had to perfrom two functions as an evaluator and designer. Not all of them comments others, either responded to other members. The rating was offered by members from other groups.

Pilot/testing: The E-questionaires were distributed to the potential end-users to gain their opinions, including a couple follow-up interview. Some notices on the results were put to the comments on the blog for further improved.

Team structure: Members as a team of multidisciplinary acts as a research team; coordinate the results.

Communication: Face-to-face is required from the members to clarify the whole process before further improvement.

Discussions

1. Diverse Inspiration: The multidisciplinary team was formed, acquired by a specific cognition and social-emotion in a sub group.

1.1 Team confidence and trust must be earlier established with the team. The members selection to the team will help members to matched themselves and show their interpersonal skills to be taken to the sub-group. Members represented their expertise and eventually be selected from the subgroup. The selection of virtual team members is the selection to fit both expertise to match the task and interpersonal skills to be in the selected group. Interpersonal skills especially cultural awareness are more important as team members attempt to communicate effectively without relying on traditional non-verbal cues (Kirkman, 2002).

1.2 Task & time management: Member recognition as unique expertise and contribution to the group will have consistently appeared on the group task & timeline. This stage is adapted to be a loose structure of the virtual multidisciplinary team that should be distributed and not strictly hierarchical structuring. Task and timeline, however, will support communication in the sub-group/community, leading and structure the work to be structured and followed by the group (Kirkman et al., 2002; Powell et al., 2004; Shaw, 2012; Zimmer, 2015; Ghiringhelli & Lazazzara, 2016) Team leader is still needed nominated by the members who for see the challenges of the lead the activity over the non face-to-face with his/her special characteristics. The discussion on the team leader who must have both task-related and socio-emotional strength to accommodate the cultural, experiential, and distance differences of virtual teams (Ford, Piccolo, & Ford (2017).

1.3 Communication: Towards the communication in the context of the virtual multi-disciplinary team; Technology as a "task & time management" features support the task structuring, direction, feedback; as appeared in the Bal and Gundry model (Ghiringhelli & Lazazzara, 2016) identified the areas in relation to team members such as team objectives for group motivation, meeting behavior derived from the trust, reward structure claimed by motivation and goal setting, and team selection occurred by supporting culture. In relation to technology, appropriate technology is selected to facilitate team effectiveness through a compelling communication channel (Ford, Piccolo, & Ford, 2017; Serrat, O., 2017; Alsharo, M., Gregg, D., & Ramirez, R. (2017)

In addition, group communication via a group "task & timeline management tool" instantly notice the updated task of the group. The rapid responses by the system will stimulate team members for the reliable group performance. While personal and sub-group communication consistently follow-through will established the "trust" and "motivate" and bring up social existence that caused an awareness of the socio-emotion in the group (Kirkman et al., 2002)

2. **Sharing Empathy**: This process of the group to experience the real users' problems.

Originally, at the inspiration phase, designers look for the opportunities with the current status of users' needs by observing and collecting insightful data from the users (Brown, 2019). At the stage of diverse group inspiration, the focus is shifted from the end-users to the multidisciplinary team. The purpose is to draw the pictures of users' problems from different angles of expertise of the team. The team represents the end-users', extreme points of view of problems and turns to a provocative ideas. An awareness of the diversity of the group, and welcome and persuade the group to the ultimate outcome. A clear and precise goal is announced on the homepage of the team. The group task is analyzed and along with the sub-team responsibility and timeline must be a group communication.

2.1 Persona: Using the "persona" technique (Brown, 2009), members from their perspectives will have experience in an insightful of the end-users. Empathy brings in the centerpiece of a human-centered design process from multiple perspectives in intrepreting how end-users perceive the problems (Standford, 2012). Similar to a qualitative research approach that is a scientifically gather non-numerical data. The "Sharing Empathy" discloses why and how a certain phenomenon occur and can be employed across all disciplined. This method will help understanding end-users needs, through an observation leading to empathy, insights and analysis, gaining an unfiltered understanding of the user's experience, abilities, and constraints. (Glen, Suciu, Baughn and Anson, 2015). Eventually, the "Sharing Analysis" will be analyzed breaking apart the root causes of a problem from multiple perspectives.

2.2 Problem oriented: The Communication Tool that supports analysis of problems and causes, cause-effect online collaborative diagram facilitate generative brainstorming from different points of view of the interdisciplinary group, rather than quickly jump into solutions. This problem orientation activity supports team to timely explore the problem from many different viewpoints, thereby remaining in the problem space for longer (Lawson, 2005 cited in Gachago, Morkel, Hitge, van Zyl and Ivala, 2017)

3. **Idea generation;**

At this stage, idea generation of the multidisciplinary team was brought into attention. This stage coincided with the work of Brown (2008) who proposed a divergent thinking from multidisciplinary; per se members from psychology, business/marketing, engineer. He postulated the "T-shaped" member; the vertical line-an individual with a depth skill, and the top of the "T" comes from openness, curiosity, and optimism from other people and disciplines. Technology supports idea generation and convergence easily present with color coding, simply as an online sticky notes, visual aids. (Brown, 2009). The colorful sticky notes could be easily rearranged, converging the idea, and move to other walls (online) (Ford, Piccolo, & Ford (2017). Visualization will help sense-making for information become meaningful. Visual aid serves as a tool in grouping pieces together a myriad of unorganized explicit artifacts in a memory for logically compare and contrast. It will spark a mental connections through a various perspectives of members (Glen, Suciu, Baughn and Anson, 2015). One best practice similar to the "Sharing space" that displays ideas to be mended together. An example of "InnoCentive" website, non-profit and business company involvement, allows currently more than two-hundred-thousands of members with multi-disciplines around the world to challenge and reward effective design solutions.

4. **Competing Prototyping**

Seven design outputs from the process of thinking from multi-disciplinary team found to be provocative as the thinking had been through the divergent and convergent thinking. Prototype is a step to make a convergent idea to be concrete. It is an iterative generation of artifacts intended to answer questions that getting closer to the final product/solution (Stanford, 2012). Competing Prototype elicit useful opinions from team to be refined and improved.

5. Pilot Testing

This stage could be a pre-execution to the vision and trial by end-users. The pilot/testing mode is beneficial for feedback about the prototype. It is literally opportunity to gain empathy for targeted end-users. An electronic assessment system could embarrassed a direct report from all perspectives of users and other teams (Kirkman, 2002). At this point, the design could iteratively to the prototyping or either bounced back to the Sharing Empathy process, acquired insightful of the end-users and redefined the problems, and work again through the ideate cycle. If the prototype could go far further than the testing of idea but interaction with users, elicit questions should remain "how" and "why" end-users have trouble with. The testing requires more than technical rationality of the courseware.

It could also a group reflection in action with other professions (Glen, Suciu, Baughn & Anson, 2015). The testing process is a reflective practice and should be continuous to promote a professional skills and resilience (Gachago,et.al.,2017; Lawson, 2015). This pilot testing could help minimizing the so-called by Taheri et.al. (2016) "creative overconfidence" caused by a lack of competence skills, overemphasis on technologies and tools rather than practices. Roles of team leaders facilitate members to genuinely and positively contribute towards the success of the team. Brown (2008) mentioned the "Design Thinking" is never ending cycle thought, thinkers (Multi-disciplinary) will never stop generating and competing idea.

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AOT- Learning Analytics of Digital Learning in Printing Production Course for Education Technology to Increase Creative Thinking in Thailand

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Keywords: Digital Learning, Learning Analytics, Creative Thinking, Education Technology

Abstract

The purpose of this study was to create the digital learning by Digital Learning Analytics' method as the appropriated tool to develop the creative thinking in Thai students. The study consists of five procedures which are, first, studying the documents, principles, theories and the researches which related to the digital learning, learning analytics and creative thinking. Second, designing the digital learning combine with the learning analytics to develop creative thinking. Third, creating and developing Digital Learning Analytics. Fourth, applying Digital Learning Analytics to printing product course for education technology. Fifth, evaluating the using of Digital Learning Analytics and Creative Thinking test. The sampling group of this study is 30 Thai students, who have basic technology skills. The result of this purposive sampling was analysed by these following methods, Mean Method and Satisfactory Evaluation. Finally, I present the using of Digital Learning Analytics, which consisted of 7 steps 1. Import Data 2. Identify problem 3. Plan the concept 4. Create a prototype 5. Utilize by user 6. Assessment process 7. Modify the route. Those results will be evaluated by the experts in Digital Learning Analytics and also the creative thinking Thai students will be evaluated as well.

1. Introduction

Nowadays, the world society is stepping into the digital society in which people communicate via the network, access information with just a click of a finger. Technology and computers have been developed and used in both the business world and personal use or for other purposes as quickly and widely as needed. Resulting in the amount of information that newly created in each day. These data are a valuable knowledge resource if we can use it. (Yaowaluk and Sophon, 2561) Information and activities through the online world is increasing every year. Data from Thailand Internet User Profile 2018 from the Electronic Transactions Development Agency (ETDA) found that Thailand has more than 57 million internet users, for social media regularly reaches 51 million. About 55.56 million people are mobile phone users, and about 46 million social media users use its through smartphones. Thai people use the internet for nearly 10 hours a day on workdays/school days and 11 hours on holidays. It is also found that the behavior of Thais who use the internet via smart phones include talking 77%, watching videos 75%, playing games 66%, searching routes 64% and making financial transactions 56% (Rohan, 2018). This dramatic increase in usage affects thinking, life, and information understanding bring data together from various media and the ability to analyse the relationships of that data, enable us to improve business operations, sales and marketing, able to take advantage of competitors or create business opportunities. As can be seen from the data collected to lead to the analysis of solutions. For example, from the article "Deciphering the unstoppable Netflix and the role of Big Data" analyze that Netflix has achieved rapid success by collecting audience data in terms of viewing history, pressing stop playback, used devices, search, rating, etc. to create Big Data which analyzed from past movies selection that which movies viewers would like to watch next. Then presenting more directly or closely to the preferences and tastes of consumers, affect the experience and satisfaction. It results in more than 137 million subscriptions (data at the end of 2018). These analyzed data is not only used to increase business opportunities but also educational has uses data collection for analysis in learning.

Learning analytics is the process of measuring, collecting, analyzing and reporting learner results for the purpose of understanding the learners. Both problems and factors that promote learners learn in order to manage the learning environment to maximize results. (Jaitip, 2016) The software features of the data analysis software set include Content analysis, Discourse analytics, Social learning analytics, Disposition analytics by analyzing various data from the collected database, it is an important part of the operation. If there is enough data and covering relevant factors, it will help the result of the analysis to be precise and accurate. Study analysis procedure begins with bringing the information that needs to be done in a form that is ready to be processed by using technology or the set of instructions and the model created in order to use the information that has been analyzed and translated or interpreted according to the context and the learning environment. It is a support for solving problems and increasing the efficiency of digital learners.

Learning in the digital age is a process or method that a person uses to create meaning from information, environment, social stimuli that are received sensory, resulting in knowledge, skills and attitudes when systematically developed, it can be predicted to be effective at full capacity (Jaitip, 2016) that is suitable for the era. Presented on the platform to reach more young people with the internet and portable communication devices like smartphones being an important factor in the digital age. People are able to use technology aggressively and perform a variety of activities within their fast communicating all the time. There are many ways to access information, sharing, exchanging ideas, freedom to express ideas and express themselves through social media and also self-learning at anytime, anywhere through resources on a vast network. Learning activities has changed not only in the classroom but also an access the classroom freely in anytime and anywhere which using digital technology as a creator (Sungkawadee & Keawurai, 2017). Resulting in methods of accessing students' knowledge to use technology as a tool and develop oneself to create knowledges and skills that are continuous and sustainable. Digital tools for learning mean software and platforms for teaching and learning as well as text, images, audio, video, and programs for editing the digital content, working together and sharing resources with others to communicate knowledge (Interactive Teaching in Languages with Technology, 2017)

Creativity is the ability of the brain to think far and wide. Many aspects of its create new ideas which are differ from before. It is the ability to see the various relationships around, learn to understand until the reaction occur to the imaginative thought, which is an important aspect of creativity, leads to the creation of new things to solve problems which will require integration from all experience and knowledge (Charnnarong, 2003) By educational in Thailand at present, students are encouraged to create creative ideas that rely on technology and the internet to apply their competencies in accordance with Thailand 4.0 policy. Thailand educational institutions must integrate creative development with the methods and learning activities of the digital age that can access information in anywhere, anytime, as well as support lifelong learning in various courses therefore, focuses on the students to use creative thinking processes to solve learning problems

Learning in printing production courses focuses on students to be able to produce publications. Not only understand the principles of production but the design of publications is also an important part. The design of print media requires principles of font or text design, material, illustration, free space and other components for the publication to meet the objectives, target group and communicate effectively

2. Research Objectives

The objectives of this study was to create the digital learning by Digital Learning Analytics' method as the appropriated tool to develop the creative thinking in Thai students.

3. Sample size 30 undergraduate students in Educational Technology department

4. Research Methodology

4.1 Studying the documents, principles, theories and the researches which related to the digital learning, learning analytics and creative thinking.

4.2 designing the digital learning combine with the learning analytics to develop creative thinking by divided into the following steps

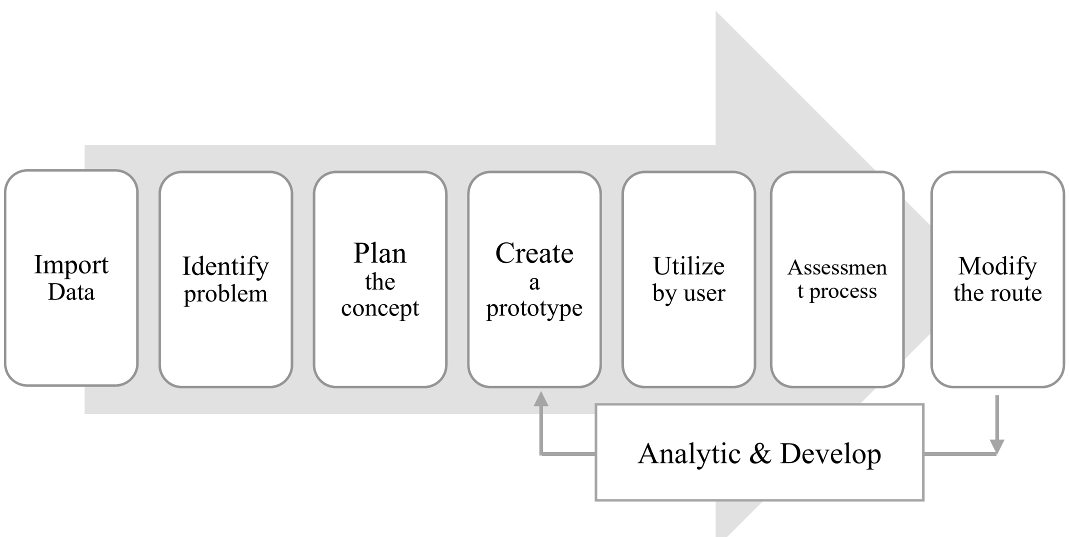
1. Defining the conceptual framework from the data obtained from the analysis in step 1 and create it in the format
2. Designing content and learning activities in the printing production course by using the creative development process, the SCAMPER model, consists of Substitute, Combine, Adapt, Magnify, or Minimize or Modify, Put to Other Uses, Eliminate, Reverse or Rearrange (Sirichai, 2015)
3. Designing Digital Learning in learning. It can be divided according to usage of the teaching and learning activities into 5 categories (Hart, 2017; Poore, 2013), including 1) Teaching management tools 2) Content development tools 3) Website resource tools 4) Social tools and 5) Personal tools and job development (Kobsuk, 2018)
4. Designing evaluation form by using the Reisman Diagnostic Creativity Assessment (RDCA) which is a test that is built on from the Torrance Tests of Creative Thinking (TTCT), the most popular test for measuring creativity that was developed in the Thai version (Naruertep & Charun, 2018) RDCA can measure 11 elements of creativity including originality, fluency, flexibility, thoughtful thinking, vague solutions, resistant of premature closure, independent thinking, convergent thinking, risk taking, motivation, and external motivation.
5. Designing analytics for learning analytics by selecting the type of discourse analytics. This type of analysis is to store meaningful information in the communication interaction of learners with Digital Learning tools in order to correct and improve efficiency of learners' creativity

4.3 Creating and developing Digital Learning Analytics. Develop tools for online teaching and learning via the internet (LMS) with Moodle software, which is a software for creating web-based tutorials. By determining to have a lesson management system which supports 3 user groups that are administrators, teachers, and learners. Provide an effective web-based learning environment. This system was developed based on Software Open source. Then create lessons in the Printing Production for education and communication course. According to the following learning units

4.3.1. Printing History
   1.1 European print production technology
   1.2 Asian publishing production technology
4.3.2. Educational publications and principles of educational publications design
4.3.3. Printing systems and materials related to printing
4.3.4. Applying graphic design principles to print design
4.3.5. Newspaper publications
4.3.6. Magazine and periodical publications
4.3.7. Book publications
4.3.8. Specialized publications (brochures, small books, booklets, flyers, posters-newsletters)
4.3.9. Specialized publications (flyers, posters-newsletters and other specialized publications)
4.3.10. Principles of designing original publications
   10.1. Publishing publication
   10.2. Principles and concepts of electronic publications design
4.3.11. Electronic publications design

4.4 Applying Digital Learning Analytics to printing product course for education technology.

4.5 Evaluating the using of Digital Learning Analytics and Creative Thinking test.Assess satisfaction and assess the creative ability of learners before-after using Learning Management System Implementation (LMS)



Model of Learning Analytics of Digital Learning in Printing Production course for Education Technology to increase Creative thinking in Thailand

Table: 1. Model of Learning Analytics of Digital Learning in Printing Production course for Education Technology to increase Creative thinking in Thailand

Model	Detail	Digital Tools	Creative Thinking	Productive
1. Import Data	Data Import - It is the import of data by testing the creativity of students.	Quizletstudy Google Form	SCAMPER creative development process Substitute Combine Adapt	Online pre-test
2. Identify problem	Problem Analysis - From the test scores, it was found that the creative scores in	Giving Opinion Reflecting Knowledge and		Discussion of messages or ideas for

Model	Detail	Digital Tools	Creative Thinking	Productive
	_________ is still missing, so promotion must be carried out	Creating links in the group area	Magnify or Minimize or Modify Put to Other Uses Eliminate Reverse or Rearrange	working in the classroom
3. Plan the concept	Action Planning - Use the analyzed problems to design the problem solving plan by brainstorming - Using the creative promotion process	Create mind maps by using the online graphic map tool.		Mind map creation Work outline
4. Create a prototype	Create templates / Create media / Create online activities to promote creative	- Online document sharing tool - Tools that help to display the idea of a work that can use text, images, video, audio - Learning Management System (LMS) tools - Classroom website		Learning Management System
5. Utilize by user	Bring the created template to be used by relevant parties such as students and teachers.	LMS Google classroom		Printing Product - Name card - Brochures - Cut out - Newspaper
6. Assessment process	Evaluation - Take post-test to measure creativity - Inspect workpieces from online activities to check creativity during school - Analyze statistics of each type of media access in order to examine access behavior, frequency level of media access that affect creativity	Assess in LMS Statistical Analysis Website		Online post-test
7. Modify the route	- Bring the results from the evaluation in all 3 dimensions to analyze and find solutions for the highest learning efficiency - Making factual solutions - Go back to the template drafting process to improve	- Online document sharing tool - Tools that help to display the idea of a work that can use text, images, video, audio - Learning Management System (LMS) tools - Classroom website		Statistical analysis from attendance and activities

5. Analysis and Discussion

Assessing the suitability of the formats Learning Analytics of Digital Learning in Printing Production course for Education Technology to increase Creative thinking in Thailand by applying the evaluation form to 5 educational technology experts

Table 1. Results of data analysis of the suitability of the overall model

Evaluation List	Experts		Level of opinion
	$\bar{x}$	S.D.	High
History of model development	4.40	0.70	High
Process of format	4.50	0.53	High
Results of the format	4.40	0.70	High
Functional Use	4.50	0.53	High
Reflection of the format	4.50	0.53	High
Total Average	4.46	0.60	High

From Table 1, the results of the data analysis on the suitability of the formats Learning Analytics of Digital Learning in Printing Production course for Education Technology to increase Creative thinking in Thailand found that the evaluation results were at a high level in all items. The process of the format, the results of the format and the suitability of the implementation of the format have the same mean score and standard deviation which is 4.50 and 0.53 respectively.

The results of the comparison of the average score of the creative thinking before and after learning of the experimental group of 30 students

Table 2. The results of the comparison of the average score of the creative thinking scores before and after learning of the experimental group.

Components of Creativity	Level of Creativity number (%)	
	Before	after
Originality	66.25	89.34
Flexibility	45.56	78.43
Thoughtful Thinking	50.14	82.27
Vague Solutions	33.64	80.65
Resistant of Premature Closure	64.33	75.89
Independent Thinking	56.09	81.23
Convergent Thinking	45.05	88.19
Risk Taking,	34.78	86.92
Motivation	48.63	79.54
External Motivation	53.25	70.08

From Table 2, the comparison of the average scores of the pre-test and post-test of the experimental group showed that there was an increase in all components of creativity. The pre-test, Vague Solutions has the smallest mean score and Originality has the highest mean score. After experiment, the researcher found that Originality has the highest mean, and Resistant of Premature Closure has the smallest mean.

Analysis of the interaction of students' interaction with Digital Learning tools in learning activities through Learning Management System (LMS)

Table 3. Analyzing the interaction of learners' communication with Digital Learning tools

Digital Learning tools	Average time spent (%)	Number of students using (%)
PDF file	15	5
Video Instruction	45	35
Social Media	40	60

From Table 3, it is found that the analysis of the interaction of students' communication with Digital Learning tools, The tools that students using the most is Social Media, followed by Video Instruction and PDF file. Moreover, spending time in learning with Digital Learning tools found that students spend the most time on Social Media, followed by Video Instruction and PDF file.

6. Discussion and Conclusion

From the study, development in the format of Learning Analytics of Digital Learning in Printing Production course for Education Technology to increase Creative thinking in Thailand consisted of 7 steps 1. Import Data 2. Identify problem 3. Plan the concept 4. Create a prototype 5. Utilize by user 6. Assessment process 7. Modify the route, when using that format for data analysis from the suitability evaluation form of the format that has been evaluated by experts. It found that the suitability of the overall format has a high level. The average value is 4.46 and the standard deviation is 0.60 which shows that this format is suitable for applying the activities of the Printing Production course.

In addition, students have a higher creative average score by using Digital Learning Tools, which found that social media has the highest number of uses and duration It corresponds to the concept of using social media in teaching and learning**.** It is an important issue at present. Teachers can apply this information to stimulate students' interest and use it as a technique to help them achieve academic achievement (Kobwit, 2011)

Moreover, teachers must have the knowledge and capability to use these tools in factual and sustainable teaching and learning processes. The teacher understands the techniques/tactics of the tools combined with teaching strategies and creating an interesting format for that student, is very challenging for teachers (Office of Technology for Learning and Teaching, 2011), which is consistent with the results of the above research that provides empirical evidence from data collection. As well as the time period for using it with the online learning management system, then analyzed for learning (Learning Analytics) is a tool to help learning design to meet the objectives, respond and support learners for effective learning.

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Teacher Candidate Students' Perception toward Online Course Quality

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Abstract

This study determined teacher candidate students' perception of online course quality and factors impacting on their course satisfaction and perceived learning. The results showed that facilitation and instructional strategies were significant factors, and there were positive relationships between self-efficacy and students' course satisfaction and their perceived learning. The findings indicated that facilitation is an urgent area of the online course that needs to improve to enhance the quality of online education. Our research also revealed that organization, facilitation, and instructional strategies significantly affected student course satisfaction while facilitation and instructional strategies significantly impacted their perceived learning. Regarding online learning self-efficacy used as a predictor for students' course satisfaction and their perceived learning, our findings showed that confidence level positively influenced student course satisfaction and perceived learning.

Introduction

In the U.S. higher education, 29.7% of all students are taking at least one distance course. The total distance enrollments are composed of 14.3% of students (2,902,756) taking exclusively online courses and 15.4% (3,119,349) who are taking both distance and non-distance courses (Allen & Seaman, 2017). With the demands of online learning, almost 40% of administrators plan to increase their budgets in the next year, and 73% of schools decide to offer online programs based on the potential student enrollment (BestColleges, 2019; Venable, 2018). However, the rapid growth of online learning in higher education requires quality control issues (Andrade, 2015; Venable, 2018). Thus, numerous research findings pointed out areas for future investigations related to the quality of online education including the nature of course designs and design aspects (Boling, Hough, Krinsky, Saleem, & Stevens, 2012; Holzweiss, Joyner, Fuller, Henderson, & Young, 2014; Kuo, Walker, Belland, & Schroder, 2013; You, Hochberg, Ballard, Xiao, & Walters, 2014); online community and student engagement and instructional techniques (Holzweiss et al., 2014); technologies use, faculty support (i.e., knowledge, skills, and pedagogical strategies) (Boling et al., 2012); online scaffolding, quality of interactions, and instructor feedback (Rourke & Coleman, 2010). There is a lack of researches conducting the teacher candidate students regarding their perception of the quality of online courses.

Recently, the College of Education, Texas Tech University developed the Quality of Online Education (QOE) framework to guide instructors to develop quality online courses based on current online course standards and guidelines. The framework focuses on the interaction among instructors, students, and contents, and it includes six core actions between the agencies to provide meaningful learning experiences.

- ***Action 1 - Organization***: refers to an organization of the course structure and information presenting through the course (e.g., syllabus, schedule, modules, assessment, etc.) to ensure that the course is presented in a consistent way in terms of aligning course objectives, learning activities, and assessment and is to minimize barriers to students understanding and confusion.
- ***Action 2 - Instructional strategies***: refers to all teaching approaches and methods that an instructor may take to engage students in the learning process (e.g., activities, assignments, and assessments). to foster student learning and aid them in mastering their learning process.

- ***Action 3 - Assessment****:* refers to designing and creating types of assessments by using a variety of methods to assess student performance during the learning process to ensure that they achieve learning objectives and meet teaching expectations.
- ***Action 4 - Materials****:* refers to providing accurate, current, and relevant contents using a variety of media (e.g., PowerPoint, Videos, online articles) that effectively delivers important knowledge and skills and visually appeals to students.
- ***Action 5 - Facilitation****:* refers to actively monitoring students' learning progress and scaffolding their learning using a variety of available resources and technology.
- ***Action 6 - Interaction****:* refers to effective communications and collaboration between an instructor and students by using a variety of available resources and technology to construct knowledge, provide constructive feedback, and build a sense of community that appreciates multiple perspectives and supports each other's learning.

The College of Education's QOE framework represents the interrelated actions among three main agencies (i.e., faculty, students, and content) in online education environments to facilitate the faculty's implementation of quality online courses. The framework focuses on interrelations among three agencies (i.e., faculty, students, and content) that play important roles in online education. It also provides a systematic approach to the interdependent nature of online environments with a graphical representation (Agency – Action - Component [What-is] - Method [How-to]). The framework provides various practice examples for the college's instructors, and it emphasizes the importance of context (e.g., discipline, students, setting, or system) that affects learning goals and activities in online courses. However, there is a lack of research on the differences of online course quality between instructors' and students' perceptions. Also, the relationships among the six actions have not been investigated yet.

Purpose of the Study

The study determined students' perception of online course quality and factors impacting on their course satisfaction and perceived learning. It allowed us to identify online course quality discrepancies and improving areas and define factors affecting student learning and satisfaction as well as figure out define factors contribute to their outcomes. With the increasing numbers of students enrolled in online higher education settings, we saught meaningful implications on both practice and research in designing online courses through this study. Research questions include:

1. Which areas of online courses need to be improved?
2. What are predictors for student satisfaction and their perceived learning in an online course?
3. What are the relationships between online learning self-efficacy and their course satisfaction and perceived learning?

Methods

A quantitative approach was used to collect students' perception about their online courses to describe trends and compare groups using statistical analysis and interpret results to answer the research questions (Creswell & Creswell, 2018).

Sample. 246 undergraduates, 25 to 35 years old at the COE, the Southwestern University voluntarily took a survey. The participant was taking a course "*Application of Technology in Education*" which is to help them develop instructional skills associated with the use of technology as an educational and assessment tool for instruction.

Instruments. The online survey collected data from students' perception and experience in their online courses. It includes demographic information, experience, course satisfaction, perceived learning, six actions (i.e., Organization, Facilitation, Interaction, Instructional Strategies, Materials, and Assessment), online learning self-efficacy, challenges, and suggestions. The survey items used Likert scale (from 1- Strongly Disagree to 5- Strongly Agree) related to online teaching-learning aspects and open-ended questions to gather their perception about their online course. It took about 15-20 minutes to complete the survey. The survey was created, distributed, and recorded responses by using the Qualtrics system.

Data collection procedures and analysis. After obtaining permission from instructors and students, the survey link was distributed to participants through a course that they are taking. They completed the survey online, and their responses automatically recorded in the Qualtrics system. Next, the pseudonymization technique was performed to maintain students' unidentified personal identifiers. All raw data was assigned to each response in a database using SPSS 25.0 for analysis. After cleaning the database to check for data entry errors, data was recorded and computed new variables (e.g., Facilitation, Organization). It was explored to inspect trends in the data and check for the normal distribution of all constructs. The correlation and multiple regression were used to identify the relationship between six actions and online learning self-efficacy affecting students' satisfaction and perceived learning.

Results

Regarding improving areas, the results revealed that the organization (M=4.17) was the highest ratio among the QOE six actions while facilitation was the lowest level (M=3.74) (See Table 1). This finding indicated that facilitation referred to an area to improve.

Table 1. Mean Scores of Students' Perception

	N	Minimum	Maximum	Mean	Std. Deviation
Organization	264	2.50	5.00	4.1711	.60564
Facilitation	264	1.17	5.00	3.7462	.79419
Interaction	264	1.40	5.00	3.9205	.72071
Instructional strategies	264	1.20	5.00	3.8803	.83054
Materials	264	1.00	5.00	3.9545	.76975
Assessment	264	1.00	5.00	4.0019	.71246

Multiple regression analysis was conducted to test if the six actions significantly predicted participants' ratings of course satisfaction and perceived learning. For the course satisfaction, the results indicated that the set of independent variables explained 56.5% (p = .001) of the variance in the course satisfaction with three of six variables: organization (β = .234, p = .001), facilitation (β = .268, p = .001), and instructional strategies (β = .272, p = .004) having a significant influence on student course satisfaction (See Table 2). As a result, organization, facilitation, and instructional strategies had the greatest impact on course satisfaction. Interestingly, although interaction, materials, and assessment were predictors to the quality of online education (Yang & Durrington, 2010), they did not play essential roles in making students satisfied and in providing students with the authentic learning experience in their online course.

Table 2. The Results of Multiple Regression Tests Regrading Course Satisfaction

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.434	.284		-1.525	.129
	Organization	.366	.109	.234	3.345	.001
	Facilitation	.320	.099	.268	3.243	.001
	Interaction	.073	.094	.056	.775	.439
	Instructional strategies	.311	.107	.272	2.901	.004
	Materials	-.003	.107	-.002	-.027	.979
	Assessment	-.006	.116	-.005	-.055	.956

a. Dependent Variable: Course satisfaction

To perceived learning, the regression results revealed that the set of independent variables explained 62.1% ($p < .001$) of the variance in the perceived learning with two of six variables: facilitation (β = .225, p = .004) and instructional strategies (β = .250, p = .005) having a significant influence on student perceived learning (See Table 3). Consequently, our findings highlighted that organization, facilitation, and instructional strategies significantly affected student course satisfaction while facilitation and instructional strategies significantly impacted their perceived learning.

Table 3. The Results of Multiple Regression Tests Regrading Perceived Learning

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-.244	.248		-.984	.326
	Organization	.157	.096	.108	1.647	.101
	Facilitation	.251	.086	.225	2.918	.004
	Interaction	.143	.082	.117	1.738	.083
	Instructional strategies	.267	.093	.250	2.852	.005
	Materials	.012	.093	.010	.124	.902
	Assessment	.197	.101	.158	1.954	.052

Dependent Variable: Perceived Learning

Regarding online learning self-efficacy used as a predictor for students' course satisfaction and their perceived learning, correlations were conducted to test if it positively correlates to student satisfaction and perceived learning. The result showed that online learning self-efficacy and course satisfaction were positively correlated r =.632, p <.001, and they had a positive relationship with each other (See Table 4).

Table 4. The Correlation Between Online Learning Self-Efficacy and Course Satisfaction

Correlations

		Online Learning Self-Efficacy	Course Satisfaction
Online Learning Self-Efficacy	Pearson Correlation	1	.632**
	Sig. (2-tailed)		.000
	N	258	258
Course Satisfaction	Pearson Correlation	.632**	1
	Sig. (2-tailed)	.000	
	N	258	264

For the perceived learning, the result reported that online learning self-efficacy was positively correlated, r = .647, p <.001 with perceived learning, and they positively related with each other (See Table 5). Therefore, our findings revealed that confidence level positively influenced student course satisfaction and perceived learning (Alqurashi, 2017; Kuo et al., 2013; Xiao, 2012).

Table 5. The Correlation Between Online Learning Self-Efficacy and Perceiving Learning

Correlations

		Online Learning Self-Efficacy	Perceived Learning
Online Learning Self-Efficacy	Pearson Correlation	1	.647**
	Sig. (2-tailed)		.000
	N	258	258
Perceived Learning	Pearson Correlation	.647**	1
	Sig. (2-tailed)	.000	
	N	258	264

Discussion

Overall, our findings indicate that facilitation is an area to improve. The findings also show that organization, facilitation, and instructional strategies had the greatest impact on course satisfaction while facilitation and instructional strategies significantly impacted their perceived learning. Online learning self-efficacy and course satisfaction have positively relationship with each other while it also positively relates with student perceived learning.

Regarding course organization, it includes several aspects to ensure the quality of online courses involving course structure, course introduction, feedback, consistency in information delivery, relevancy, learning objectives, and technical support (Bickle & Carroll, 2003). Courses designed with facilitation increase students' performance and satisfaction by promoting interactions and collaboration. Instructors should maintain the alignments of learning objectives with the instructional methods and learning activities with the assessment. The well-organized course will reduce students' confusion.

Facilitation plays an essential role in enhancing the online course, which confirmed from previous studies (Bigatel, Ragan, Kennan, & Redmond, 2012; Ragan, 2008). It also helps students become responsible for their self-assessing and learning progress and encourages them to solve problems (Eom & Ashill, 2016; Jaggars & Xu, 2016). To increase facilitation level of student learning in online courses, instructors should provide opportunities for students to reflect on course activities (e.g., reflection journal), provide specific feedback on their assignment and activities, regularly monitor their learning progress, encouraged them to ask questions, and actively participated in online discussion by replying to students, summarizing discussion, or asking questions to students.

In terms of online learning self-efficacy, it plays a significant role in the performance of online learners (Taipjutorus, Hansen, & Brown, 2012). For example, students with a higher level of self-efficacy have better learning performance and increase their learning confidence which makes them satisfied with their learning (Taipjutorus et al., 2012). Moreover, students with higher self-efficacy are more likely to perform well and persist in online courses. The level of self-efficacy increases when they successfully complete their activities (Alqurashi, 2017). To increase students' online learning self-efficacy, instructors can build up student self-efficacy with supportive communication and constructive feedback to guide them through the tasks and activities and motivate them to through challenge projects to boost their best effort to achieve the learning goal. They are also positive and supportive to students to continue participating in the online course.

Conclusion

The study determined students' perception of online course quality and factors impacting on their course satisfaction and perceived learning. The research findings showed that facilitation is an urgent area of the online course that needs to improve to enhance the quality of online education. The findings also revealed that organization, facilitation, and instructional strategies significantly affected student course satisfaction while facilitation and instructional strategies significantly impacted their perceived learning. Regarding online learning self-efficacy used as a predictor for students' course satisfaction and their perceived learning, our findings revealed that confidence level positively influenced student course satisfaction and perceived learning. Therefore, it is important for instructors to design well-structured courses, maintain regular communication and presence in their courses, and promote student engagement. This can lead to greater student perceptions of learning and satisfaction. The practical implication of this study identified key components of high-quality online courses based on the instructors' and students' perceptions to improve the quality of online courses. We believe that this research generated useful knowledge on how to design and develop online courses based on the QOE framework (six actions) which provide students with the authentic learning experience and promote their learning satisfaction in the online environment.

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Dropout in Open and Distance Learning: Active and Passive Learners

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Keywords: Open University, Anadolu University, Dropout, Passive Learners, Active Learners

Abstract

One of the issues in the field of open and distance learning has been the dropout rate. However, due to the flexible nature of open and distance learning, a great deal of studies that focused on dropout rate was criticized. This paper intended to elaborate the dropout issue by using the Anadolu University's distance education system as a case. One of the important points that this paper focuses on the concepts 'active learner' and 'passive learner' that usually do not seem in face-to-face settings.

Introduction

Open and distance learning is a structure based on self-learning and leaving the responsibility of learning to the individual to a large extent (Holmberg, 2005). Learners are responsible for their own learning experiences. They may encounter different challenges during the learning process and may have to drop out. Dropout is an important problem in terms of open and distance learning.

In the literature, there are many definitions regarding dropout. The students, who prefer other educational institutions, leave their institutions or end their educations due to economic, social or family-related reasons while their educations are still continuing, are defined as dropout students (Chen, 2008). According to Cheung and Kan (2002), the students, who drop out, are defined as the individuals who officially leave the school, leave without informing the school or cannot continue to a department during a term. According to another definition, the dropout students are the ones who voluntarily leave the department after paying the tuition fee and completing add/drop procedure (Kaplan, Peck and Kaplan, 1997). Although it is known that learners are willingly enrolled in open and distance learning, the dropout rate is higher compared to traditional education (Moore and Kearsley, 2005). When the literature is examined, the dropout rates in open and distance learning programs are between 25% and 40% (Lee and Choi, 2011). In this field, a great number of studies have been conducted on the reasons of dropout rather than identifying who are the dropout students. In the literature, a different definition for Dropout was made and "theoretical break" was used. This definition is based on the probability of students not continuing a specific academic programme following several consecutive semesters of "theoretical break", and is highly adaptable to institutions offering distance education with no permanence requirements, that is ones offering the possibility of taking breaks (Grau-Valldosera & Minguillón, 2014).

However, there are the concepts of 'active learner' and 'passive learner' which are used in open and distance education systems but not used for face-to-face education. In the institutions providing education through open education, it can be stated that the concepts of active and passive learner should be discussed together with the concept of dropout.

Open education is used for the practices that provide large masses with the opportunity of internet-supported and relatively low-cost education (Aydın, 2011). In the broadest sense, open university refers to the elimination of all possible political and practical obstacles to reach learning resources. It is an instructional approach that does not have a time and space limitation, is based on self-learning of learners, is supported by open sources, and in which the support of instructors is obtained when needed (Distance Education Dictionary, 2019). In Turkey, Anadolu University is among the mega universities in terms of the number of open education students. An important problem of distance education institutions is dropout. Examining the number of dropout students in open education faculties in Turkey in terms of dropout will shed light on the subject of active-passive learners of open universities. In this research, the status of active and passive learners receiving open education in Turkey was examined within the scope of dropout.

Open Education Enrollment Types

In this section, how students are admitted to open education faculties in the Turkish higher education system was examined before addressing the definition of the concepts of active learner and passive learner. According to the data of September 2019, there are totally 207 universities in Turkey. 129 of them are state universities while 78 of them are foundation universities (Higher Education Information Management System, 2019a). Three of these universities incorporate open education faculties. In the higher education system, there are different types of enrollment for the candidates who want to enroll in open education faculties. These types can be listed as SSPS (Student Selection and Placement System) new student enrollment, vertical transfer, lateral transfer, second university and degree completion.

The most known way to receive education in the higher education system in Turkey is the Central Placement Examination. Candidates are required to take transition to higher education examination conducted by the Center of Assessment Selection and Placement (CoASP). A similar situation is in effect for both face-to-face and open education. Student quotas of open education faculties are determined by the Council of Higher Education (CoHE).

According to the examination conducted by CoASP, the candidates, who have graduated or will graduate from at least a high school or an equivalent school, need to take the Higher Education Institutions Examination in order to gain the right to new enrollment (CoASP, 2018). For the candidates taking the examination and receiving the required score for making a selection among the associate degree and undergraduate programs, the department and program lists of the open education faculties are published and selection procedures are followed. According to the results of the placement to be performed by CoASP within the quotas specified by CoHE, the right to new enrollment is gained. Following the placement, enrollment procedures are completed within the announced dates. Additional placement procedures are applied for the candidates who cannot be placed in any program in line with the available quotas. Similarly, the selection and placement results are announced, and the new enrollment process is completed.

Another method to gain the right to studentship in open education faculties is the enrollment through vertical transfer. Candidates, who want to continue their undergraduate education after graduating from Vocational Schools and Open Education Faculty associate degree programs, can enroll through vertical transfer. Candidates are required to take the Vertical Transfer Examination conducted by CoASP. After the examination, selection and placement procedures are applied as in the Higher Education Institutions Examination.

In the enrollment through lateral transfer, transition to open education associate and undergraduate degree programs from formal programs can be performed within the framework of certain legislations and codes of practice between associate and undergraduate degree programs in higher education institutions.

Enrollment within the scope of second university is for the graduates of any higher education program and students who are still receiving education. Within the scope of second university, students who have graduated from or are studying in an undergraduate program can enroll in associate degree or undergraduate programs, and students who have graduated from or are studying in an associate degree program can only enroll in associate degree programs. Enrollments to open education undergraduate completion programs are carried out by the Council of Higher Education (CoHE, 2018) through central placement.

The Concepts of Active and Passive Learner

In this section, the concepts of "active learner" and "passive learner" used for open universities are discussed. These concepts are not generally used for face-to-face education In Turkey, the students, who have an enrollment in the open education system and perform course enrollment in the relevant education term, are called "active learners". Those, who do not perform course enrollment in the relevant term despite of having an enrollment and do not have the right to studentship, are called "passive learners".

Termination of the education by students is only possible with disenrollment according to the higher education legislation in Turkey. Disenrollment is only related to the student's own request (petition), disciplinary action or period of study. The periods of education are clearly stated in the Law No. 2547. The 44th clause of the Law No. 2547 is as follows (Legislation Information System, 1981, pp. 5370–1). “Students, except for one-year foreign language preparatory class, by starting from the term in which the courses related to the enrolled program are provided and regardless of whether they have enrolled for each term, have to complete the two-year associate degree programs in maximum four years, four-year undergraduate programs in maximum seven years, five-year undergraduate programs in maximum eight years and six-year undergraduate programs in maximum nine years. The maximum period of the preparatory education is two years.”

In the related law, the section related to the exmatriculation of students is as follows (Legislation Information System, 1981, pp. 5370-1). “Students will not be exmatriculated due to non-payment of the contribution or tuition fee within the maximum periods. However, exmatriculation of students can be performed due to the decision of the authorized boards of the university and the approval of the Council of Higher Education because of non-payment of tuition fees and non-renewal of enrollment for four consecutive years.”

In the last sentence of the clause c and paragraph 3 of the article 44, it is stated that “Open education students are not limited to these periods provided that they benefit from their studentship rights”. Regarding the legal basis, the disenrollment or exmatriculation process of the students is not performed by the institution.

By force of legal obligations, universities do not perform disenrollment process. If the student does not voluntarily disenroll, his studentship continues. This approach is very attractive for learners. They can continue their education as an "active learner" at any time they reenroll for any term. It can be stated that it is a model applied in the context of the openness philosophy. However, this process increases the number of the student group called "passive learner".

Traditional universities continue to transform some of their face-to-face courses into a form of distance education. There are also higher education programs where all courses are performed distantly. However, an important problem of distance education is the high dropout rates. At this point, open universities can be addressed differently from the traditional universities. In Turkey, Anadolu University is among the mega universities in terms of the number of open education students. Examining the number of dropout students of open education faculties within the scope of dropout will shed light on the subject of “active learners” and “passive learners” of open universities.

Purpose and Research Questions

The purpose of this research is to reveal the status of open education active and passive learners within the scope of dropout in open and distance learning. In this research, the answers of the following questions were searched for.

1. What is the rate of the number of open education students to the total number of higher education students?
2. What is the change in the total number of open education students by years?
3. What is the change in the number of active and passive open education learners by years?
4. What is the change in the number of new enrollment students in open education by years?

Method

This study is a descriptive research designed according to screening model. Since the status of open education active and passive learners were tried to be analyzed in this research, descriptive screening model was used. Screening models are research approaches that aim to describe a situation existing in the past or still as the way it exists. In this research, the numbers of open education active and passive learners and their changes by years were examined within the scope of dropout.

In order to observe the changes in the numbers of students in the higher education system, the data in the Higher Education Information Management System of the Council of Higher Education (CoHE) were used. The data obtained are limited to the data reached between 2014-2015 academic year and 2018-2019 academic year.

In the research, the data included in the CoHE Higher Education Information Management System (Higher Education Information Management System, 2019b) and the page of Anadolu University Student Numbers (Anadolu University, 2019). The numbers of active and passive open education learners were reached from the university web page. The obtained data were analyzed and presented in tables.

The numbers of Open Education students between the 2014-2015 and 2018-2019 academic years were converted to table format. Graphs were used to emphasize the change in the number of students by years. In the analysis of the data, numbers and percentages were used and visuality was enabled. The change in the number of active learners, change in the number of passive learners, change in the total number of students and change in the number of new enrollment students were summarized in tables and graphs. The changes in the number of open education students were analyzed by years and findings were created.

Findings

In the numerical change in the open education faculties of Turkey, the number of new enrollment students is an important factor. In each academic year, new students are accepted based on different enrollment types. The total number of the new enrollment students between 2015-2018 are given in Table 1 by years (Okur, 2019).

Table 1. The Number of new students enrolled between 2015-2018 to Open Education Faculties

2015	520.907
2016	585.484
2017	486.939
2018	512.817

According to the data obtained, it is seen that approximately 520 thousand students enrolled to open education faculties between 2015-2018 every year. The concept of New Enrollment is used for all students who enroll for the first time within the scope of new enrollment, vertical transfer, lateral transfer, second university and degree completion.

In Turkey, the total student number of face-to-face and open education faculties enrolled in the higher education system at associate and undergraduate degree is 7.250.129 by July (Higher Education Information Management System, 2019b). The total numbers of open education active-passive learners of universities and their rates by the numbers of students in higher education are shown in Table 2.

Table 2. Percentage of Open Education Students by the Number of Students in Higher Education

Total Number of Students in Higher Education	7.250.129
Total Number of Students in Open Education Faculties	3.889.506
Rate by the Number of Students in Higher Education	53.64%

The numbers in the table include the total number of active and passive learners of universities. The students, who have an enrollment in the open education system and make course enrollment in the relevant education term, are called "active learners". Those, who do not enroll in any course in the relevant term even though they have an enrollment and do not have the right to studentship, are called "passive learners". By force of the relevant law, the enrollments of students are not deleted due to their education periods. In Turkey, there are 3.889.506 open education students enrolled in the higher education system (Higher Education Information Management System, 2019b). The total rate of the open education faculty students by September 2019 constitutes 53.64% of the higher education system in Turkey.

Only the numbers of students are included in the Higher Education Information Management System. Active or passive information of open education students is not included. The numbers of active and passive learners can only be learned through the corporate websites of the universities. It was determined that only the numerical data of Anadolu University Open Education System students were shared among the universities having open education faculties. The number of passive learners enrolled in the Anadolu University open education system is 2.464.412 by March 2019 (Anadolu University, 2019). In Figure 1, the distribution of Anadolu University Open Education System students by active-passive years is visually summarized.

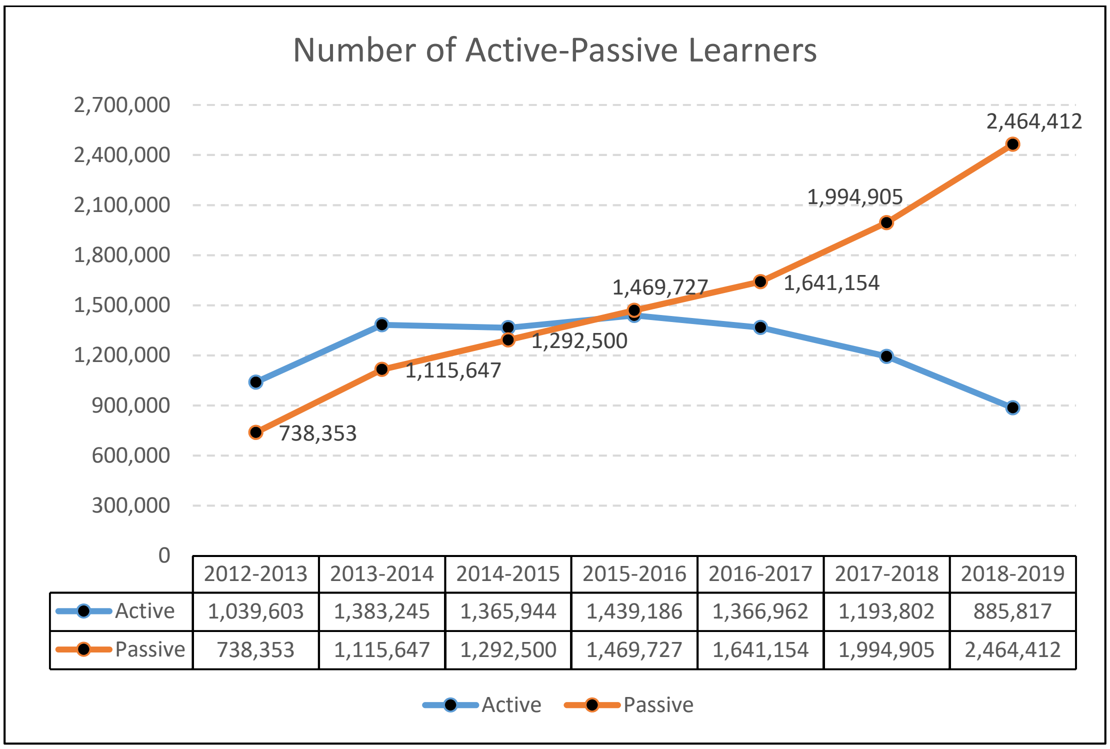

Figure 1. Distribution of the numbers of active-passive learners in open education system by years

In the light of the data obtained, it is seen that the open education passive learner rate in Turkey has a tendency to continuously increase by years. This is seen as an important and significant problem that needs to be addressed. It is clear that the reasons of students for being passive should be examined in institutional terms.

Enrollment through Second University provides the candidate students with the opportunity to enroll in the open education faculty without examination. The graduates of any higher education program and students who are still studying can enroll in open education within the scope of Second University without taking any examination. It is a very important and attractive enrollment type within the scope of lifelong learning. Table 3 shows the number of new enrollment students according to the second university enrollment type by years (Open Education Faculty, 2019).

When Table 1 and Table 3 analyzed together, it is seen that the majority of the students who newly enrolled to higher education system in Turkey are included within the scope of second university. Second university is a type of enrollment that provides lifelong learning for individuals graduating from any higher education program. When Table 3 is examined, it is seen that student interest has increased in this context.

Table 3. The numbers of students enrolled within the scope of Second University between 2015-2018

2015	135.429
2016	136.121
2017	180.996
2018	224.859

Conclusion

In Turkey, students are admitted to the open education system at higher education level under different enrollment types. Particularly in the context of lifelong learning, it is seen that enrollment within the scope of second university is prominent. According to Table 1, every year approximately 520 thousand new students enroll in open education faculties. However, as seen in Figure 1, there is an increase in the numbers of passive learners in the face of these high new enrollment figures. Dropout is an important problem of the distance education system.

Mega universities have large rates in terms of student numbers. In these structures, which offer a mass education, passive status of students is a situation that needs to be considered. A passive learner can become an active learner by enrolling again in the relevant term. This procedure is very simple. It is a structure that is very appropriate to the philosophy of openness. Therefore, passive learners in open universities need to be handled differently from dropout in distance education practices. Regaining dropout students is relatively difficult compared to passive learners. However, open universities can develop ways to regain by making strategic moves on passive learners. It can be stated that with different studies, the reasons for being a passive learner should be determined and solutions should be developed in this regard.

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Identification of the Nature of Educational Technology as a Field

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Abstract

This study demonstrates that longitudinal quantitative analyses outside the established publication record (peer-reviewed journals) in shared communities of practice exhibits empirical regularity with persistent patterns of lognormal distribution. Bibliometric data was collected from the AECT Conference Proceedings in order to visually map communication through co-citation and validate Educational Technology as a scientific specialty. The nature (nodal development, seminal works, leading institutions, and researchers at the research front) of educational technology was determined.

Introduction

Where does scientific specialty begin? How and when do scientific specialties emerge in a discipline? At what point in development does a specialty become a field or a discipline in and of itself? Identifying the nature of scientific specialties is a fundamental challenge for information science. Morris and Van der Veer-Martens (2008) break scientific specialty into three components for the purposes of modeling: researchers, base knowledge, and formal literature thereby representing the social, cognitive, and communitive processes in a specialty. When scientific specialty is studied in information science, researchers are studied through citation practices, the knowledge base is studied through content analyses, and communication is studied through co-citation and bibliographic coupling.

Indeed, co-citation studies of peer-reviewed journal articles recorded in scientific databases, such as Web of Science, are the most common methodology used to identify science and make informed purchasing, tenure, and science policy decisions; but are they the most effective way to identify scientific specialties? “In a global citation analysis, the researcher examines how often a particular publication or a selection of discipline-specific publications are cited without regard to the citing authors’ institutional affiliations or geographic regions” (White 2019). Not every bit of science is written about and published in traditional scientific journals indexed in traditional databases. Conversely, local citation studies focus on the citation habits of users affiliated with a particular institution and studies of this nature demonstrate a high percentage of coverage of faculty citations within affiliated libraries employing this methodology. In short, we buy or provide access to the science that our faculty write about and cite. This phenomena may not provide insight about emerging specialties. Further, with the expanding opportunities to publish outside peer-reviewed journals, especially for technology related fields, a general absence of specialty emergence may occur within a local library collection or global indexes. A method to study scientific specialties that coalesce outside the established publication record should be considered.

Theoretical Background

Kuhn’s seminal work, *The Structure of Scientific Revolutions,* emphasized the importance of community in the development of science in that paradigmatic development occurs with shared practices of inquiry. Science, in its purest iteration, is a shared social practice and depends on a shared professional context or “selection environment” (Leydesdorff, Wagner, & Bornmann, 2018). “Research specialties consist of relatively small self-organizing groups of researchers that tend to study the same research topics, attend the same conferences, publish in the same journals, and also read and cite each other’s research papers” (Morris & VanderVeer-Martens, 2008, p.213).

According to Rons (2018), “Sufficient bibliometric focus at the specialty level requires an aggregation of publications that is more fine-grained than the broad subject categories grouping interrelated journals that form the backbone of commonly used global publication and citation indexes” (p. 114). Global publication and citation indexes overlook some publications until such time that the publication has sufficient global appeal. Conference proceedings, which are not often indexed in global indexes, provide a set of publications that focus on the interactions of a self-organizing research community that are often overlooked but provide a sufficient oeuvre for the identification of scientific specialties in that conference proceedings provide a view at the convergence of community.

The goal of this study was to conduct bibliometric analyses of a non-traditional oeuvre from a self-organizing group of researchers--conference proceedings--in order to inform about its nature as a specialty by measuring its growth through lognormal distribution and visually mapping its development through network analysis as a knowledge domain.

Methods

Scientific specialties form communities of practice most often with a convergence of the community in technology sectors through conference attendance. The Association for Educational Communications and Technology (AECT) is an international organization of instructional/educational technologists and researchers that has published its annual conference proceedings since 1979. These conference proceedings provide 35 years of published papers in this specialty that were not indexed in traditional journal databases and therefore provide an overlooked knowledge domain worthy of study for the identification of the nature of this scientific specialty.

Bibliometric indicators were extracted and collected into custom databases for truncation into Characteristic Scales and Scores (CSS), co-citation analyses, and multidimensional graphing. Mean citation rates and distribution were calculated in 5-year sets. The application of the CSS method took into account the full set of citation counts where all authors were considered equal. Lognormal distribution was iteratively generated following a specific parametrization where the CSS algorithm was applied to each sample and the values were identified at the point of convergence.

Co-citation was tracked in custom databases in 5-year dispersions in order to conduct visual network analysis. Gephi 0.9.2 software was used to create multidimensional graphs to identify developmental and incremental change within the knowledge domain with the purpose of understanding the developmental pattern of the specialty.

Results

The researchers, seminal works, and the formal literature in each data set were identified and exhibit indicators for decision making. Table 1 represents the most cited authors within the thirty-year studied span and the knowledge base of Educational Technology. Gagne, Hannafin, Jonassen, Dwyer, and Reigeluth were the most cited authors over the 30 year period.

Table 1. Authors Representing the Knowledge Base

1979-1984	**1985-1989**	**1990-1994**	**1995-1999**	**2000-2004**	**2005-2009**
Dwyer	Tennyson	Jonassen	Gagne	Jonasson	Jonassen
Witkin	Gagne	Gagne	Jonassen	Reiguluth	Mayer
Salomon	Clark	Hannafin	Hannafin	Mayer	Garrison
Gagne	Hannafin	Reigeluth	Keller	Duffy	Anderson
Snow	Salomon	Ross	Reigeluth	Hannafin	Ertmer
Paivio	Merrill	Tennyson	Collins	Keller	Sweller
Cronbach	Anderson	Salomon	Duffy	Gagne	Reigeluth
Goodenough	Snow	Merrill	Brown	Dick	Archer
Clark	Reiguluth	Mayer	Dick	Bandura	Hannafin
Winn	Witkin	Keller	Dwyer	Collins	Bandura
Levin	Dwyer	Johnson	Ross	Clark	Keller
Fleming	Ross	Dwyer	Salomon	Ertmer	Pintrich
Simonson	Kulik	Clark	Klein	Wenger	Schunk
Levie	Mayer	Johnson	Johnson	Bonk	Wenger
Ausubel	Winn	Wittrock	Johnson	Moore	Bonk

Travers	Kulhavy	Carrier	Merrill	Gunawardena	Duffy
Lamberski	Rakow	Briggs	Hooper	Richey	Klein
Merrill	Heinich	Morrison	Sullivan	Sweller	Vygotsky
Karp	Levin	Rieber	Wilson	Becker	Moreno
Berry	Rieber	Collins	CTGV	Carey	Gunawardena
Mayer	Levie	Brown	Slavin	NCES	Brown
Oltman	Briggs	Dick	Briggs	Schunk	Zimmerman
Allen	Canelos	Kulik	Morrison	Wilson	Bruner
Briggs	Phillips	Winn	Wager	Salomon	Bransford

Seminal Works are represented in Figure 1. The most influential reference work of the period studied was *Principles of Instructional Design* by Gagne and Briggs with over a twenty-five-year span of influence. Two other titles influential over a twenty-year span were *The Conditions of Learning* by Gagne, and *Instructional Design Theories and Models: an Overivew of Their Current Status* by Reigeluth.

Figure 1. Timeline of Seminal Works and Their Span of Influence

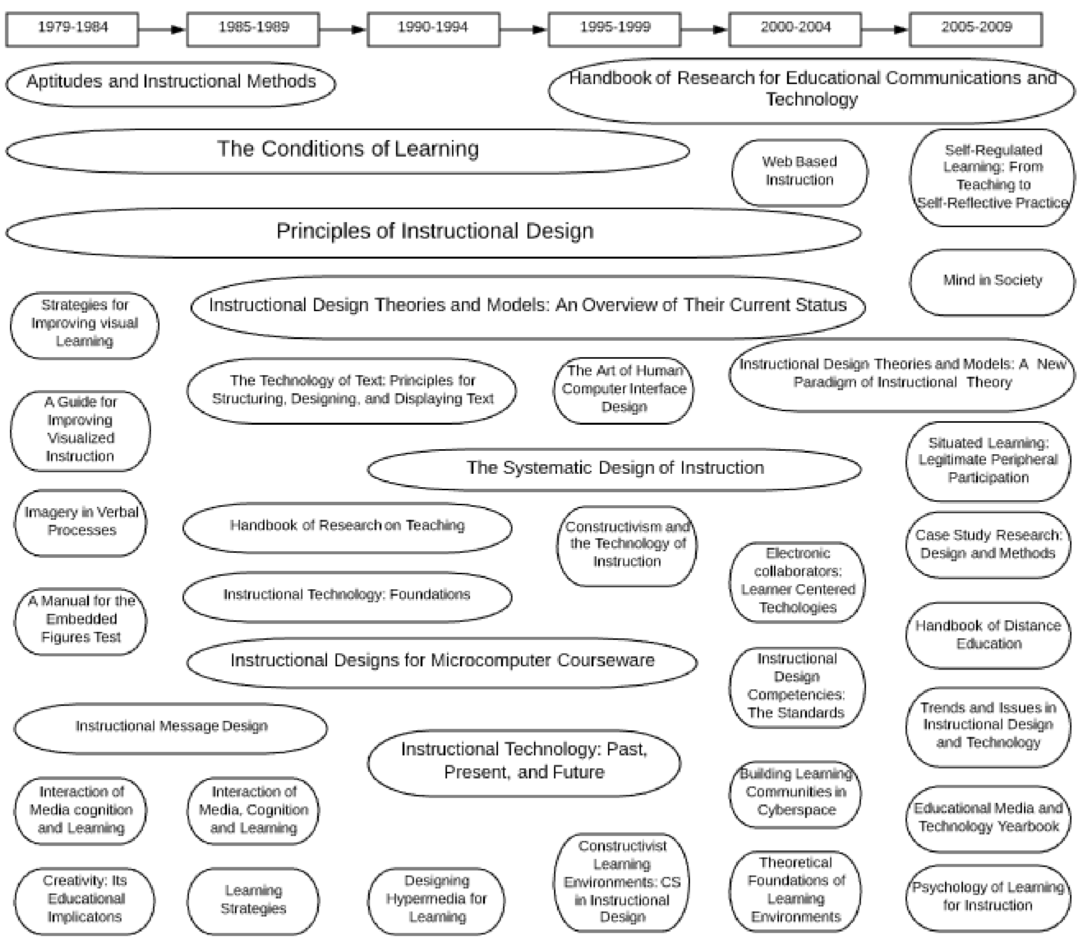

Figure 1. Timeline of the most cited Reference Works presented in linear scale over the division of the data subsets with each Reference Work title orb indicating span of influence. Created with Online Diagram Software & Visual Solution | Lucidchart. Copyright 2018 by www.lucidchart.com.

Table 2 represents the most cited academic publications within the thirty-year span of Educational Technology represented in this knowledge domain.

Table 2. Most Cited Academic Publications (Formal Literature)

Variable	**All Journal Citations N=48,063**
J OF EDUCATIONAL PSYCHOLOGY	2075
EDUCATIONAL TECHNOLOGY	1471
ETR&D	1393
REVIEW OF EDUCATIONAL RESEARCH	930
ECTJ	657
AV COMMUNICATIONS REVIEW	602
J OF EXP PSYCH: HUMAN LEARNING & MEMORY	495
EDUCATIONAL RESEARCHER	487
J OF COMPUTER BASED INSTRUCTION	462
AMERICAN EDUCATIONAL RESEARCH JOURNAL	332
J OF INSTRUCTIONAL DEVELOPMENT	309
THE AMERICAN J OF DISTANCE EDUCATION	285
INSTRUCTIONAL SCIENCE	283

Lognormal Distribution

Characteristic Scales and Scores (CSS) offered a straightforward measure for benchmarking the citation performance of individual authors in relation to their peers and the overall population based on a common framework of algorithmically constructed performance classes. This methodology relied on "a recursive procedure of iteratively truncating a sample according to mean values from the low-end up to the high-end" (Glanzel 2011, p.42). While citation studies have relied on the Pareto Distribution (80/20 rule) since the 1960's, a recent study by Viiu (2018), found that "irrespective of scientific field and citation window, CSS tend to uncover an extraordinarily stable distribution of papers across predefined classes of citedness. Virtually all fields of science are shown by CSS to be fundamentally similar in that they share an approximate 70-21-6-3% distribution (Viiu, 2018, p.402) Evans, Hopkins, and Kaube (2012) confirm this claim at the level of a specific research institute, at the sub-level of departments, but also for data from the arXiv eprint archive. Perianes-Rodriguez and Ruiz-Castillo (2016) also verify this distribution at as a universal claim at the institutional level. While three performance classes were employed in this study, CSS identified a lognormal distribution.

Table 3. Citations by Dataset

Subset	**5 or more Citations**	**2 to 4 Citations**	**1 Citation**
1979-1984	10(5%)	37(20%)	141(75%)
1985-1989	16(7%)	45(19%)	176(74%)
1990-1994	16(4%)	99(25%)	278(72%)
1995-1999	13(3%)	106(23%)	345(74%)
2000-2004	27(3%)	256(28%)	635(69%)
2005-2009	22(3%)	174(24%)	518(73%)

Network Analysis

According to Citron and Way (2018), “Co-authorship networks are a measureable representation of the communities that assemble in order to work in a particular area of research (p. 181). In network theory, centrality focuses on the interaction between individual participants within a network. Between-ness Centrality (BC), the most prominent measure of centrality in network analysis, measures the relative number of times that a node (individual participant) is part of the shortest distance (the co-citation connection) between nodes (individual participants) in a network (Leydesdorff, Wagner, & Bornmann, 2018). Figures 2-8 represent a diagrammatical representation of the authors in terms of influence during each data set employ Between-ness Centrality to display co-citation connections and, taken as a series, demonstrate growth. A topological transition was apparent between datasets demonstrating the communication interactions of a mature scientific specialty or field.

Figure 2. Data Subset 1979-1984 Cocitation Network Analysis of the Most Influential Authors

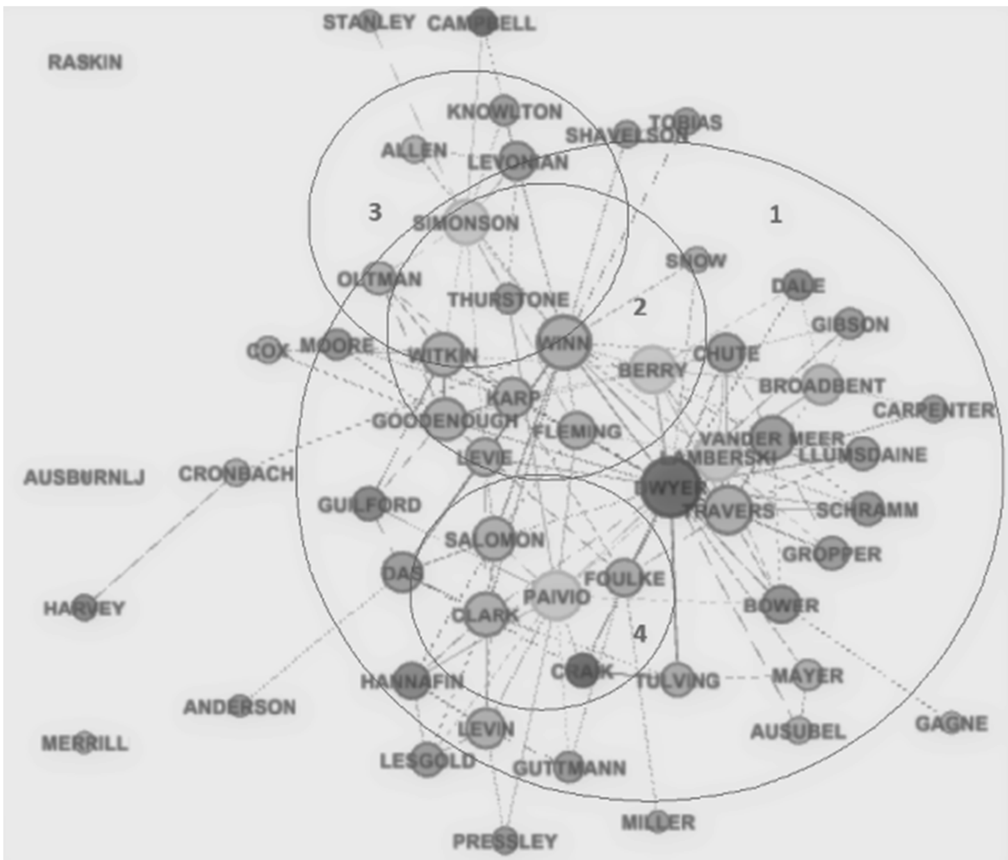

Figure 2. A bibliometric multi-dimensional map of the author cocitations from the Data Subset 1979-1984 from the Conference Proceedings of the AECT. Visualized with Gephi 0.9.2 software employing the Yifan Hu algorithm.

Figure 3. Data Subset 1985-1989 Cocitation Network Analysis of the Most Influential Authors

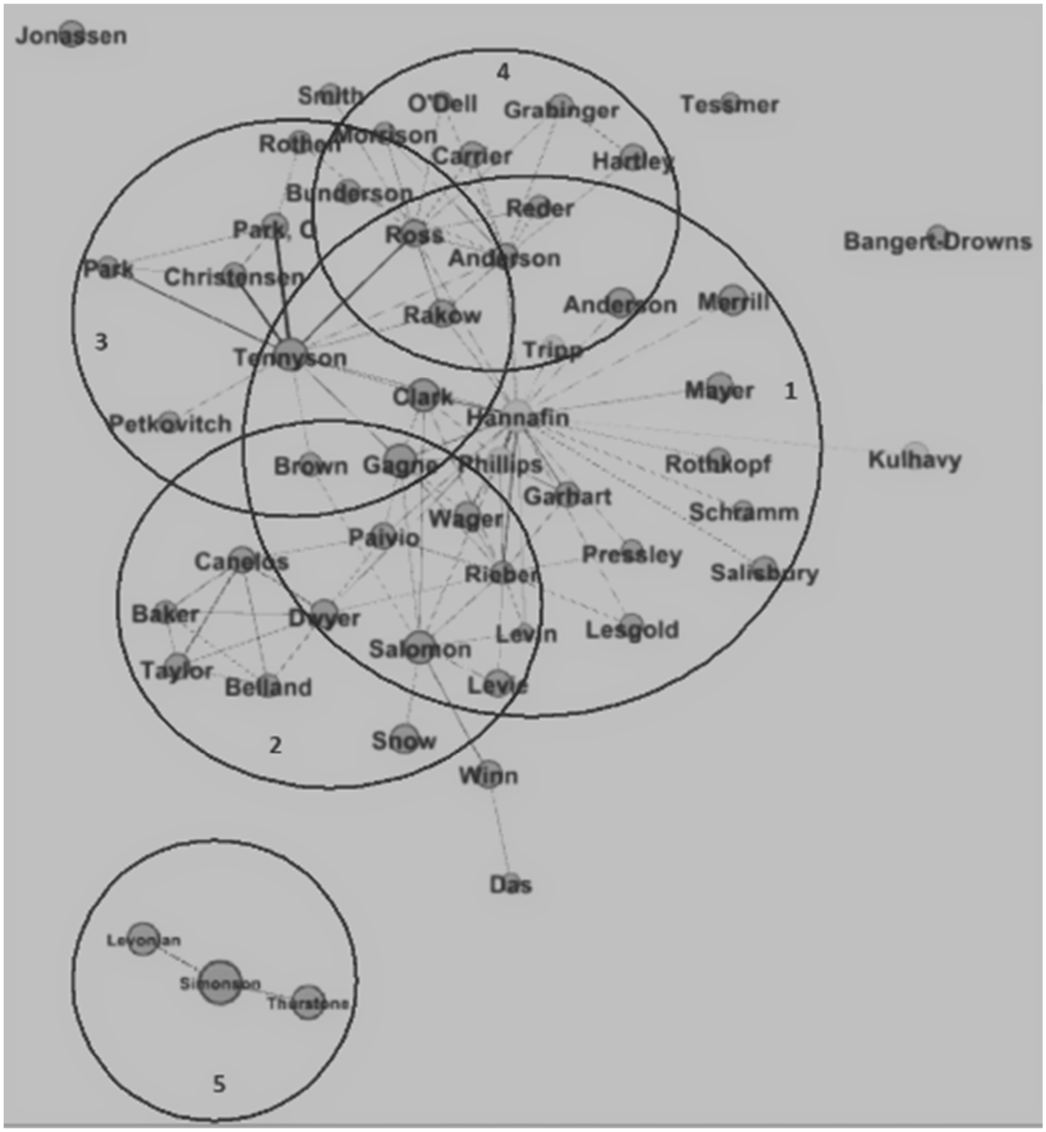

Figure 3. A bibliometric multi-dimensional map of the author cocitations from the Data Subset 1985-1989 from the Conference Proceedings of the AECT. Visualized with Gephi 0.9.2 software employing the Yifan Hu algorithm.

Figure 4. Data Subset 1990-1994 Cocitation Network Analysis of the Most Influential Authors

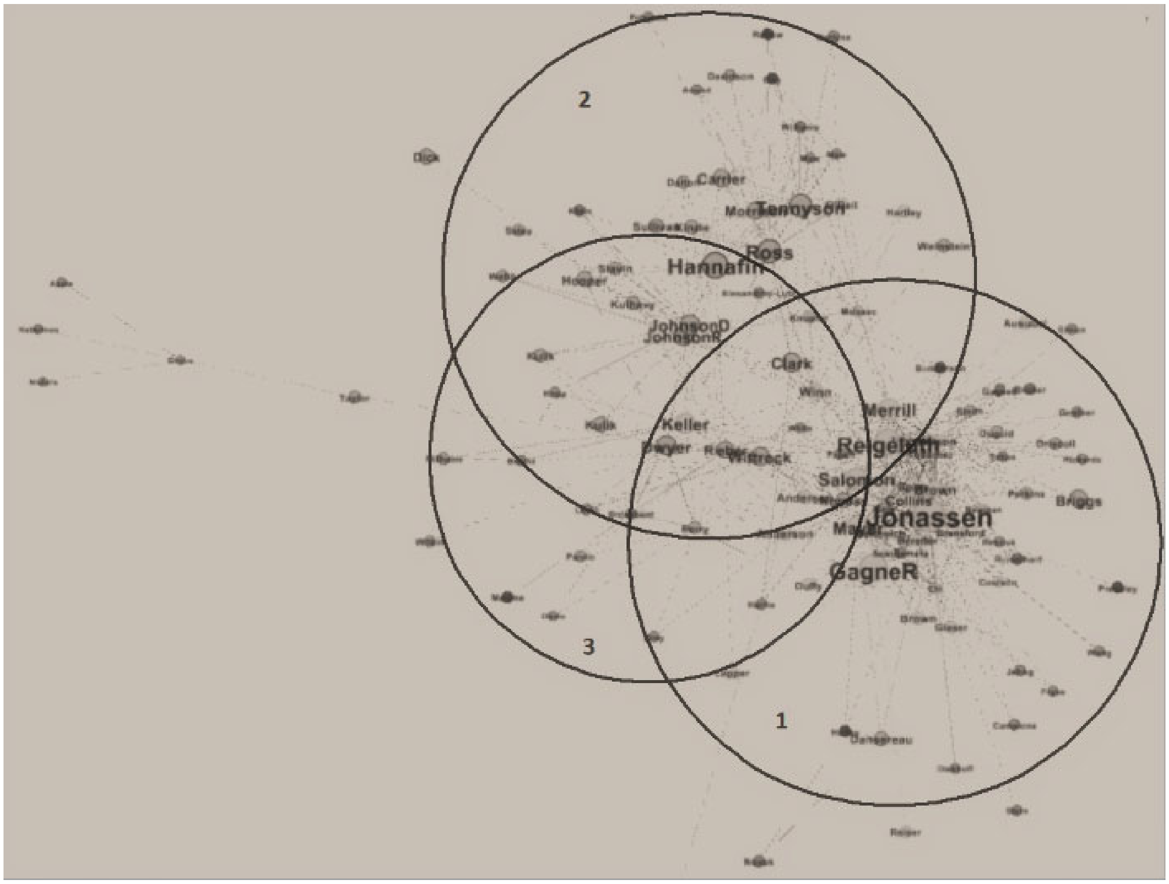

Figure 4. A bibliometric multi-dimensional map of the author cocitations from the Data Subset 1990-1994 from the Conference Proceedings of the AECT. Visualized with Gephi 0.9.2 software employing the Yifan Hu algorithm.

Figure 5. Data Subset 1995-1999 Cocitation Network Analysis of the Most Influential Authors

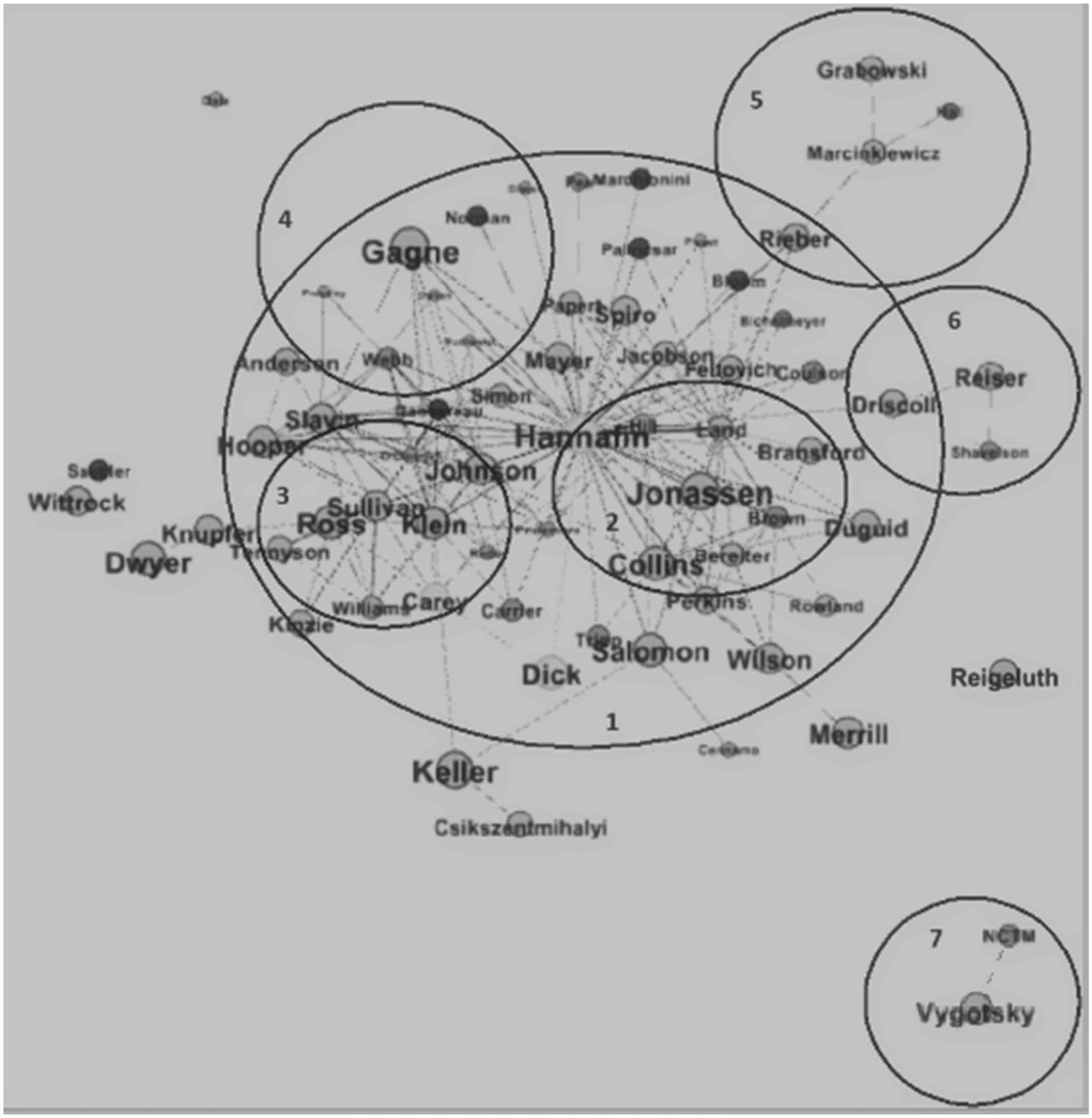

Figure 5. A bibliometric multi-dimensional map of the author cocitations from the Data Subset 1995-1999 from the Conference Proceedings of the AECT. Visualized with Gephi 0.9.2 software employing the Yifan Hu algorithm.

Figure 6. Central Embryonic Cluster of Data Subset 2000-2004 Cocitation Network Analysis of the Most Influential Authors

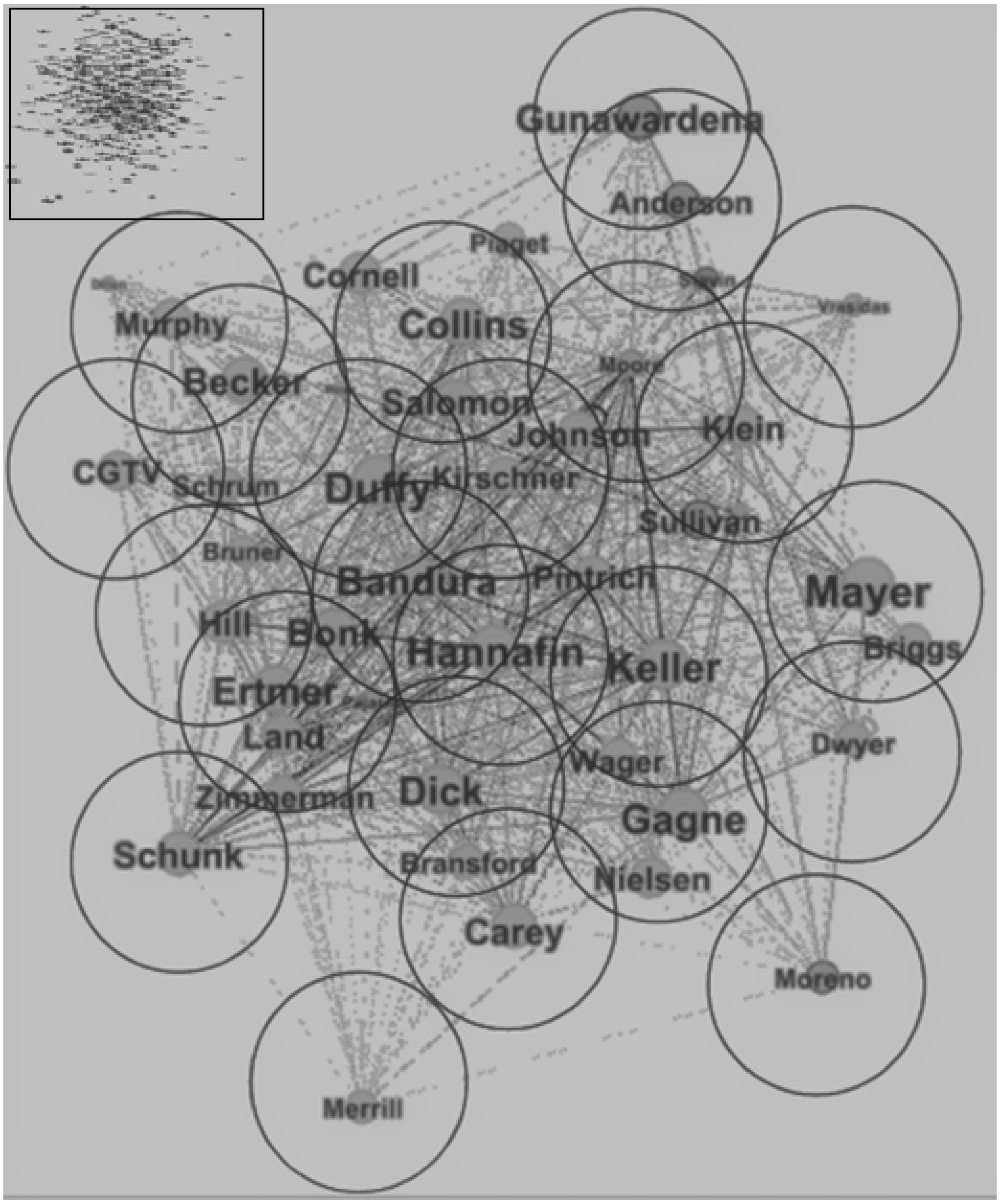

Figure 6. A bibliometric multi-dimensional map of the author cocitations from the Data Subset 2000-2004 from the Conference Proceedings of the AECT. Visualized with Gephi 0.9.2 software employing the Yifan Hu algorithm.

Figure 7. Data Subset 2005-2009 Cocitation Network Analysis of the Most Influential Authors

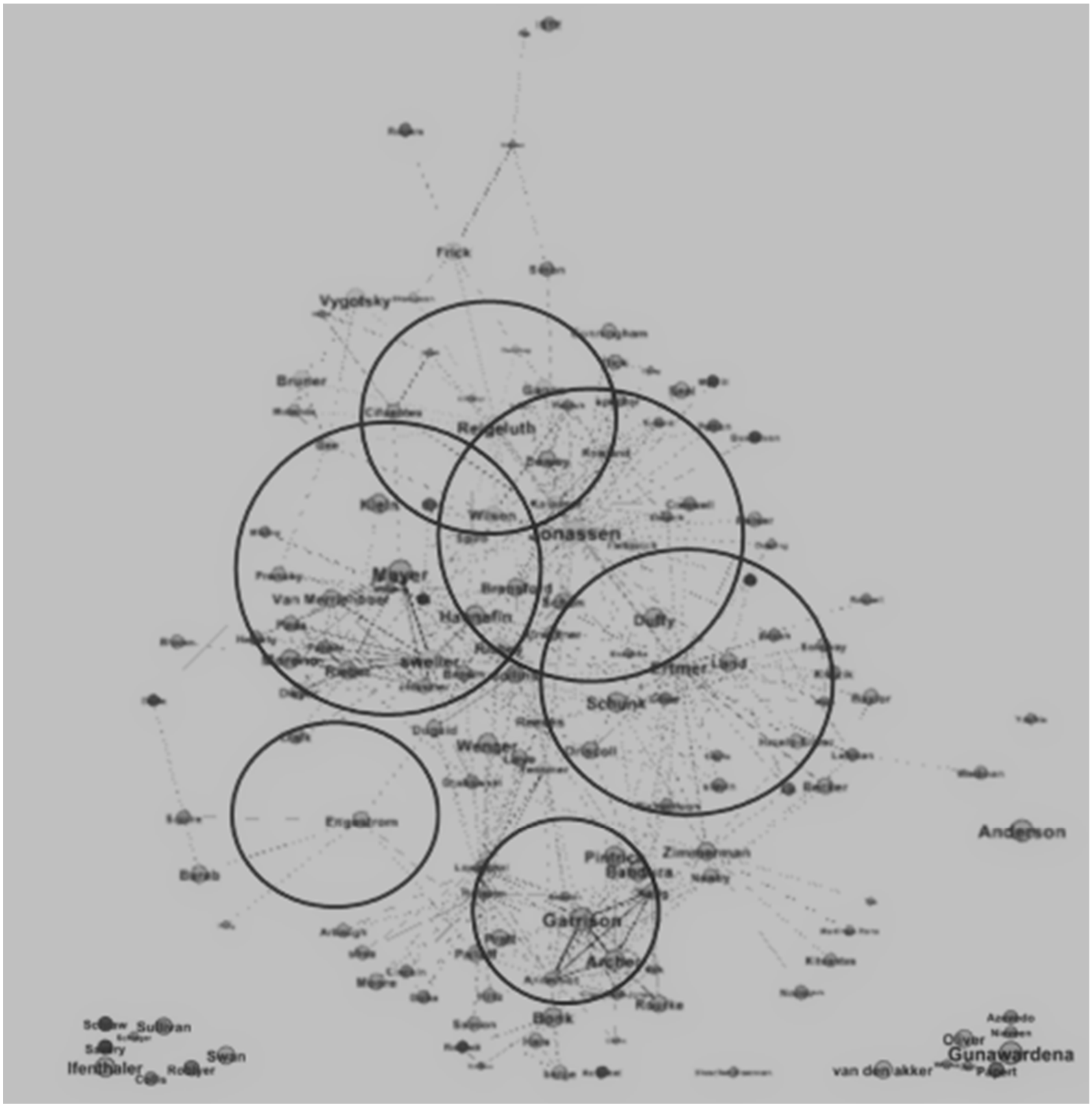

Figure 7. A bibliometric multi-dimensional map of the author cocitations from the Data Subset 2005-2009 from the Conference Proceedings of the AECT. Visualized with Gephi 0.9.2 software employing the Yifan Hu algorithm.

Conclusion

The nature of scientific specialties can be identified in knowledge domains outside of the traditional publication record of global indexes. "Disciplinary communities have been described as tribes each with its own norms, categorizations, bodies of knowledge, sets of conventions, and modes of inquiry, which compromise a recognizable culture" (Hyland & Salager-Meyer, p. 311). This study provided on one level a simple working model of specialty identification at the convergence of community that included the network of researchers, the base knowledge, and the specialties' formal literature.

On another level, specialty identification was confirmed by the lognormal distribution of Characteristic Scales and Scores. Virtually all fields of science are shown by CSS to be fundamentally similar and the presence of CSS 70-21-9% distribution of citation counts within the conference proceedings as the knowledge domain representing Educational Technology confirms the presence of a scientific specialty or field.

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Multimedia, Social Presence, and Message Design Preferences in Online Classes: “If You Were an Online Student, Which of These Videos Would You Prefer?”

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Keywords: Online learning, multimedia design, social presence

Abstract

There are many ways instructors and instructional designers can design and develop multimedia for online courses. This research looked to define evidence-based best practices for the design of multimedia content that also enhanced social presence in distance learning and online environments. The study asked 596 participants to consider the perspective of online students and select one of five videos that they would prefer viewing during their online course. These participants included a diverse sample of students, faculty, administrators, researchers, and instructional design and support staff. The findings indicate that 91.7% of participants preferred the two variations that included video of the instructor and the instructor’s presentation slides at the same time. Among the reasons why, participants responded, “this is more like an actual classroom experience” and “I like being able to see the instructor.” These results also indicate the importance for instructors and instructional designers to consider the pre-production and post-production implications and resources required to develop content in these formats.

Introduction and Background

Instructors and instructional designers have many tools at their disposal to develop multimedia content for their online classes. This research study sought to better understand how specific combinations of video and content could help foster social presence. Social presence is the ability to use technology to create and foster interpersonal relationships in learning environments between instructors and students (Short, Williams, & Christie, 1976). Social presence in instructional message design can be used to enhance motivation, which can lead to learning effectiveness and student retention (Fleming & Levie, 1993; Ramlatchan, 2019). Multimedia is the inclusion of several means to communicate information integrated thoughtfully in the same presentation to create or enhance the learning experience (Clark & Mayer, 2016). This study combined applications of video, multimedia learning and design, and their potential impact on social presence to help inform best practices in instructional message design. The design of the modules used in this study presented multimedia to viewers using several combinations of recorded video and presentation slides with text and graphics. The goal was to determine which design combinations resonated best with students, especially in terms of enhanced social presence. This study’s specific research question sought to explore which design was preferred by students, faculty, and instructional design and support staff and why?

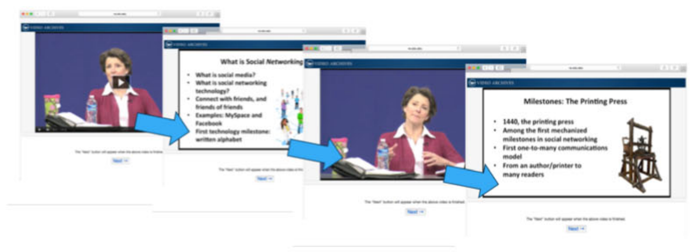
Research Design

This study asked viewers to compare five variations of a multimedia presentation and to select which design they preferred. Each of the five designs are currently used in the host university’s distance learning courses, online programs, and are representative of existing course content. An experienced presenter was recorded in one of

Participants viewing the "instructor-only" option were only able to see the instructor, while volume was turned down during the data collection, participants were asked to assume that the narration was the same for all five options

Participants viewing the "slides-only" option were only able to see the instructor's PowerPoint slides, they would not see the instructor

Participants viewing the "video-switching" option saw the video alternate between a view of the instructor and a view of the PowerPoint slides (the slides were viewable long enough for participants to read each slide)



Participants viewing the "dual-windows" option could see the instructor in a window in the upper left and see the PowerPoint slides in a larger window on the right

Participants viewing the "layered-video" option could see the instructor as a layer of video in the foreground and they could see the PowerPoint slides as a second layer of video behind the instructor

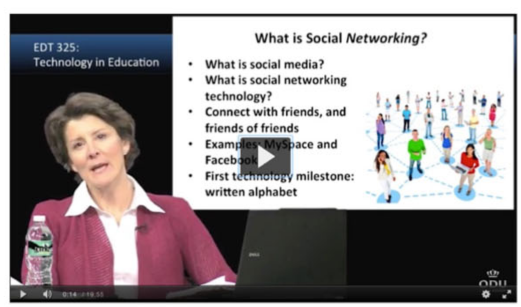


Figure 1. Each participant was able to compare each multimedia design and select their preference (modified from Ramlatchan & Watson, 2019)

the university's audio and video production studios. The instructor presented a 20-minute module on social media and social networking intended for an online "communications" or an "introduction to technology" course. Thus, the instructor, instructor video, and the content presented in the PowerPoint slides were kept consistent throughout the study.

Data was collected at Old Dominion University's 2018 Faculty Summer Conference, from online and virtual classroom students also at Old Dominion University, from the University Reception at the 2018 AECT (Association for Educational Communications and Technology) conference, and during the 2018 SACSA (Southern Association for College Student Affairs) conference. The result was a diverse sample of 596 participants that included students, faculty, administrative staff, and instructional design and support staff across a wide range of ages, academic experience, and subject matter areas. The five multimedia designs presented to participants included an instructor-only, a slides-only, a video-switching, a dual-windows, and a layered-video variation (see Figure 1). These five multimedia designs are currently in use in some form at the host university in online classes and programs and represent examples of what online students enrolled in those programs would see. The instructor-only version only showed video of the instructor's camera. The slides-only version only showed the instructor's PowerPoint slides. The video-switching version showed the instructor's PowerPoint slides long enough for a student to read a slide, then the video switched back to show the instructor until the next slide. The dual-windows version showed the instructor video as a smaller window on the screen and showed the instructor's PowerPoint slides as a larger window. The layered-video version used a black background with the slides as a second layer of video over the background and the instructor as a third layer of video over both the background and slide layer.

All five designs were played as 20-minute videos on a continuous loop on five identical laptops (see Figure 2). The five laptops were numbered and setup side-by-side on a 6-foot table with a ballot box paired with each laptop, this arrangement allowed participants to simultaneously view and compare all five designs. When potential research participants approached the table they were given a pen, a clipboard, a 3-inch x 5-inch card to write why they made their selection, and asked "if you were an online student which of these videos would you prefer?" The

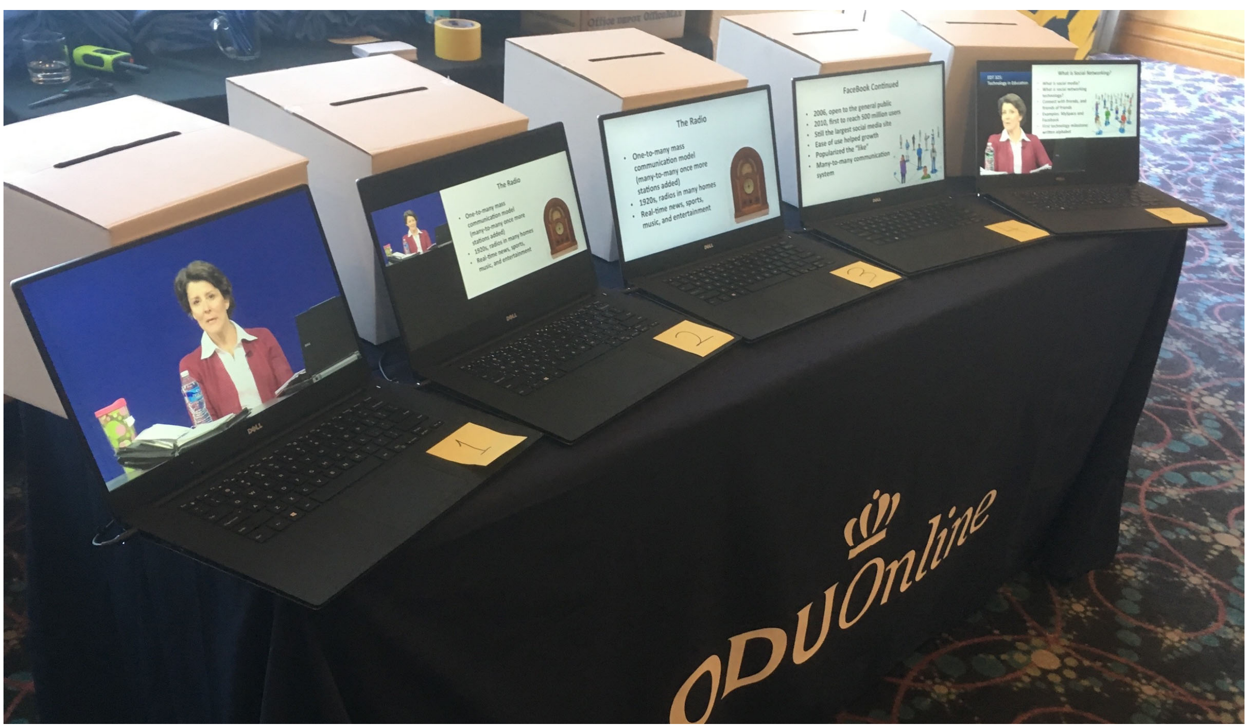


Figure 2. Each of the five options were played on a loop on five identical laptops, participants wrote their reasoning for selecting their preference on a 3x5-inch card and dropped the card in the appropriate ballot box (the "video-switching" option was played on the center laptop in this example, and was showing the slides when this picture was taken, it would periodically alternate between showing the slides and video of the instructor during data collection).

contributing students, faculty, administrators, and staff indicated the design they preferred, wrote a short reason why they made that selection, and dropped their card into the appropriate ballot box. Participants received either a t-shirt or a plush mascot keychain for their feedback. The data collection process took approximately 30 to 60 seconds to complete.

Results and Discussion

The results of this experiment were surprisingly consistent, especially given the four diverse samples used in data collection. The 2018 Faculty Summer Conference group consisted of students but was mostly a group of instructional design staff, administrators, and faculty at the host university (n = 158). Of this group, 79.1% preferred the layered-video, 14.6% preferred the dual-windows, 5% preferred the video switching, 1.3% preferred the slides-only, and 0% preferred the instructor-only.

The virtual classroom and online student group consisted of approximately 85% students and 15% faculty and staff enrolled in, or teaching, or supporting classes at the host university (n = 176). Of this group, 60.2% preferred the layered-video, 31.3% preferred the dual-windows, 5.1% preferred the video switching, 2.3% preferred the slides-only, and 1.1% preferred the instructor-only.

The 2018 AECT conference group was a very diverse range of students, instructional designers, administrators, teaching faculty, and researchers from a wide range of private, public, large, small, regional, national, international, online, and traditional on-campus colleges and universities (n = 138). Of this group, 70.3% preferred the layered-video, 18.1% preferred the dual-windows, 6.5% preferred the video switching, 2.9% preferred the slides-only, and 2.2% preferred the instructor-only.

The 2018 SACSA conference group also represented a diverse number of students, faculty, and staff in a wide range of student support disciplines from a number of colleges and universities in the southeast region of the United States (n = 124). Of this group, 75% preferred the layered-video, 18.5% preferred the dual-windows, 5.6% preferred the video switching, 0.8% preferred the slides-only, and 0% preferred the instructor-only.

In total, there were 596 participants, 70.6% preferred the layered-video, 21.1% preferred the dual-windows, 5.5% preferred the video switching, 1.8% preferred the slides-only, and 0.8% preferred the instructor-only (see Table 1 and Figure 3). Based on observations during data collection it is estimated that 50% of the total participants were active students, while the other half were faculty, staff, and administrators. However, the perspective of faculty, staff, and administrators are important to consider as not only were these participants likely former college students at one time, they also fall into the adult learning demographic for prospective future graduate students. Additionally, the researcher has found no significance difference when comparing pilot data collected from confirmed students and pilot data collected from faculty, staff, and administrators in terms of similar social presence and multimedia studies (Ramlatchan & Whitehurst, 2019).

Table 1. The number and percentage of participants who selected each option

Multimedia Design Option	# of participants who selected that option	% of participants who selected that option
Instructor Only	5	0.8%
Slides Only	11	1.8%
Video Switching	33	5.5%
Dual Windows	126	21.1%
Layered Video	421	70.6%
Total	**596**	

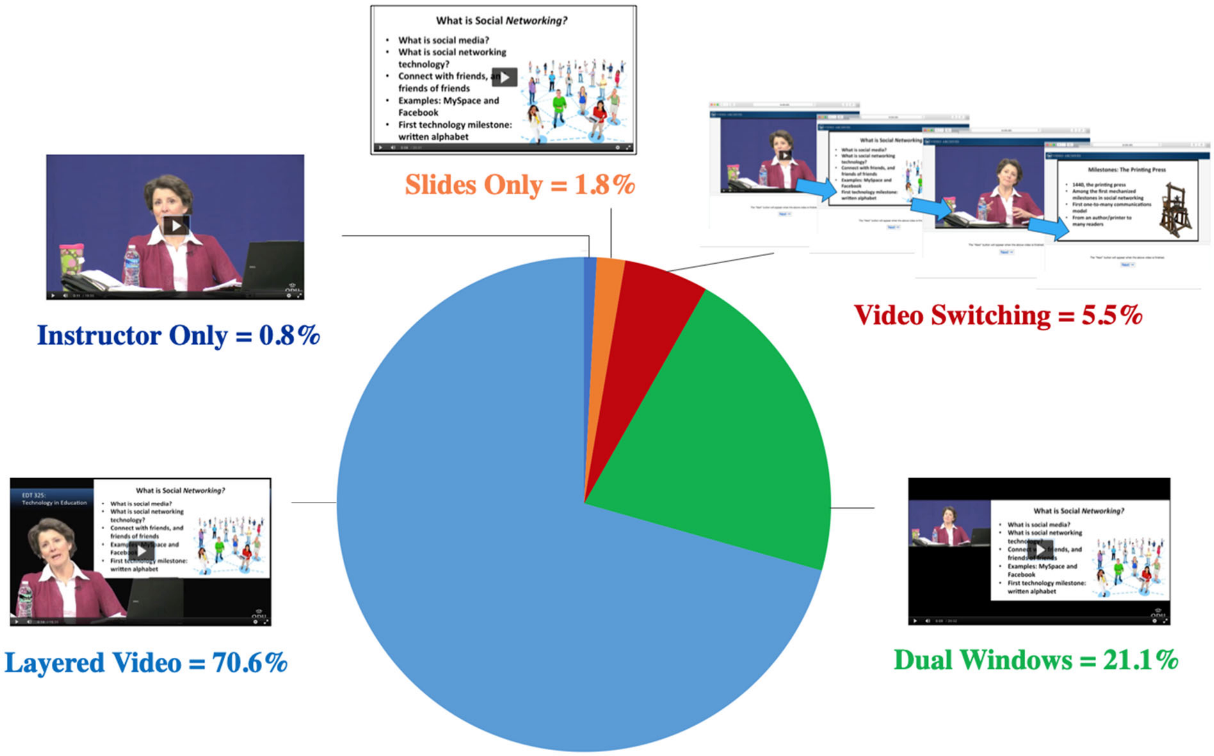


Figure 3. The layered-video option was the most preferred multimedia design, followed by the dual-windows variations (for a combined 91.7%), this result would appear to indicate the overall preference for the ability to see both the instructor and the instructor's slides during online courses that include video.

The preference for seeing both the instructor and the instructor's slides is consistent with other social presence research that found similar results (Ramlatchan & Watson, 2019). Qualitative feedback for these two options often included a variation of "this is more like an actual classroom experience" and "I like being able to see the instructor." Both the quantitative data and the qualitative feedback on their 3x5 cards indicated the importance of social presence or the ability to see an authentic instructor.

The most preferred options (the overall preference for layered-video and the dual-windows options for a combined 91.7%) were also the most resource intensive to produce. Interestingly, the options that likely require the least amount of time and effort to produce, were also the options least preferred by participants. The slides-only version is a very common online presentation technique as there are many programs that can add instructor audio voiceover to screenshots, screen grabs, or other means of slide capture. The 'talking head' of the instructor-only version is also very ubiquitous, easy to create, and was also among the least preferred by participants in this study. The dual-windows option is created by a telepresence recording platform from Cisco Systems that while automating the recording of web conferencing classes, also requires a significant infrastructure investment. The layered-video variation was by far the most preferred, but also requires the most overall time and effort to produce. A post-production time and effort investment must be made as a video editor or producer has to create this presentation by making a new video that is a composite of the virtual background, the slides, and the audio and video recording of the instructor. However, the result of this production effort is a presentation format that retains as much as possible the social presence aspects of the face-to-face classroom environment for online students.

Conclusion

The purpose of this study was to better understand the impact of multimedia message design on social presence based on the preferences of a large diverse sample of students, faculty, and staff among several colleges and universities. Participants viewing the five options were simply asked "if you were an online student which of these videos would you prefer?" The results indicate that participants consistently selected the multimedia designs that allowed them to see both the video of the instructor and the PowerPoint slides for the full duration of the presentation. This consistency was present when traditional students (approximately 50% of the total 596 participants) provided feedback, as well as when instructional design staff, instructors, and administrators (who also fall within the host university's adult learner demographic) provided feedback. The layered-video version was by far the most popular for several reasons which include the design's approximation of the face-to-face classroom experience and the maximization of social presence. These results can also likely be generalized and applied to a diverse set of learning environments, across many fields of study, at many colleges and universities. Online students prefer multimedia designs that enhance social presence, such as multimedia designs that allow them to see both their instructor and their instructors' presentation at the same time. This instructional message design best practice can be used to enhance motivation, retention, and overall learning effectiveness in online courses and programs.

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The Social Presence Benefits of Synchronous, Interactive Video in Online Classes

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Descriptors: Social presence, online learning

Abstract

What are the benefits of interactive, two-way video and web conferencing in online classes in terms of social presence? This study compared four presentations, two were synchronous and were delivered in real-time and two were pre-recorded and delivered asynchronously. Student volunteers (n = 162) were organized into four treatment groups. The first treatment group participated from an immersive telepresence, video conferencing system, the second group participated via online web conferencing, the third group viewed a recording of the telepresence group's meeting, and the fourth group viewed a recording of the web conferencing group's meeting. The use of the telepresence system improved participants' sense of instructor immediacy and social presence, followed by the perception of the web conferencing group, while the asynchronous viewers reported a lower sense of connectiveness. The data analysis also indicated no significant difference among the treatment groups in terms of extraneous cognitive load. The results indicate the social presence benefits of real-time engagement, active learning, and suggests that instructors and instructional designers should consider the integration of synchronous activities in their online classes.

Introduction

We know that maintaining retention and ensuring learning effectiveness in online environments is a challenge for distance learning and distributed education programs. One means to support both motivation and learning effectiveness is to create learning environments that foster and enhance social presence. Social presence in the context of education is the student's perception that they are communicating and engaging with an authentic instructor (Short, Williams, & Christie, 1976). Social presence in this study was explored in terms of instructor immediacy, or the verbal and nonverbal communication effectiveness of the instructor from the perspective of online students (McCroskey & Teven, 1999; Violanti, Kelley, Garland, & Christen, 2018). The social presence implications of instructor immediacy has been explored in a number of other multimedia studies, however, these studies focused on pre-recorded, scripted instructor presentations (Jayasinghe, Morrison, & Ross, 1997; Ramlatchan & Watson, 2019). The present study has a similar research design, though instead now includes two treatments with a live, real-time instructor that encourages student interactivity and asking questions.

Instructional message design is the purposeful, thoughtful, and evidence-based development of instructional material, content, or other vehicle of instruction and can influence motivation, learning effectiveness, and retention (Fleming & Levie, 1993; Ramlatchan, 2019). The ideas of social presence and message design can be combined with the heuristics of multimedia learning to further improve overall learning effectiveness. Multimedia learning theory suggests using words and pictures, reducing extraneous information, and connecting new concepts to previously learned concepts in instructional designs (Clark & Mayer, 2016; Mayer, 2009). Multimedia learning theory builds upon cognitive load theory, which suggest that extraneous cognitive load should be removed or reduced as much as possible from message designs to improve learning efficiency and effectiveness (Paas & Sweller, 2014).

In the context of this study, the multiple media used in the instructional message design includes synchronous or asynchronous online visuals of both the instructor and the instructor's presentation as well as the narrative voice of the instructor. While there is an established body of knowledge on the use of multimedia learning theory, there has not been significant research into the area of live, interactive, synchronous video. This study sought to explore the connection between multimedia design, social presence, and interactive video. Specifically, when the instructor and the subject matter are kept constant, how does the inclusion of live engagement in the multimedia design impact social presence in terms of student perceptions of instructor immediacy? This research project also gauged the impact of each presentation on student perceptions of extraneous cognitive load.

Research Questions

The problem this research sought to address was the lack of quantitative experimental results when comparing a student's ability to interact with an instructor and the impact on social presence in terms of instructor immediacy and the impact in terms of any added extraneous cognitive load:

Research Question 1: What impact will variations of synchronous and asynchronous online multimedia presentations have on student perceptions of instructor immediacy?

Research Question 2: What impact will variations of synchronous and asynchronous online multimedia presentations have on student perceptions of extraneous cognitive load?

Research Design

This study employed four treatment groups to explore interactive multimedia and instructor immediacy (see Figure 1). The same instructor presented the same subject matter with the same PowerPoint presentation in each group. The slides were designed to present the content in a clear, concise manner, with a concerted focus to avoid extraneous distractions. The instructor presented a 20-minute module on "Transcendentalism, Romanticism, and Regionalism" from her online American Literature course. There were four specific times in the mini-lecture where the presenter specifically asks a question to engage and solicit thoughts and feedback from participants. The first treatment, the telepresence group, employed two telepresence equipped classrooms. Telepresence in the context of this study is the practical application of immersive video conferencing, such as using a Cisco IX-5200 or similar immersive system which includes high resolution video, multiple large, high-definition displays, and high-fidelity audio. The instructor presented from one classroom, volunteers participated from another classroom. The students and the instructor could see and hear each other in real-time in each classroom and the students could also see the PowerPoint slides. Students in the second treatment, the web conferencing group, participated online via web conferencing, with the instructor still in the same telepresence classroom as the first treatment group. Each student could see the instructor and see the PowerPoint slides. The third treatment group viewed a recording of the telepresence group's meeting. The fourth treatment group viewed a recording of the web conferencing group's meeting. These two groups could also see the instructor and the slides.

Volunteers for this study were students enrolled at a mid-size, metropolitan, public university. A link to participate in the study was included in a university events and announcements email sent daily to all students; the only requirement to participate was the ability to attend the presentation in the telepresence classroom or have a reliable Internet connection. The study continued until at least 30 students had participated in each treatment group. The social presence component of instructor immediacy was measured using the McCroskey's Source Credibility Measure (McCroskey & Teven, 1999). Cognitive load was measured using the NASA Task Load Index (Hart, 2008; Hart & Staveland, 1988). These two survey instruments, and an additional item asking them to enter in any additional comments, were accessible to participants as a survey after they viewed the presentation. Each student only participated in one treatment group and each were given a free t-shirt for their time and feedback.

Figure 1a. Participants in the synchronous telepresence video conference treatment group viewed the instructor in the classroom's center display and the PowerPoint slides on the two outer displays.

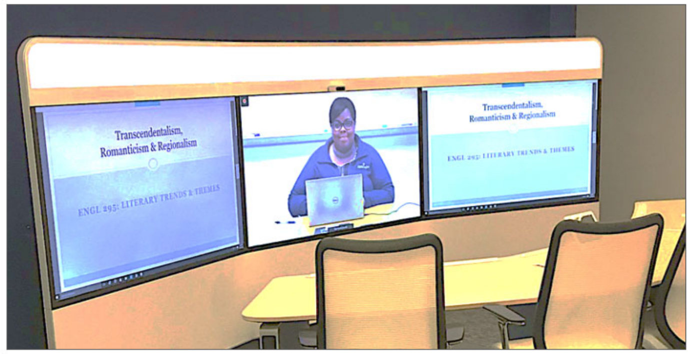

Figure 1b. Participants in the synchronous web conference treatment group viewed the instructor on the right and viewed the PowerPoint slides on the left, both of these windows could be resized or made full-screen based on the preferences of the viewer.

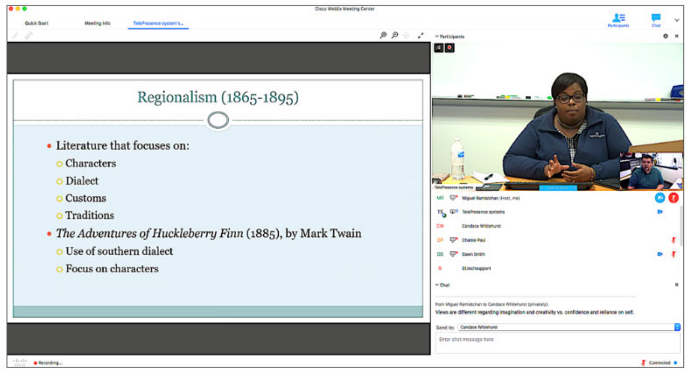

Figure 1c. Participants in the asynchronously viewed telepresence video conference recording treatment group viewed the instructor on the left and viewed the PowerPoint slides on the right.

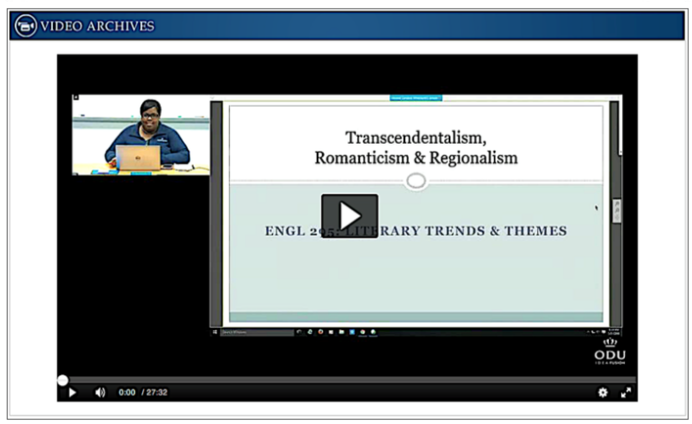

Figure 1d. Participants in the asynchronously viewed web conference recording treatment group also viewed the instructor on the left and viewed the PowerPoint slides on the right.

Figure 1. Volunteers in this study participated in one of four different treatment groups, two were delivered live and allowed for real-time interaction with the instructor and two were pre-recorded (modified from Ramlatchan & Whitehurst, 2019).

Results

A one-way univariate Analysis of Variance (ANOVA) was conducted to determine the effect of the four presentation methods on the mean score of participants on the Nonverbal Immediacy Behaviors Index section of the survey. The ANOVA indicated a significant difference between treatment groups, $F(3,156) = 5.8$, $p < .01$ (see Table 1). A follow-up Tukey HSD test was conducted to determine the distinction among the groups, which showed a statistically significant difference between the telepresence group and the three other treatments (see Figure 2).

Table 1. Nonverbal Immediacy Behaviors Index Measure of each Treatment Group

Treatment	n	Mean (SD)	95% Confidence Interval
Synchronous telepresence video conference	**33**	**5.03 (.53)***	**[4.85, 5.21]**
Synchronous web conference	38	4.54 (.72)	[4.31, 4.77]
Asynchronously viewed telepresence video conference	51	4.51 (.67)	[4.33, 4.69]
Asynchronously viewed web conference	37	4.42 (.73)	[4.18, 4.66]

Note. Nonverbal Immediacy measured on a 1 to 6 scale, with 6 being the most immediate.
* A significant difference was found between this treatment and the three other treatments, $p < .05$

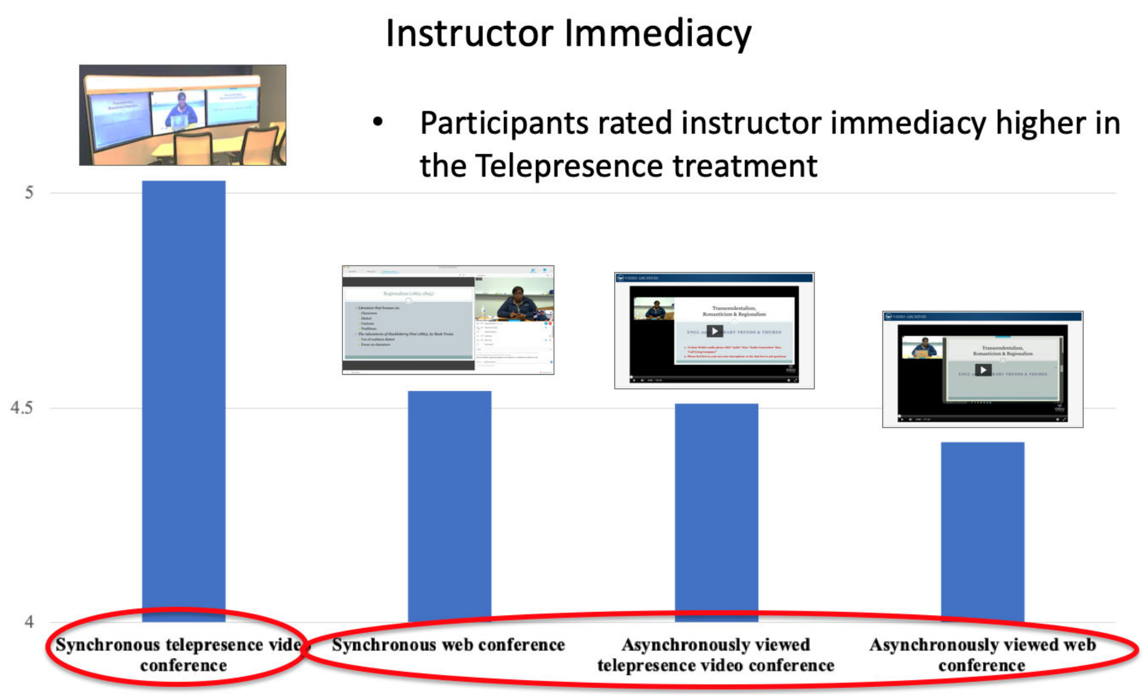

Figure 2. A one-way ANOVA and Tukey HSD post-hoc analysis indicated a significant difference in participant perception of immediacy, or the communication effectiveness of the online instructor. Participants in the live telepresence classroom treatment felt a high degree of social presence.

A one-way univariate Analysis of Variance (ANOVA) was also conducted to determine the effect of the four presentation methods on the mean score of participants on the NASA Task Load Index section of the survey (see Table 2). While a pattern may appear to forming, the ANOVA indicated no significant difference between treatment groups in terms of participant perception of extraneous load, $F(3,158) = .32$, $p = .81$ (see Figure 3).

Table 2

NASA Task Load Index (TLX) Measure of each Treatment Group

Treatment	n	Mean (SD)	95% Confidence Interval
Synchronous telepresence video conference	33	2.35 (1.62)	[1.83 to 2.87]
Synchronous web conference	39	2.45 (1.56)	[1.96 to 2.94]
Asynchronously viewed web conference	39	2.45 (1.97)	[1.83 to 3.07]
Asynchronously viewed telepresence video conference	51	2.72 (1.69)	[2.26 to 3.18]

Note: Extraneous load measured via the NASA TLX was measured on a 0 to 10 scale, with 10 being the most demanding, stressful, or cognitively distracting.
No significant differences were found between these treatments, $p < .05$

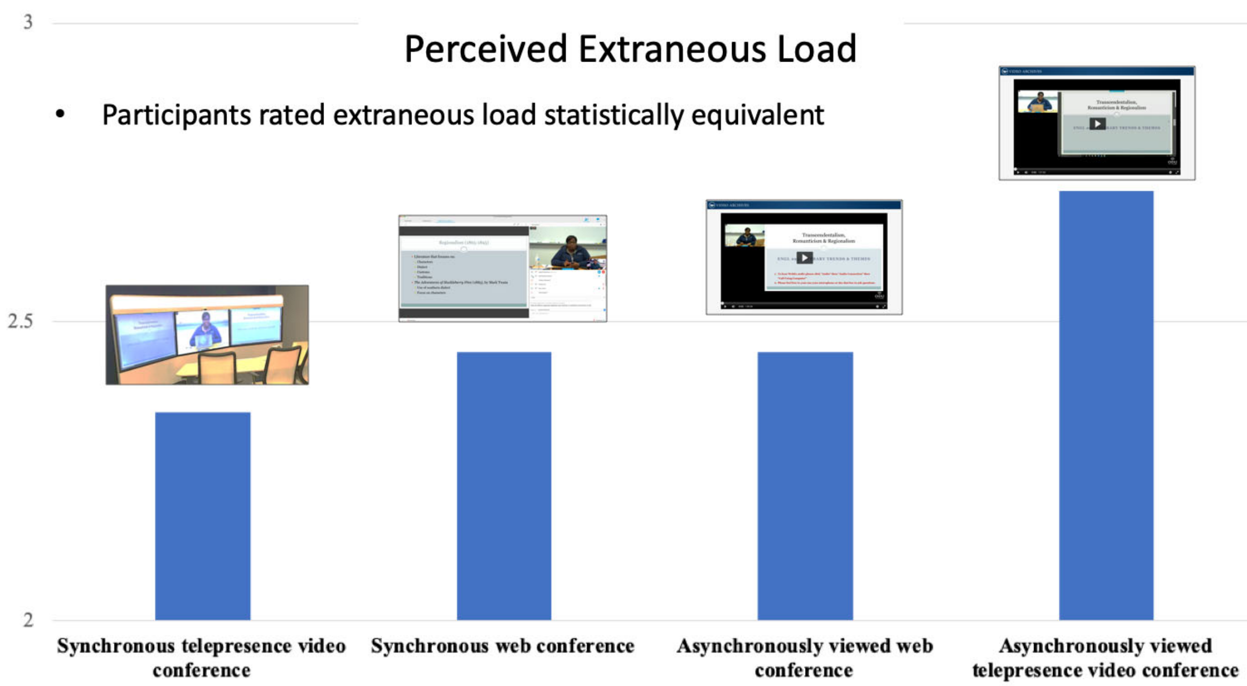

Figure 3. A one-way ANOVA indicated a no significant difference in participant perception of extraneous load when measured with the NASA TLX (unweighted), although there does appear to be a pattern indicating the ease of use of the classroom environment.

The online survey used in this study included a write-in box for other participant comments. This qualitative data collection yielded several interesting responses. One participant during the synchronous web conferencing treatment reported:

I think the instructor in this case covered things very well and seemed, in hindsight, to give a lot of time to students for questions and comments. I can see classes like this feeling a lot more communal to distance learning students, giving students the opportunity to discuss and "be together" all in one place at the same time.

This statement appears to highlight the importance of keeping students engaged. Another participant during the synchronous telepresence treatment echoed this response:

The interaction with the instructor was super helpful due to the fact that we were actually able to engage in conversation and when any of us had questions, she'd be more than willing to answer and explain information further.

This feedback would tend to indicate some of the advantages of a synchronous online tool in terms of allowing the instructor to guide a discussion beyond a scripted presentation. However, even participants in the asynchronous treatment groups appeared to appreciate the instructor's desire to engage with students. For instance, one participant during the recorded asynchronous telepresence treatment commented:

The instructor was very well paced through the presentation; questions were asked throughout the presentation that were thought provoking and let the discussion evolve with the participants.

Conclusions

The significant contribution to the existing body of knowledge on the subject of multimedia, social presence, and online learning was the use of interactive communication in two of the four treatment groups. This allowed for a comparison between live interactivity and pre-recorded, asynchronous multimedia presentations, using the same content and instructor. The results of this study indicate that participants rated the instructor highest in terms of immediacy during the live interactive telepresence treatment. A pattern in the data indicated that both live treatment groups outscored the two recorded video viewing groups in terms of perceived instructor immediacy. This finding suggests and helps confirm that students feel a high degree of social presence when they are able to engage in real time with their instructor. This study also indicated that while the peripheral distractions of the classroom environment was rated lower, neither of the presentation formats appeared to statistically significantly differ from each other in terms of cognitive load, especially extraneous cognitive load. These findings could indicate that the design of the classroom, the design of the web conferencing application, and the design of the video playback interface did not introduce a significant level of extraneous cognitive load. The instructional message design of these learning environments did not appear to negatively impact learning effectiveness from this perspective.

Feedback from participants who viewed the recordings and commented that they appreciated the instructor asking and answering questions and engaging with the live students were interesting given that they themselves were unable to ask questions and participate in that discussion. In effect, it appears that both synchronous and asynchronous students benefited from the instructor actively engaging with the live audience. While this finding makes intuitive sense in terms of social learning and social presence, a future study could remove the question and answer periods from the recording and try a new series of treatments to confirm this conclusion. Another avenue for future research could be the use of eye-tracking techniques to more directly measure extraneous cognitive load as compared to the indirect self-reporting used in this study. Yet another series of experiments could vary the instructor, subject matter, and include the use of whiteboards or writing on digital tablets to further explore how multimedia presentation design can impact social presence in our online learning environments.

To increase social presence in their online classes, and thus increase learning effectiveness and motivation, instructors and instructional designers should consider the use of synchronous tools in their online instructional designs. The ability for students to see and hear their instructor, live and in real time, and the ability to ask questions, have a discussion, and actively engage in learning can create and enhance positive environments for social presence in online classes and programs.

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Right Info, Wrong Answers: Eyeing the Search for Why with Tracking Technology

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Abstract

This poster reports an exploratory study about the process or the quality of the search online information, including how the information was found and “read” (or “seen”). Inspired by the eye-tracking technology and the idea of “eye-mind hypothesis,” the study explores students’ online information searching/browsing behaviors and what eye movement data can provide to better understand Web searching/browsing behaviors, and therefore, to inform practitioners (i.e., instructional designers, librarians, and information specialists etc.) for better design.
Keywords: information seeking behavior; scan path; eye tracking

Introduction

In the information age, students constantly search for information on the internet. Sometimes a search for information to specific inquiries is successful; sometimes it is not. Even with success, scant information is available about the process or the quality of the search, including how the information was “read” (or “seen”), not to mention whether the reader engaged with the information that was seen or read. Understanding how users perform online information searching is a pervasive interest of librarians, information specialists, and instructional designers. For example, researchers have been focused on how visual design or presentation/display format was associated with learning performance, reading comprehension, and decision making. (Agostinelli et al., 2012; Bettman & Kakkar, 1997; Biehal & Chakravarti, 1982; Tomita, 2017; Zikmund-Fisher et al., 2016). While conventional user research methods are effective in obtaining users feedback on usability and their experiences, they have several key limitations. For example, traditionally one can verify whether the users actually “look at” the information on the present screen (or Web pages) by asking the participants follow-up interview questions and retrospective analyses of their online behaviors or to engage in self-report/think-aloud activities as they search. However, the latter approach may interrupt participants as they engage in resource intensive search behaviors, while the former methods rely on limited human memory. With eye tracking data (i.e., scan paths, fixation counts, and fixation duration), the researcher can explore a user’s searching and ‘reading’ behaviors by accessing the visual path track. Therefore, this study investigates online information browsing behavior with deeper exploration by incorporating eye-tracking data into conventional user research methods.

Background

The research detailed here was driven by a previous usability study, which the instructional designer accidently found that some users responded with the ‘wrong’ answer to a common library inquiry when they all arrived at the ‘target’ pages where information was located. A pilot study (Sun, Sheu, & Tsai, 2018), as part of a large project, was meant to be a test round for the protocol and the tasks were serve as warm-up tasks. Therefore, the tasks were designed to be simple and easy to complete. The tasks were to find answers from a selected website for two simple questions derived from the commonly asked questions at the library settings (e.g., library hours, directions, and eligibility of ‘membership’ etc.). The two questions were: (1) what’s the library hours for Tuesday? and (2) Can a 15-year old high school student apply for a library card?

In the pilot study with eight participants, all participants completed both tasks/questions within 90 seconds, meaning that all participants were efficiently locate the information on the website and turned in the task sheet with their answers. The total number of Web pages visited was less than six for both tasks, excluding the home page/starting page. It was another indicator for efficient performance. All participants fulfilled the first inquiry correctly, but surprisingly three out of the eight respondents got the second question wrong even though they all successfully ‘locate’ the information. In other words, the participants have ‘arrived’ the target page that contains the necessary information to answer the question correctly but failed to choose the right answer.

Based on the data from the task sheets, desktop screen recording, and direct observations, we knew that all participants efficiently “arrive” on the target page and successfully locate the necessary information. They also felt confident about their search and answers. From a usability standpoint, it was a success. However, we do not know why some of participants get the second answer wrong when they have the information in front of them. It raises questions: what are the possible explanations and how can this be improved by design if applicable. The motivation to find answers has led to the present study.

Purpose of the study

The primary purpose of the present study was to explore possible explanations of why some participants respond with the "wrong" answer when they have "right" information in front of them by investigating user's information search process, including visual browsing/reading patterns, presentation style of the information used, and general performance (e.g. time spent, number of pages visited, completion rate etc.)

The study was an extended study from the previous pilot study, using the same research design with a larger number of participant data set. Descriptive results regarding the search process and performance were reported. However, instead of focusing on how the users 'arrive' or 'found' information on the website, the question becomes how the users 'read' or 'look at' the information.

Methods

As mentioned earlier, the present study was a study extended from previous pilot study aiming to seek possible explanation with a larger data set. User research methods were adopted, which involved asking participants to perform a given task in a lab setting and directly observing what they do. A well-designed library website was applied to test out two search tasks commonly seen in libraries, which are 'searching for library hours' and 'eligibility of applying for a library card.' All participants were performing these two tasks after the study was introduced and the consent of participation was obtained. Computer screen was recorded during the process. In addition, an eye-tracking device (Tobii 4C eye-tracker) was used to detect the visual pathway.

Participant

The target audience of the library website is general adults. Therefore, the general selection criteria were adults aged 20 years old or older with no severe visual impairments. Recruitment information was posted on Facebook and PTT, a social media tool used by students in Taiwan. Due to the geographic convenience, all participants were students from a public university where the lab was located. A total of 37 valid data sets were collected from the eligible participants. They are 27 females and 10 males with average age 26 years old.

Data Analysis

Study included both qualitative and quantitative data. In order to get an overall picture of searching and browsing process, descriptive data analysis was employed, describing demographic data, task completion, time spent, and the average number of web pages browsed. In addition, screen recording with scan path video was further used to analyze the user's visual behavior patterns. Qualitative content analysis was applied to analyze videos, which inquired about visual patterns and type of message display. Video were reviewed and coded into emerged categories. The majority of respondents were under the age of 30, and 4 of the 37 people aged 30 or older.

Results & Discussion

The efficiency and effectiveness of online information searching performance were evaluated via various indicators, such as completion rate, time spent on tasks, number of pages/clicks count, accuracy etc. (Goldberg, Stimson, Lewensteln, Scott, & Wichansky, 2002). In this study, we reported completion rate, number of pages browsed, time spent on tasks, and accuracy of responses. To illustrate the qualitative differences as well as triangulate possible explanations, results also include the type of information display (e.g., table vs. paragraph) and visual patterns that emerged from the scan path video.

Completion rate

Same as defined in the pilot study, the definition of technical completion is to 'arrive at the "target web page," which refers to where the necessary information for completing tasks is located. The soft definition for completion was when the participant indicated they were finished (writing down answers and return the task sheet to the facilitator). All participants completed the tasks. Overall the participants have no problem finding information in responding to the given tasks. All participants completed both tasks within four minutes.

Browsed page count

As mentioned earlier, the browse page count is one of indicators associated with search efficiency (Goldberg et al., 2002.) Results showed that all participants complete both tasks within eight pages, excluding the home page/starting page. Most of the participants completed the two tasks within two pages respectively. Twenty-nine out of 37 participants (78.38%) finished task one within two pages, and 32 out of 37 respondents (86.49%) completed task two within two pages. In other words, most of the participants completed each task with 2 clicks, which is considered rather efficient (see Table 1).

Table 1. Browsed page count per task (n=37)

Number of pages visited	Task 1	Task 2
	N	N
1-page	20	24
2-page	9	8
3-page	4	3
4-page	4	1
7-page	0	1
Total	37	37

Time spent

As shown on Table 2, the average time spent on task one and task two were 63.59 seconds, 51.26 seconds, respectively. The average time to complete task one and two was 114.85 seconds. We further split time spent into two parts: one was the time spent on searching (from the departure point to the arrival of the target page); the other was the time spent on the target page (where the necessary information was located). For task one, the average *searching time* was 33.14 seconds, and the average time spent on the result page (target page) was 30.45 seconds. For task two, the average time that participants spent on searching targeted page was 22.03 seconds, and the average time spent on the result page was 29.23 seconds. Comparing the time participants spent on the two different tasks, results showed spent longer time on the first task than those on the second task, both searching the target page and stayed on the target page.

Table 2. Time spent on search, reading and completion

Time (Seconds)	Task 1	Task 2
Average search time (starting point to target page)	33.14	22.29
Average time stayed at the result page	30.45	28.80
Average total time to complete task	63.59	51.26

Accuracy

All participants got the first question right and 11 out of the 37 respondents (29.7%) answered the second question incorrectly. The number of incorrect responses for the second question was “relatively” high while considering the ease of the task. During the observation process, all participants filled out answers confidently, and most importantly, they all had the right information in front of them. This aligns with the findings from the pilot study. The answer to the second question was “yes,” a high school student can apply for a library card. In general, only 16 years old or older can apply for a library card. However, full-time students under 16 years old can also apply for a card. Both pieces of information were listed on the target pages. Unlike task one, which was straightforward, task two requires some thinking to process both ‘conditions. We know that participants have “arrived” the “target” pages that contain the necessary information for the question/inquiry and possible “look at” the information before answering it. However, we do not know if the participants actually “read” the information and how they read it. This is one of the areas where eye tracking data can provide additional information for better understanding without interrupting task process. We turned to desktop recording with eye tracking data for better insights and possible explanation.

Display/layout of information

How information is structured and display often plays an important role for reading (or browsing). The tasks were live search and participants were free to go to any page and use any strategies to find answers for the given inquires except using ‘search tool.’ Based on the data we collected, there were three ‘target pages’ where the participants “found” or “landed” for the inquiry #2 (task 2). One page presents the information in table format, whereas one was all text in paragraph format. The third page was a pdf document regarding library policy. The information was displayed in text form in paragraph as well. Therefore, we coded videos into two categories based on the format of display: table vs. paragraph.

As shown in Table 3, 23 participants landed on table format and 14 participants landed on paragraph format. Among the participants in table group, 18 (78.26%) got the answer right while eight (57.14%) participants in paragraph group got the task 2 right. One possible explanation was the table format of information display helped participants read the information.

Table 3. Task 2 responses by display format (n=37)

Response	Table		Paragraph	
	N	%	N	%
Correct	18	78.26	8	57.14
Incorrect	5	21.74	6	42.86
Total	23	100	14	100

Moreover, for task 1, participants spent more time on ‘searching’ than ‘reading,’ whereas for task 2, participants took longer time on ‘reading’ than ‘searching.’ While reading time between the two tasks was not relatively meaningful, it is interesting to see the time difference on reading/finding information between two display styles (table vs. paragraph) regarding the task 2 responses.

In general, participants who get the answer wrong spent more time on target page too. It could be that most participants who get the wrong answer landed on paragraph format, which naturally take more time to read and process information. As mentioned earlier, 23 out of 37 participants “landed” on the target page with table display and 14 on paragraph display. The average time for “table” group of participants to spend on the target page before writing down answer was 23.46 seconds while the average time spent on the target page for “paragraph” group 38.72 seconds. This could mean that it took longer for participants to process information in the paragraph format than table format. This finding aligned with common design principles for organizing information. Table helps to visualize information with simplify form. The paragraph format also contains more text. However, this is not to suggest that all information needs to be organized in table format. It will depend on the context that is designed for, such as the content, the purpose, needs, and the audience etc.

Table 4. Time spent on task 2 (n=37)

Time (Seconds)	Display format		Response	
	Table (n=23)	Paragraph (n=14)	Correct (n=27)	Incorrect (n=11)
Average search time	18.71	27.47	21.4	23.6
Average time stayed on result page	23.46	38.72	26.5	35.7
Average total time to complete task	42.17	66.19	35.7	59.3

Visual Pattern

After reviewing all scan path video, two general patterns were identified. One was “focus,” which most of visual movement was more congregate or assembled. They also fall into the area of interest, the area that contain answers or necessary information to make a judgement (see Figure 1). The other type of visual pattern was “spread” or “scattered,” which by contrast, majority of visual attention fall outside of the area of interest or the visual path was (more) spread out (see Figure 2).

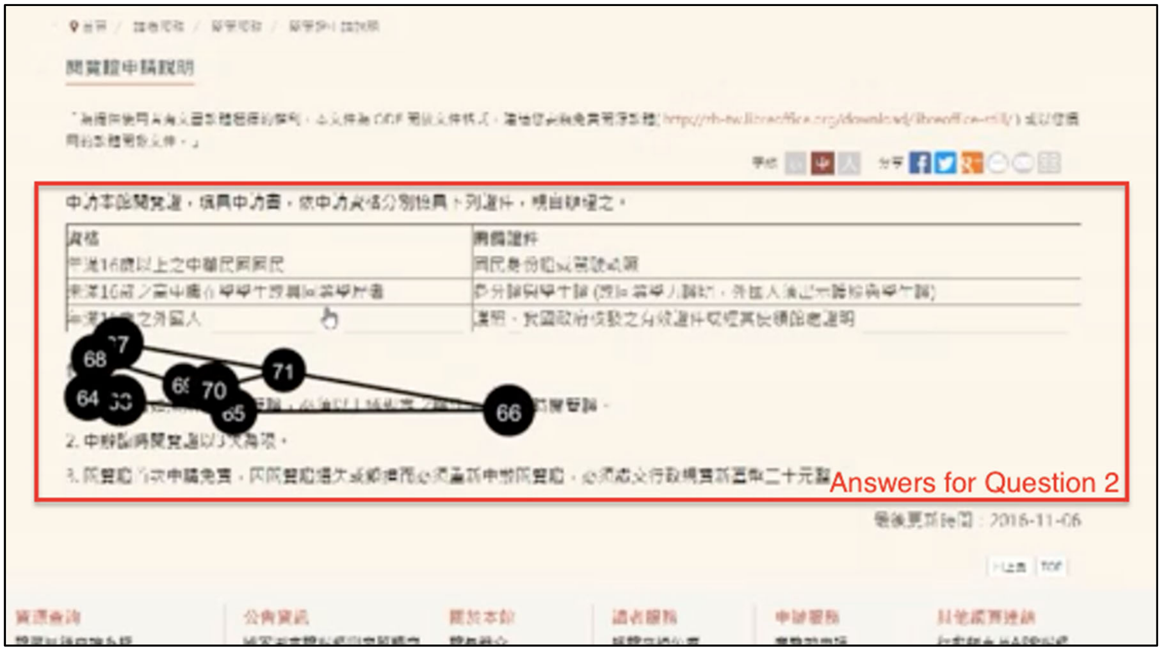

Figure 1. Example of “focus” visual pattern

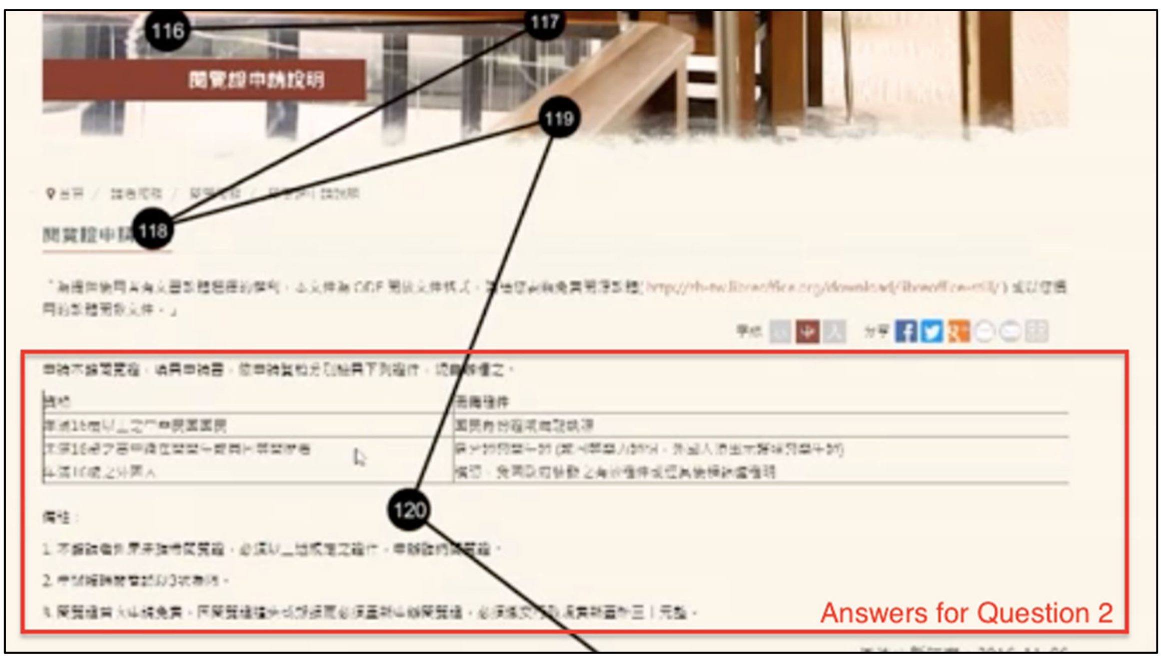

Figure 2. Example of “spread” visual pattern

As shown in Table 5, the participants whose visual pattern was more focused or strategic have higher percentage getting the answer correct (96%) while the participants in spread or scattered visual pattern have a higher percentage of people get the answer wrong. For a few cases, it was challenging to determine which category when there was a mix of patterns with high speed of visual movements. For example, the visual attention might focus (fixation) on one spot or one focused area but quickly move around for the rest of time and in some cases come back to the same spot. When it happened, the video was reviewed by the third person and discussed with all coders (total of three) until reach consensus. With that in mind, some cases are in the grey area. Another interpretation can be that the visual pattern of the participants who answered correctly was more ‘focused’ or strategic searching/browsing pattern, whereas the participants who did not respond with the correct answer showed no patterns or spread out pattern regarding the visual path when conducting the task. That could mean the participants 'skimming’ through a lot of text quickly without ‘reading’.

Table 5. Task 2 responses by visual pattern (n=37)

Response	Focus		Spread	
	N	%	N	%
Correct (n=26)	23	96	3	23.07
Incorrect (n=11)	1	4	10	76.93
Total	24	100	13	100

Among 23 participants who landed on the page with table format, 18 participants’ visual pattern was “focus.” And only one out of 18 got the wrong answer. While among 14 participants who landed on the paragraph format, there were only six participants’ visual pattern was “focus” and all six responded with correct answer (see Table 6). This finding could indicate that table format helps allocate visual attention and ultimate help the “reading.”

Table 6. Task 2 responses correction, type of display used, and users’ scan path patterns (n=37)

Type of display Used	N	Scan path pattern	N	Task two response	N
Table	23	Focus	18	Correct	17
				Incorrect	1
		Scatter	5	Correct	1
				Incorrect	4
Paragraph	14	Focus	6	Correct	6
				Incorrect	0
		Spread	8	Correct	2
				Incorrect	6
Total	37		37		37

Conclusion

With a larger data set (larger number of participants) and eye-tracking data, we were able to get more insights on how participants search/browsing the web content for inquiry-based tasks. We find that the findings regarding general search/browsing behaviors from the pilot still hold true. The website is well designed from a usability standpoint. All participants efficiently completed the tasks by “conventional definition,” which users arrived at the designated locations and spent approximately the same amount of time to search information and completed the tasks (whether they got the answer wrong). They have the same patterns to use both top navigation menu and the sitemap on the bottom of each page to get around the site.

Eye-tracking data provide additional information that conventional methods cannot obtain, which helps to confirm or triangulate a specific phenomenon, in this case, their visual browsing/reading patterns on the target information. It took longer for participants to process information in paragraph format than table format, which is normal. However, more participants who landed on table format have the correct answer for task 2 than percentage in paragraph format.

In general, we can conclude that table format works better than paragraph format for this type of information or inquiry. The table format in general guides visual attention to the target information if designed well. We may be able to design in a way to guide visual attention for better performance beyond just usability. However, we cannot guarantee users to engage with the information they see even if they read it. It might require a different type of research for user engagement; specifically, the type of engagement with the content. More future research is needed.

Based on the results, we can conclude that the characteristics of visual pattern for most participants in ‘right answer’ group was more focused while the pattern was more spread for the other group. We can conclude that for people in the right answer group seem to have more focused visual patterns while the other group have more spread or scatter visual patterns. In addition, the information in the table format seem to help users in ‘reading’ the information.

Finally, individuals may have seen the information but not ‘read’ it carefully or the reading was not ‘registered’ in the mind. Since it requires to put two conditions together for task 2, somehow the information that has been ‘seen’ or ‘read’ need to be engaged with the mind as well. However, we are not able to know for sure whether the information that has been ‘seen’ or even ‘read’ was ‘processed’. Further research is needed in exploring higher level information processing.

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Can Cartoon Characters Help? Enhancing Student Engagement with Story-Based Animation

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Abstract

In response to evolving changes in the teaching and learning and in contrast to conventional screen recorded video tutorials with narratives, story-based videos were developed with cartoon characters, settings, and contexts similar to student life. Both types of videos are used for library instruction. A user study with 53 first-year students was conducted to examine student learning experiences with both types of videos. The present paper shares detailed results and comments from students, including their feedback on engagement, satisfaction, conference level, and video style preference. Results show that both types of instructional videos are equally effective in terms of immediately learning outcomes. However, students rated higher on engagement, satisfaction, confidence level on story-based/carton animation video and prefer story-based/cartoon animation if they were given an option.

Keywords: action research; engagement; animation

Introduction

Online learning is a trend in changing learning environment and, in some cases (e.g., rural areas), deliver learning materials through the Internet is the only or the most efficient way to provide services for students at distances. As a result, it is important to design and create effective learning materials for online delivery. It is no exception to academic libraries in supporting student success through multiple modes and provide access to materials in variable formats (Arola, Sheppard, & Ball, 2014, Carlito, 2018, Cordes, 2009, Kress, 2010). Carlito (2018) suggested librarian may implement multimodal support to improve information literacy through a multimodal model, which consists of four strata, including discourse, design, production, and distribution. Video tutorials are one of mode that libraries use to deliver library instruction in helping students learn about library resources and how to effectively identify and utilize them for their academic needs. For example, Xiao, Pietraszewski, & Goodwin (2004) used online database instructional videos to provide contextual and relevant assistance in a just-in-time manner. Malone (2015) synchronous video were provided to online library instruction to respond the increased request for research consultations from online courses students. Librarians are familiar with multimodal deliveries of instructions and services. Carlito (2018) further suggested that the use of video clips, image, colors were the strategies to implement design element in library instruction.

Like other teaching and learning professions, academic libraries follow best practices and several trends in the field of instructional design and scholarship of teaching and learning. This includes to utilize sounds instructional approaches (e.g., story-based learning) as well as effective educational technology (e.g. multimedia, animation, AR, VR, etc.)

In education literature, successful experiments regarding the effectiveness of story-based learning have been reported (Kose, Koc, & Youcesoy, 2013; Kroth & Cranton, 2014; Shaw, Lind, & Ewashen, 2017; Wong & Poon, 2013; Wong et al., 2019). Story-based learning refers to the learning approach applied attractive stories on human learning process. In the field of education, stories have been considered as special and supportive elements to facilitate educational processes (Kose et al., 2013). A study of Shaw and colleagues (2017) found story-based learning enable nursing students enhance advanced communication skills in pediatric nursing. Moreover, researchers have indicated that stories possess a powerful to engaging the audience's emotions and affective, and the potential to transform their perspectives and actions (Kroth & Cranton, 2014; Wong & Poon, 2012; Wong et al., 2019). In short, story-based approach helps to make connection between the learners and the content by making the materials relevant.

Another long proofing practice is the application of animation in education. Animation video clips can be effective instruction (especially young learners) because it: (1) provides students opportunities to involve in specific content interactively; (2) offers learns an opportunity to be engaged in their own learning process; and (3) allows students to share information through social media channels with friends around the world (Gurvitch & Lund, 2014). Yeh et al. (2012) suggested that applying animation appropriately is beneficial for reducing extraneous cognitive load and improving students' understanding of complex phenomena. Cook (2006) also suggested an animation-based approach is beneficial for students learning science.

The value of engagement in student learning is no longer questioned (Trowler & Trowler, 2010). There is positive association between engagement level and learning outcome, the deeper engagement levels, the better learning outcome (Grissom, McNally, & Naps, 2003). In order to enhance the engagement and in response to evolving changes in the teaching and learning environment, our libraries re-designed several videos to promote a more engaging learning experience by incorporating new instructional strategies, such as micro-learning, story-based learning, and problem-based learning. A set of video-based library tutorials were created and designed to support distance education students and independent learners who want to learn the content themselves. This poster reports a practice of instructional design and development on a creation of library tutorial videos using story-based approach, specifically using cartoon characters and animations to present content that has been traditionally delivery through screencast with narrative.

The study aims to collect information about learners' perceptions of the different representations (e.g., video presentation style) with respect to student's viewing experiences. This information can hopefully provide insight into the dialogues regarding the roles and influences of animation in instruction. The study was primarily driven by the following two questions: First, what is the impact of a story-based strategy on the user learning experiences when using online video tutorials (i.e., satisfaction, engagement, confidence, and preference). Second, what is the impact on the learning outcomes from such a story-based approach?

Methods

In order to achieve our research goals, we conducted a user study with first year students who are the primary or target audiences of the library video tutorials. We utilized methods from user experience research, which focuses on understanding users' needs, behaviors, and motivations through task analysis, observation, and other feedback methodologies, including survey/questionnaire and contextual interviews.

Two library video tutorials were used with the 53 first-year students to assess their experience in video watching and understanding of the video content. One video was a "conventional" show-and-tell video with a screen recording and voiced by a librarian. The other video was story-based with conversation by characters (i.e., conversations students have with the professor in the classroom). The contents of both videos were the same, which involved: (1) finding a specific database (in this case, PsycINFO) from the library home page, (2) conducting a keyword search for journal articles on given topics, and (3) refining a search to peer review journal articles. The length of the videos is also about the same. There is only a few seconds' difference between them.

Video format is the independent variable in the study, including study-based and non-story-based. Video watching experience, the dependent variable, was assessed after watching story-based video and non-story-based video, respectively. The investigator attempted to examine if college students' watching experience in story-based tutorial video differ from non-story-based tutorial video. If one type of video was more preferable for participants, we would expect the score of watching experience is higher than the other type of video.

Participants

College students were recruited from a mid-size research university in the Midwest area in the U.S. Student is the main patron of the university libraries, as well as the main user of library tutorial video. Focusing the user experience on student allows librarian develop better understand user experience and create proper service experience for students. The current study further targeted first-year college student since they may have limited experiences in library tutorial trainings relatively compared with the students in their second- to fourth-year. In total, 53 first-year colleague students were recruited for the study with ages ranging from 18-21 years old.

Data collection procedures

Ethical approval was obtained from the Institutional Review Board (IRB) of the author's institution before the beginning for participant recruitment. Recruitment information was sent to all first-year students through email. A preliminary inquiry about participants eligibility was conducted when people contact the researcher indicated their participation interest. Written informed consent was obtained from each participant before participating in the study. Each participant participated in two sessions, one week apart. During the first session, all participants were asked to view videos, perform tasks (based on video content), and fill out a survey questionnaire regarding their video viewing experiences, including satisfaction, engagement, and preferences of video presentations. A quick follow-up interview was followed to clarify questions raised during the session. Demographic data was also collected. At the second session, participants were asked to perform tasks based on the video content in previous session. Then watch the other video clip and fill out a survey regarding their video viewing experiences. A quick follow-up interview was followed to clarify questions raised during the session.

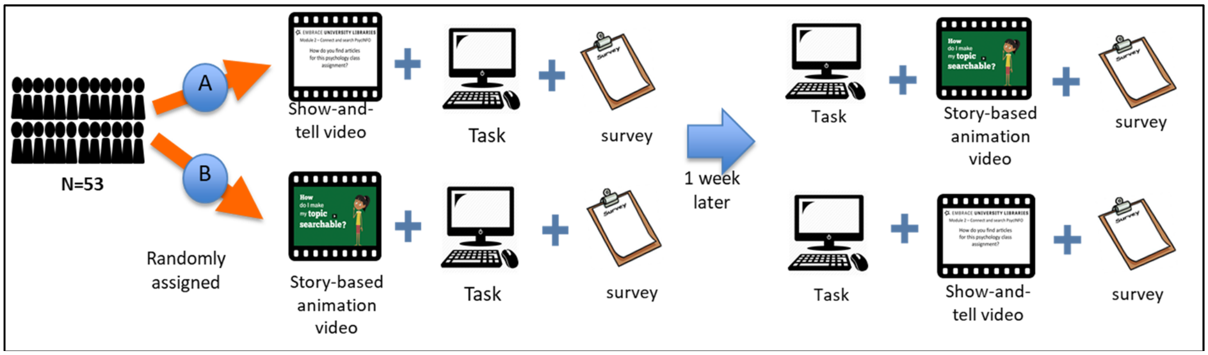

Figure 1. Data collection procedure

Data collection tool

A 22-item questionnaire was developed to assess participants' video watching experience. Four questions related to demographic characteristics, such as gender, age, and academic status, and two questions assesses participants' impression of video in general (i.e., preference and learning new). Sixteen Likert-scale questions (1= strongly disagree to 5= strongly agree) assess participants' experience and understanding of videos from three aspects including engagement, satisfaction, and confidence. Questions about engagement assess how engaging the video is based on participant's perspective. Questions related to satisfaction assess the feeling of pleasure regarding the videos. Finally, questions about confidence assess participants' confidence level to perform the task that they just watched from the video. The reliability for engagement (α = .872), satisfaction (α =.792), and confidence (α = .821) scale were good respectively. The questionnaire was distributed in both sessions. However, the questionnaire in the second session did not include four demographic items.

Data Analysis

Descriptive analysis and pair-sample t-test were used for data analysis. The collected survey data was imported into SPSS. The descriptive analysis was used to present the features of the participants, and the pair-sample t-test was applied for data analysis to examine participants perception regarding the two types of video format. An alpha level of .05 was used for all statistical tests.

Result & Discussion

Demographic information

As stated earlier, a total of 53 students participated in the study. The majority of the respondents were freshmen, came to school less than one year, and aged 18 to 21 years old. Thirty percent of the students were male, fifty-six percent of participants were female, and seven students did not answer. Descriptive statistics for participants demographic characteristics were listed in Table 1.

Prior experience

We wanted to know more about their prior experiences with library video tutorials and knowledge about the content covered in the video. So, the participants were asked if they have watched library tutorials before and if they learn anything new after viewing the video. Approximately 86% of the students reported they have never watched library tutorial videos before. Some of them have watched but they did not remember what it was at all. When asked, approximately 83% of the participants indicated they learned something new from the video; while about 10% of the students indicated that they did not.

Table 1. Descriptive characteristics of the Survey Respondents (n=53)

	N	%
Academic Status		
Freshmen	50	94.3
Sophomore	3	5.7
Age		
18-21 years old	53	100.0
Gender		
Male	16	30.2
Female	30	56.6
Not answered	7	13.2

Engagement/ satisfaction/ confidence

The results of pair-sample t-test for the mean value of engaging, satisfaction, and confidence after watching the story-based and nonstory-based library tutorial videos were listed in Table 2. Results showed the mean value of engaging rating, satisfaction, and confidence for story-based tutorial video is higher than nonstory-based video. It means participants had higher rating for story-based video than nonstory-based video. Results further indicated a significant difference in the mean of engaging rating between nonstory-based and story-based tutorial videos [t (51) = - 6.15, *p* < .001]. It means the participants felt more engaging in story-based tutorial video than nonstory-based tutorial video. On the other hand, the mean difference of satisfaction between story-based and nonstory-based video was not significant [t (52) = - 0.22, *p* = .831]. These findings reveal that participants' level of satisfaction regarding story-based tutorial video and nonstory-based tutorial video are about the same. Similar results were found in participants' level of confidence that the mean confidence between story-based and nonstory-based videos was not significant [t (52) = - 1.67, *p* = .102]. Such findings suggested that the participants' understanding of video content stayed the same after watch story-based and nonstory-based videos.

Table 2. Descriptive Statistics and t-test Results for Non-Story Based vs. Story-Based Video

	Nonstory based		Story based			95% CI for Mean		
Outcome	M	SD	M	SD	n	Difference	t	df
Engaging	3.70	0.62	4.17	0.52	52	-0.63, -0.32	-6.15*	51
Satisfaction	4.26	0.83	4.29	0.79	53	-0.29, 0.24	-0.22	52
Confidence	4.54	0.57	4.66	0.50	53	-0.27, 0.03	-1.67	52

* p < .05.

Video Preference

When participants were asked about their preferences of presentation type (cartoon animation vs. convention screencast with narrative) if given an option, most participants (76.1%) choose cartoon presentation. The participants did not give any "deep" reasons. Most of them simply said because they like it. Some did provide a little explanation about cartoon style does not seem as heavy and 'the other one was kind of boring." On the other hand, some participants feel that carton video seems "a little bit cheesy."

Performance

The unique aspect of this study was to investigate the video viewing experiences with multiple perspectives (i.e., engagement, satisfaction, confidence, and immediately learning outcome) and with actual target users, first-year students who have relatively few or no university library experience. As mentioned earlier, all participants were able to complete the given tasks taught by the video within an average of three minutes. Both types of videos worked effectively on immediate learning outcomes (i.e., perform a similar task right after watching it).

Conclusion

Overall, students more engaged in story-based library tutorial video than nonstory-based tutorial video. Based on the results, we can conclude that the format of library tutorial video had an effect on college students' engaging rating, but not satisfaction or confidence. In general, story-based video is more attractive for freshman student than nonstory-based video. If given a choice, they prefer story-based representation. The presentation style (or the representations) of the video did not make an effect on students' understanding or impression regarding video content. In other words, both representations of video had no difference regarding the impact on immediate learning outcomes. While both types of video were equally effective, we should still try to make the viewing experience more engaging or even entertaining. However, the video clips used in the present study were less than three minutes. It would be worth exploring the effect of the video representations with longer lengths (or more content) on both immediate learning outcomes as well as retention (long term learning).

This study provides insights for the instructional designer who helps with creating multimedia in support of distance education or eLearning as well as librarians who provide information literacy instruction; in particular, those using videos for online environment, and researchers who are interested in user experiences and instructional design. The author believes the story-based approach has great potential to enhance student learning in online settings; specifically, one-shot library instructions. This study tests the approach in an academic library setting with first-year college students. The results of the study potentially can lead to improvements in information literacy programs and inform library practices; in particular, those pertaining to designing, developing, and implementing better, more high-impact and innovative story-based approaches.

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Teaching Educational Technology: An Analysis of Course Syllabi from Teacher Education Programs

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Descriptors: Educational technology, Teacher education

Introduction

The literature reveals that courses on education technology are taught sporadically in teacher education programs and there are limited guidelines for course design (Hsu & Hargrave, 2000). Despite the increasing interest in integrating technology in classrooms, teachers often find themselves challenged by the lack of content-specific pedagogical strategies, and the time required to design classes (Bakir, 2016). In response to the need for baseline data for additional research and practice, the present study examines how education technology courses are taught in major teacher education programs in U.S. universities.

By reviewing the literature, we found few studies or reports have been conducted to provide a national landscape view of how educational courses are taught in teacher education in the United States (U.S. Congress, Office of Technology Assessment [OTA], 1995; Hsu & Hargrave, 2000; Moursund & Bielefeldt, 1999). The OTA study (1995) has shown that upon graduation, preservice teachers learned little about technology and its application in teaching and learning. Hsu and Hargrave (2000) surveyed 88 teacher preparation institutions, and their study results showed a shift of course content from educational media or instructional design to computer technology in teacher preparation. Their results also showed that compared with personal technology use or teacher productivity, there was a growing emphasis on integrating technology with curriculum. On the other hand, in recent years scholars and teacher educators have been advocating a stand-alone educational course in teacher education programs (Fedon, 2018; Jia, Jung, & Ottenbreit-Leftwich, 2017). They argued that together with method courses and field experiences, preservice teachers will be better prepared to integrate technology in their teaching (Fedon, 2018).

A major shift occurred in teacher education with the establishment of the International Society of Technology in Education standards (ISTE), previously known as the National Educational Technology Standards (NETS) (Bakir, 2016). In 2013, the National Council for Accreditation of Teacher Education (NCATE) adopted ISTE standards and required teacher education programs to restructure accordingly. The ISTE standards contributed to teacher education program by outlining and guiding fundamental concepts, skills, and attitudes pertaining to technology applications in educational settings (ISTE, 2008). However, there is a limited study on how ISTE standards are applied in the field.

Extensive studies have been conducted on innovative ways to improve preservice teachers' technology integration skills in teacher education programs. A study by Cherner and Curry (2017) showed that preservice teachers tend to use "low-level" technology in their practice. That is to say, instead of using technology to redefine or transform learning experiences for students, preservice teachers utilized technology to as a replacement or enhancement of existing educational activities. Results showed that the level of using technology shift higher as preservice teachers became more experienced and progressed through their internship. In another study, Zipke (2018) reported on the impact of a newly designed course that emphasized authentic learning experienced and field-based applications. Results showed an improvement of technology use in preservice teachers' lesson planning. On the other hand, several studies have shown that preservice teachers improved proficiency in technology use and felt interested in utilizing technology after various interventions, but they were not confident to use technology in their own class later on (Fedon, 2018; Zipke, 2018). Zipke (2018) suggested that it was crucial for preservice teachers to have constant training, modeling, and support from inservice teachers who were tech-savvy in order to extend what they have learned in teacher education programs. By reviewing the literature, we found that more recent data is needed for deeper and more vigorous analysis on how educational technology is taught in teacher education. The following questions guided our research agenda:

1. How is education technology taught in teacher education programs in the United States?
2. What are the foci of learning objectives in educational technology courses?
   a. How are these course objectives aligned with ISTE Standards for Educators?
3. What pedagogical features do education technology syllabi emphasize?
   a. What sources do educational courses use as text or reading(s)?
   b. What technological skills are embedded in educational technology courses?

Theoretical Framework

Ample studies have been conducted to examine pedagogical features associated with positive changes in teachers' knowledge, skills, attitudes, and teaching practices. For example, Darling-Hammond et al. (2017) identified seven course characteristics of effective professional development based on their extensive review of the literature. Courses for technology integration were also studied (An, 2018). By reviewing the literature (An & Reigeluth 2011; Asghar, Ellington, Rice, Johnson, & Prime, 2012; Garet, Porter, & Desimone, 2001), we have developed a combined codebook of pedagogical features (RQ3), which includes eight categories: subject specific, active learning, coherence, models and modeling, coach and expert support, collaboration, feedback and reflection, and technical skills. Description of each category is listed in Table 1.

Table 1. Effective pedagogical features of professional development

Subject focus	This element includes an intentional focus on discipline-specific curriculum development and pedagogies in areas such as mathematics, science, or literacy. (Darling-Hammond et al., 2017; Asghar et al., 2012). If a course has assignments or other course elements that entail subject-specific technology integration ideas, it would also count (An & Reigeluth, 2011).
Active learning	Active learning engages pre-service teachers directly in designing and trying out teaching strategies, providing them an opportunity to engage in the same style of learning they are designing for their students. Such PD uses authentic artifacts,

	interactive activities, and other strategies to provide deeply embedded, highly contextualized professional learning. This approach moves away from traditional learning models and environments that are lecture based and have no direct connection to classrooms and students. (Darling-Hammond et al., 2017).
Coherence	A PD activity is more likely to be to effective if it forms a coherent part of a wider set of opportunities for pre-service teacher learning and development. (Garet et al., 2001; Asghar et al., 2012). Three dimensions: the extent to which it builds on what teachers have already learned; emphasizes content and pedagogy aligned with national, state and local standards, frameworks, and assessments; and, support teachers in developing sustained, ongoing professional communication with other teachers who are trying to change with their teaching in similar ways.
Collaboration	"Collaboration" can span a host of configurations—from one-on-one or small-group interactions to schoolwide collaboration to exchanges with other professionals beyond the school (Darling-Hammond et al., 2017).
Use of Models and Modeling	PD that utilizes models of effective practice has proven successful at promoting pre-service teacher learning and supporting student achievement. Curricular and instructional models and modeling of instruction help pre-service teachers to have a vision of practice on which to anchor their own learning and growth. The various kinds of modeling can include (Darling-Hammond et al., 2017): video or written cases of teaching, demonstration lessons, unit or lesson plans, observations of peers curriculum materials including sample assessments and student work samples concrete sample activities and modules that were ready to go (Asghar et al., 2012)
Coaching and expert support (who delivered PD or provided support)	Coaching and expert support involve the sharing of expertise about content and evidence-based practices, focused directly on pre-service teachers' individual needs. (Darling-Hammond et al., 2017).
Feedback and reflection	Feedback and reflection are two other powerful tools found in effective PD; they are often employed during mentoring and coaching but are not limited to these spaces (Darling-Hammond et al., 2017). Feedback from peers Self-reflection of learning and practice (e.g. journal)
Technological skills	Technology skills in the context of designing learner-centered learning activities in their subject areas (An & Reigeluth, 2011).

ISTE standards contribute to teacher education by outlining and guiding fundamental concepts, skills, and attitudes pertaining to technology applications in educational settings. In the current study, ISTE Standards for Educators (See Table 2) are used as guidelines to analyze learning objectives in the course syllabi that we collected.

Table 2. International Society of Technology in Education Standards for Educators (ISTE, 2016)

Domain	Description
Learner	Educators continually improve their practice by learning from and with others and exploring proven and promising practices that leverage technology to improve student learning.
Leader	Educators seek out opportunities for leadership to support student empowerment and success and to improve teaching and learning.
Citizen	Educators inspire students to positively contribute to and responsibly participate in the digital world.
Collaborator	Educators dedicate time to collaborate with both colleagues and students to improve practice, discover and share resources and ideas, and solve problems.
Designer	Educators design authentic, learner-driven activities and environments that recognize and accommodate learner variability.
Facilitator	Educators facilitate learning with technology to support student achievement of the 2016 ISTE Standards for Students.
Analyst	Educators understand and use data to drive their instruction and support students in achieving their learning goals.

Method

Education technology courses for prospective teachers often go by different names, such as "Education Technology," "Technology Integration," and "Computer Applications in Teaching." Most of these courses are offered by Schools/College of Education (SCOE) in the fall and spring semesters.

In order to answer how education technology is taught in teacher education programs in the United States (RQ1), we selected one university with the largest preservice teacher enrollment in its state in 2017, according to National Teacher Preparation Data (US Department of Education, 2017), from each U.S. state as a representative university (total n=50). We then collected teacher education program information on these 50 universities' websites and whether educational technology courses were included in their teacher education degree plan. Data is reported descriptively.

To look into course objectives, course alignment with ISTE Standards (RQ2), and pedagogical features of educational technology courses (RQ3), we solicited course syllabi from the same education programs in RQ1 via email. Contact information of course instructors was collected on university websites. If no instructor was found, we contacted the director of teacher education programs for a referral to relevant course instructors. Reminders were sent two weeks after the initial request. As the time of writing this conference proceeding, we have collected and analyzed 20 course syllabi from 12 universities in 12 states, as it turned out some universities have more than one educational course in teacher education. The following information was recorded for each syllabus (Merced, Stutman, & Mann, 2018): learning objectives, course assignments, required textbooks, and types of supplementary resources (e.g., journal articles, educational news, videos).

The guidelines of Strauss and Corbin (1990) were followed in the coding of learning objectives (RQ2). First, each learning objective was independently coded by two researchers to generate a list of initial codes. Each code represented one single idea and if a learning objective had more than one idea, each idea counted once, which lead to a list of 187 learning objective ideas for a total 20 of course syllabi. Then the third and fourth researchers reviewed and verified the codes and resolved any disagreement. If there were any questions, the entire research team met again and revisited the raw data, codes, and made necessary adjustments to ensure data validity and reliability. Using the constant comparative method (Creswell & Creswell, 2017), we made coding modification, realignment, and refinement during the coding and recoding process. This process went through iterative cycles until codes were categorized, and 100% inter-rater reliability was reached. After we categorized learning objectives, we coded it with ISTE Standards for Educators (See Table 2) to see to what extent they were matched.

Course pedagogical features (RQ3) were analyzed qualitatively (Creswell & Poth, 2013). We first looked for instances in course syllabi that reflected pedagogical features in the Effective Pedagogical Features of Professional Development framework (See Table 1). Each syllabus was coded by at least two researchers and researchers met regularly to compare notes. Discrepancies were discussed and resolved until 100% inter-rater reliability was reached.

In the following section, we present the results of our preliminary study, an analysis of 20 course syllabi from 12 U.S. universities. Course short names[1] would be used to denote courses when we present data, such as ISTC 302 or EDTL 6272.

Results

Educational Technology Courses in The United States. According to our results, 32 out of 50 universities (64%) require an education technology course(s) for at least one certification area in their teacher education program. Among the 32 universities, 18 universities (36%) offer education technology courses in all their teacher education certification areas. Some universities only require students from certain majors to take the course (n=10, 20%). For instance, an education technology course is only required for undergraduates in Mathematics and Science teacher certification at the University of Georgia.

There are 16 out of 50 universities (32%) do not provide education technology course in undergraduate teacher education programs. Instead, educational technology is embedded in other courses taught in teacher education. Among the 16 non-edtech-course universities, there are three universities (6%) that require the course in their graduate level teacher education programs. In addition, two universities (4%) have an undergraduate minor in educational technology, which is an add-on to their preservice teacher programs, and aim for preparing teacher candidates for technology integration within the instructional contexts where they will teach.

For the 20 course syllabi we collected so far, four of them are optional courses, the other 16 courses are required for at least one certification area in teacher education. Most courses are for undergraduate level (n=17); three course delivery formats were revealed: face-to-face (n=6), blended (n=8), and online (n=6).

Foci of Learning Objectives. Among 187 learning objectives from 20 course syllabi, a total of seven categories emerged (See Table 3). Results show that designing and developing a technology-rich environment to facilitate K-12 student learning is the most frequently mentioned learning objective (42.2%; n=79), which usually involve master technical skills and incorporate digital tools with curriculum and instructional materials. Promoting teacher candidates' digital literacy is another major focus of these courses (18.2%; n=34), which include evaluating and selecting new information resources, implementing digital assessments and using resulting date to inform teaching. Developing knowledge around ethical issues of technology integration is mentioned less often (9.1%; n=17) and focused on including digital equity and responsible social interactions. A certain amount of learning objectives has shown a focus on teachers' awareness of developing digital literacy and 21st century skills of K-12 students (8.0%; n=15), such as critical thinking, creativity, problem-solving skills and collaboration. The category of developing professional learning networks, on the other hand, is less covered in these courses (11.2%; n=21). Teachers are taught to continue to learn and develop their skills within and outside of an digital learning community. In terms of demonstrating pedagogical knowledge and skills (7.0%; n=13), 13 learning objectives out of 187 are categorized in this category. Even though a majority of course objectives are aligned with certain national standards, only in a few courses student teachers themselves are taught to know or use these standards. Only 8 learning objectives among 187 mentioned student teachers should properly explain standards to K-12 students and their colleagues (4.3%; n=8).

Table 3. Learning objectives in educational technology courses

	Categories	Example	Percentage
A	Demonstrate knowledge, skills and participation of designing and developing technology-enriched learning experiences.	Design and customize technology-enriched learning experiences to engage students in activities that deepen understanding in core subject areas (ED 308/CE 444).	42.2% (n=79)
B	Demonstrate proper attitudes towards technology; develop digital literacy to support teaching and learning.	Model and facilitate effective use of current and emerging digital tools to locate, analyze, evaluate, and use information resources to support research and learning (ED 408).	18.2% (n=34)

[1] Course short names were modified to protect data privacy.

C	Demonstrate concerns and consideration of ethical issues in technology integration and use, including digital etiquette and responsible social interactions.	Demonstrate the basic principles of computer ethics and legalities to ensure compliance by professionals and students with laws, guidelines, licenses and security in the use of all media (ED 305).	9.1% (n=17)
D	Knowledge of K-12 student learning in a digital age; focus on using various digital tools to promote students 21st century skills.	Identify and discuss the critical skills, referred to as 21st century skills, essential to student success and vocational preparation in the 21st century and beyond (ED 307).	8.0% (n=15)
E	Develop professional learning network, continue to learn and develop their skills within and outside of an electronic learning community.	Craft a professional learning network, articulating clear goals for continued professional growth and documenting the development of digital skills (EDTL 6270).	11.2% (n=21)
F	Demonstrate pedagogical knowledge and skills.	Compare and contrast a variety of partnering pedagogies, including inquiry-, problem- and project-based methodologies (ED 307).	7.0% (n=13)
G	Knowledge of standards and requirements.	Explain the use of ISTE NETS for students and teachers (ED 410).	4.3% (n=8)
	Total		100% (n=187)

Course Alignment with ISTE Standards for Educators. Our results show an uneven distribution of course content aligning with the ISTE Standards for Educators (2016) (See Figure 1). Most of course learning objectives fell into *Designer* category (n=92, 47%), that is to design technology-enriched learning experience for students. However, compared with ISTE's emphasis on designing authentic and learner-driven activities (ISTE, 2016), most learning objectives in our data corpus put more emphasis on the mastery of computer skills and general technology integration in curriculum. For example, *learn how to use a variety of technology and media resources* (ISTC 301), *develop the basic understanding of productivity and utility software capabilities and be able to use a variety of applications* (EDLT) and *gain experience in planning to integrate technology into the classroom curriculum* (ISTC 301).

There are 42 learning objectives (21%) that could be categorized in *Citizen* domain of ISTE Standards (ISTE, 2016). To be specific, most of the content (n=32, 17%) covers the digital literacy aspect of *Citizen*, e.g. the "establishment of a learning culture that promotes curiosity and critical examination of online resources and fosters digital literacy and media fluency" (ISTE, 2016, p.1) while only a portion (n=10, 5%) covers the ethical aspects of *Citizen*, e.g., "Mentor students in the safe, legal and ethical practices with digital tools and the protection of intellectual rights and property" (ISTE, 2016, p.1).

Following *Citizen*, the next ISTE categories that have the largest number of learning objectives in our data corpus is *Learner* (n=16, 8%) and *Facilitator* (n=16, 8%). First, to be a successful educator in the digital age, ISTE requires teachers to continually improve their knowledge and practice of utilizing technology in a professional learning network. On the other hand, ISTE stressed that teachers need to utilize technology to facilitate student learning in digital age, e.g. taking ownership of their learning goals and outcome, becoming digital content creator. However, our data shows more emphasis on facilitating student critical thinking, creativity and communicative skills. For instance, *promote the development of 21st century skills such as creativity, critical thinking, problem solving, and communication* (ED 308).

As for *Collaborator* (n=14, 7%), our data shows that most of the collaboration in educational technology courses refers to collaboration with colleagues, while ISTE Standards have a unique aspect of collaborating and communicating with K-12 students (ISTE 2016). Given the context of these courses are taught in preservice teacher education programs, it is understandable that course instructors do not put much focus on collaboration with K-12 students.

Results show a limitation of teaching pre-service teachers to be *Leaders* (n=7, 4%) or *Analysts* (n=9, 5%) in educational technology courses. According to ISTE's description on *Leader* (2016), educators need to seek out opportunism to engage with educational stakeholders for student learning empowerment, model digital literacy for colleagues, and advocate for digital equity for all students. Our data show all 7 learning objectives are modeling effective technology use for colleagues and K-12 students. As for *Analyst*, there are nine learning objectives that cover using digital assessment tools and having data-driven decisions.

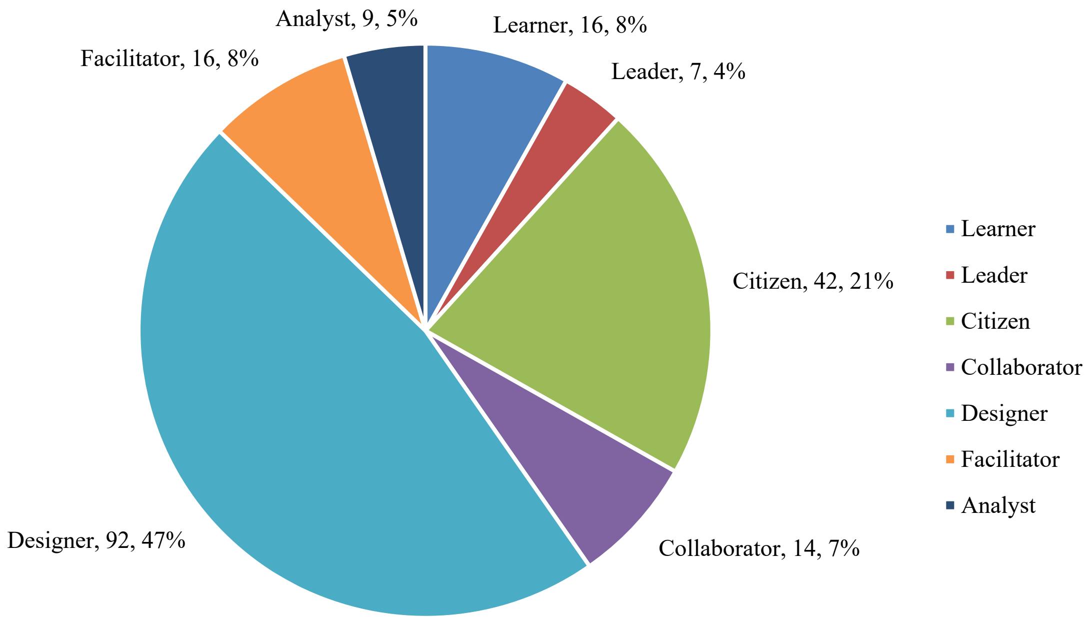


Figure 1. Course Alignment with ISTE Standards

Pedagogical Features. Results show an extremely uneven distribution of pedagogical features among the 20 courses we examined. First, 19 courses were not subject-specific, except for *EDTL 6270 Technology and the Reading Classroom*. There were 14 courses had active learning opportunities that engaged students directly in their practice. For example, in ED 305 Technology & Media in Education, student teachers are required to use SoftChalk course authoring software to create a developmentally appropriate lesson covering the topic of digital citizenship. In this assignment, students are given a chance to develop and practice skills that they will use for their future classrooms.

More than half of the courses required group projects that entailed collaboration. Four courses incorporated models of effective practice in their instruction, either from inservice teachers or previous students. There are 19 courses that required students to master some amount of technical skills. Regarding Coherence, 18 courses touched on at least one dimension, but most of them were not comprehensive. For instance, 18 out of 20 courses are aligned with national or state standards in their syllabus (Coherence 2), but only two courses mentioned that the course content is built on what teachers have learned before (Coherence 1) and seven courses had provided learning chances that support teachers in developing sustained, ongoing professional communication. For Coaching and expert support, four courses indicated that students should talk to the course instructors and receive guidance prior to some assignments. Over half of the courses used peer feedback and provided opportunities for reflection.

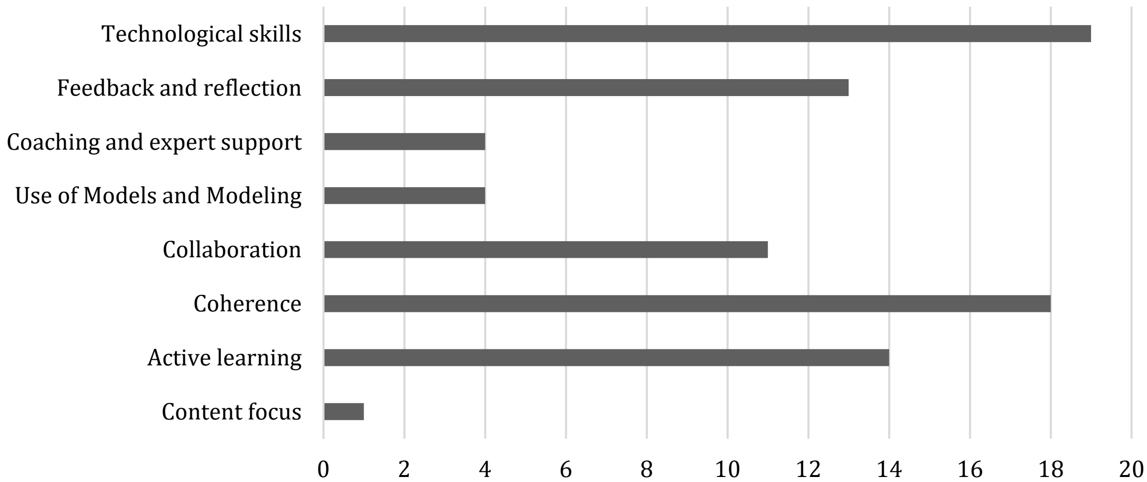


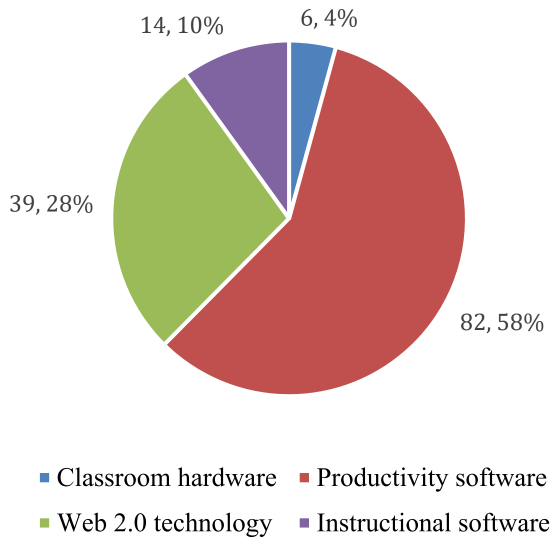
Figure 2. Distribution of course pedagogical features

Readings and Resources. Among 20 courses, six courses required textbooks in their syllabi and only one course required students have a lecture capture software, Snaglt. The other courses used a variety of resources, including news reports, materials written by instructors, blogs, educational websites, videos, and journal articles. Four courses provided supplementary resources for student learning, which included educational websites, blogs, news websites, videos, government report, state standards, journal articles, and book chapters. Notably, the types and range of instructional resources varied drastically from course to course. For example, one course does not require a textbook, but instead offers a wide range of resources from practitioner perspectives, including news, EdTech news, and government reports. On the other hand, another course used only one type of resource (journal articles) for its required and supplementary materials (See Appendix I).

Technological Skills. In the examination of educational technology course syllabi, we identified four categories of technological tools that preservice teachers were required to learn in class, including classroom hardware, productivity software, Web 2.0 technology and instructional software. We used the following inclusion criteria:

- Classroom hardware – tools and equipment that teachers and/or students use in class.
- Productivity software – application software used for producing information, such as documents, presentations, worksheets, charts, graphs, and digital video.
- Web 2.0 technology – tools and websites that emphasize user-generated content and participatory culture for end users.
- Instructional software – application software that include text, pictures, sounds, animations, and other various media used specifically to teach content-specific knowledge and skills.

Our results show that most technological skills that were required from preservice teachers were the mastery of productivity software (n=82, 58%). It reflects that producing digital content, e.g., slides, digital lesson plan and images, is seen as the most important technological aspect in teacher education. Another relatively large aspect is the use of Web 2.0 tools (n=39, 28%). What is worth mentioning is, besides the fluency in using Google Suites, many courses require preservice teachers to create websites or blogs as course assignments. As for instructional software (n=14, 10%), most of applications mentioned in technology courses for pre-service teachers are learning manage system (LMS), while it also includes lecture capture software (SnagIt), and online assessment tool (Quizlet). Classroom hardware is the least mention technology tools for preservice teachers to master (n=6, 4%), which include assistive technology, laptop, interactive white boards (IWB) and Clickers, an assessment tool.



Discussion & Implications

According to the results from our preliminary study, we found remarkable variations in the ways education technology is taught in teacher education programs. Each course had its own emphasis either on technical skills, pedagogical knowledge, or history and theories, reflected in the resources they cited/utilized. The present study could provide meaningful information for designing and teaching educational technology in teacher education programs while providing a current snapshot of the field.

Advocate for a stand-alone technology course in teacher education programs. First, we found out that only part of teacher education programs in our sample offered educational technology courses. Previous studies have suggested that a stand-alone technology course is beneficial for teachers' knowledge and skill development, and future practice with technology (Fedon, 2018). Thus, we suggest there should be a place for educational technology courses in teacher preparation sequence.

More content specific educational technology course in teacher education is needed. Among all 20 courses we examined in the study, only one is subject specific. However, literature has shown that one major feature of effective professional development is discipline specific (Darling-Hammond et al., 2017; Asghar et al., 2012; An & Reigeluth, 2011). They argued that this type of professional development gave teachers "the opportunity to study student work, test out new curriculum with their students, or study a particular element of pedagogy or student learning in the content area" (Darling-Hammond et al., 2017, p.5). Technology courses should have content specific focus as well (An, 2018).

Further effort is needed to align course content with the national technology standards. Our data shows that even though some courses were designed in line with some aspects of national standards, there are some improvement needed. First, instructors should update their references with a newer version of the standards. For example, we found out the prevalent use of NETS in course syllabi while NETS has changed its name and content to ISTE in 2007 and has released a couple of updated versions since. Second, a more comprehensive and in-depth reflection of ISTE standards needs to be considered at designing educational courses. Our results show an uneven distribution of alignment with ISTE standards. Nearly half of the courses learning objectives focus on preparing preservice teachers to become *Designer* (e.g., designing technology-enriched learning experiences for K-12 students), while only 4% has touched on developing professional learning network (e.g., *Learner*). What's more, even within the most popular *Designer* category, many courses didn't reflect the essence of ISTE standards. Compared with ISTE's emphasis on designing authentic and learner-driven activities (ISTE, 2016), most learning objectives in our data corpus remains on the level of the mastery of computer skills and general technology integration in curriculum.

Technology in courses. Our study suggests that technological skills embedded in educational technology courses should move to a higher-level, e.g., from productivity to instructional software, from teacher-centered to student-centered. Our study has confirmed previous study results that the focus of technology use in teacher preparation is still teacher centered and often involves productivity and efficiency (Cherner & Curry, 2017; Hughes, Cheah, Shi, & Hsiao, 2019).

Limitation

The current study has a few a limitation. First, it collected data from only 50 universities that prepare the largest number of teachers. Second, for RQ2 and RQ3, we collected and analyzed course syllabi, which are limiting in many ways. Course syllabi outline the basics of a course, but they do not describe how the course is actually implemented in practice. Some course syllabi were less detailed than others and didn't include enough description of assignments or tasks. Despite these limitations, the need for examining how educational technology courses are taught is needed in the field.

Conclusion

This qualitative research study collected data on teacher education programs and examined course syllabi of education technology that are taught in major teacher education programs in U.S. universities. We are interested in how the course is taught and what pedagogical features do these courses emphasize. Our results revealed a wide range of course objectives, which mostly focus on developing student teachers' knowledge and skills to design and develop a technology-rich environment; on the other hand, ethical issues and professional learning are covered less. Most courses are non-subject specific but certain assignments would involve students to incorporate subject ideas. The present study could provide meaningful information for designing and teaching educational technology in teacher education programs while providing a current snapshot of the field.

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Appendix I Required & Supplementary Resources in Educational Technology Courses:

Required/Optional	Types	Titles
Required	Software	Lecture capture software – SnagIt can be purchased for 29.95 through the educators discount: https://www.techsmith.com/products.html
Required	Book	Roblyer, M. D. and Hughes, J. E. (2019). *Integrating Educational Technology into Teaching* (8th ed.). New York, NY: Pearson Education, Inc.
Required	Book	Hall, T. H, Meyer, A., & Rose, D. H. (Eds.). (2012). *Universal Design for Learning in the Classroom: Practical Applications*. New York, NY: Guilford Press
Required	Book	Bender, W. B. (2012). *Technology and the New Differentiated Instruction from Differentiating Instruction for Students with Learning Disabilities: New Best Practices for General and Special Educators*. Thousand Oaks, CA: Corwin
Required	Book	Bender, W. B. (2012). *Technology and the New Differentiated Instruction from Differentiating Instruction for Students with Learning Disabilities: New Best Practices for General and Special Educators*. Thousand Oaks, CA: Corwin
Required	Book	Prensky, M. (2010). *Teaching digital natives: Partnering for real learning*. Thousand Oaks, CA: Corwin.
Required	Book	Simonson, M. R. (2012). *Teaching and learning at a distance: Foundations of distance education*. Boston: Allyn & Bacon.
Required	Book	Lindsay, J. (2016). *The Global Educator: Leveraging Technology for Collaborative Learning and Teaching*. Arlington, VA: International Society of Technology in Education
Optional	Book	Jonassen, D.H. (2006). *Modeling with technology: Mind tools for conceptual change (*3rd ed.). Upper Saddle River, NJ: Prentice Hall.
Optional	Book	Newby, T. J., & Lewandowski, J. O. (2013). *Teaching and learning with Microsoft Office 2010 and Office 2011 for Mac*. Upper Saddle River, NJ: Pearson
Optional	Book	O'Blannon, R.W., & Puckett, K. (2007). *Preparing to use technology: a practical guide to curriculum integration*. Boston: Allyn & Bacon.
Optional	Book	Prensky, M. (2010). *Teaching digital natives*. Thousand Oaks, CA: Corwin
Optional	Book	Rice, K. (2012). *Making the move to K-12 online teaching: Research-based strategies and practices.* Boston: Allyn & Bacon.
Optional	Book	Roblyer, M.D., & Edwards, J. (2006). *Integrating educational technology into teaching* (4th ed.) . Upper Saddle River, NJ: Prentice Hall.
Optional	Book	Bellanca, J. (2010). *Enriched Learning Projects: A Practical Pathway to 21st Century Skills*. Bloomington, IN: Solution Tree Press

Optional	Book	DuFour, R., DuFour, R., Barell, J., Darling-Hammond, L., Dede, C., Fisher, D., Fogarty, R. J. (2010). *21st Century Skills: Rethinking how Students Learn. Bloomington*, IN: Solution Tree Press.
Optional	Book	Jacobs, H. H. (2010). *Curriculum 21: Essential Education for a Changing World*. Alexandria, VA: ASCD.
Optional	Book	Prensky, M. (2005). *Don't bother me mom – I'm learning!* St. Paul, MN: Paragon House.
Optional	Book	Prensky, M. (2001). *Digital game-based learning*. Columbus, OH: McGraw Hill.
Optional	Reference	Academic OneFile - Academic database with millions of articles in full text with extensive coverage of the physical sciences, technology, medicine, social sciences, the arts, theology, literature and other subjects.
Optional	Reference	Academic Search Premier - Large academic multidisciplinary database with full-text for over 4,000 magazines and journals, 90% of which are peer-reviewed
Optional	Reference	Access Science - Electronic version of the McGraw-Hill Encyclopedia of Science & Technology, featuring information on more than 7,000 scientific topics
Optional	Reference	Chronicle of Higher Education - College and university-related news articles and job information
Optional	Reference	ERIC - Citation and abstract information from over 1,000 journals in education
Optional	Blog	Davis, V. (n.d.). Cool Cat Teacher Blog. Retrieved from http://coolcatteacher.blogspot.com/
Optional	Website| Mindshift	Duncan, A. (n.d.). Mindshift: How we will learn. Retrieved from http://blogs.kqed.org/mindshift/
Optional	Website| Edutopia	George Lucas Educational Foundation. (2012). Edutopia. Retrieved from http://www.edutopia.org/
Optional	Website| ISTE	International Society for Technology in Education. (2012). NETS: Advancing digital age teaching. Retrieved from http://www.iste.org/standards/nets-for-teachers.aspx
Optional	Book	Williams, R. (2014). *The Non-Designer's Design Book 4th Edition*. New York, NY: Pearson Education, Inc.

Open and Distance Learning in Turkish Journals

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Descriptors for use in the index: Open and distance learning (ODL), Systematic review of research, Turkish Journals

Abstract

The goal of this paper has two folds: First was to analyze the research articles published in 3 widely accepted journals published in Turkey to be able to explore the current trends in the field of ODL research during the period 2010-2015. Based on this analysis, second, it it tries to draw a big picture about the issues and problems in ODL research in Turkey. The results, or lessons drawn from this study can be summarized as: technology integration to traditional education is gaining importance, the focus of the research studies has shifted from teachers to learners, educational technology, learner characteristics as well as theories and models are the most common research areas, achievement is the most focused variable among Turkish researchers, quantitative research method is also the most popular research method, the references and authors cited in the articles are quite diverse from all over the world.

Introduction

Turkey met open and distance learning nearly sixty years ago and then due to the advancements in information and communication technologies (ICT), open and distance learning has evolved deeply. In addition to these developments, new implementations, pedagogies, theories and models have occurred globally in the field of open and distance learning. Harasim (2000) states that Web technologies made online education increasingly open, accessible and flexible which allowed new pedagogical models to emerge and reasoned the revolution in digital knowledge age that enabled greater and faster human communication and collaboration and led to fundamentally new forms of economic activity that produced the knowledge economy and required basic changes in education.

Turkey has always been trying to keep up with these improvements. Today, the number of distance education providers in Turkey has reached to 88. According to Higher Education Council (HEC) statistics (2018), there are nearly 8 million students in higher education and nearly 2 million of them are distance learners. This means that there is great demand for open and distance learning. In order to be able to response this demand, educators and administrators must have the latest knowledge and skills about current trends in the field.

Although open and distance learning has a long tradition in Turkey in terms of practice, the research published in Turkish journals is a bit less than it has to be. In order to spot the open and distance learning trends and provide a detailed list of current research trends in Turkey, this study proposes to fill the gap in the field of open and distance learning research conducted and published in Turkey.

Literature Review

Systematic review of research has been accepted as a research method for some time as a result of the studies employed this method over the last couple decades. In the field of ODL, we observed several major systematic reviews. One of them, for instance, was carried out by Berge and Mrozowski (2001) who examined the ODL literature between the years 1990 and 1999. In this research, the author reviewed 890 articles under the categories proposed by Sherry (1996): participants, technology selection and adoption, design issues, strategies to increase interactivity and active learning, learner characteristics, learner support, operational issues, policy and management issues, equity and accessibility, and cost/benefit trade-offs. The results showed that pedagogical themes and strategies for active learning were the most frequent topics used in the field.

Another major study was conducted by Lee, Driscoll and Nelson in 2004. They examined 383 articles published in four journals (The American Journal of Distance Education-AJDE, the Journal of Distance Education - JDE; Distance Education-DE, and Open Learning-OL) from 1997 to 2002. The authors have examined the articles based on topics, research method, the statistical analyses, citation of authors, and the cited books.

Zawacki-Richter, Bäcker, and Vogt (2009) conducted an extensive study by examining the 695 articles published in five prominent journals of ODL. The authors limited their study with the articles published between the years 2000 and 2008. Their study concluded that interaction and communication patterns in computer-mediated communication, instructional design issues, learner characteristics, and educational technology are the most frequently investigated topics in ODL research domain. Later, in one another study, Zawacki-Rihter (2009) developed a set of categories showing the research areas in the field of OLD which became one of the widely used categorization of the research topics in ODL. To be able to make this categorization, a Delphi study and an extensive literature review were carried out. As a conclusion, 15 research areas that were organized into 3 broad categories were created (Table 1).

Table 1. Classification of Research Areas in Distance Education

Macro level: Distance education systems and theories.
1. Access, equity, and ethics: The democratization of access to DE afforded by new media and by finding ways to deliver high-quality education to those who have limited resources and poor infrastructure; issues that refer to the (sustainable) provision of DE in developing areas. What is the impact of DE (e.g., via mobile learning) on narrowing the digital divide and what is the role of ICT (information and communication technologies) and/or OER (open educational resources) in terms of access to education?
2. Globalization of education and cross-cultural aspects: Aspects that refer to the global external environment and drivers, the development of the global DE market, teaching and learning in mediated global environments, and the implications for professional development.
3. Distance teaching systems and institutions: DE delivery systems, the role of institutional partnerships in developing transnational programmes, and the impact of ICT on the convergence of conventional education and DE institutions (hybrid or mixed mode).
4. Theories and models: Theoretical frameworks for and foundations of DE, e.g., the theoretical basis of instructional models, knowledge construction, interaction between learners, or the impact of social constructivism learning theories on DE practice.
5. Research methods in distance education and knowledge transfer: Methodological considerations, the impact of DE research and writing on practice, and the role of professional associations in improving practice. Literature reviews and works on the history of DE are also subsumed within this area.
Meso level: Management, organization, and technology.
6. Management and organization: Strategies, administration, and organizational infrastructures and frameworks for the development, implementation, and sustainable delivery of DE programmes. What is required for successful leadership in DE? DE and policies relating to continuing education, lifelong learning, and the impact of online learning on institutional policies, as well as legal issues (copyright and intellectual property).
7. Costs and benefits: Aspects that refer to financial management, costing, pricing, and business models in DE. Efficiency: What is the return on investment or impact of DE programmes? What is the impact of ICT on the costing models and the scalability of DE delivery? How can cost effective but meaningful learner support be provided?

8. Educational technology: New trends in educational technology for DE (e.g., Web 2.0 applications or mobile learning) and the benefits and challenges of using OERs, media selection (e.g., synchronous vs. asynchronous media), technical infrastructure and equipment for online learning environments, and their opportunities for teaching and learning. **9. Innovation and change:** Issues that refer to educational innovation with new media and measures to support and facilitate change in institutions (e.g., incentive systems for faculty, aspects referring to staff workloads, promotion, and tenure). **10. Professional development and faculty support:** Professional development and faculty support services as a prerequisite for innovation and change. What are the competencies of online teachers and how can they be developed? **11. Learner support services:** The infrastructure for and organization of learner support systems (from information and counselling for prospective students about library services and technical support to career services and alumni networks). **12. Quality assurance:** Issues that refer to accreditation and quality standards in DE. The impact of quality assurance and high quality learner support on enrolments and dropout/ retention, as well as reputation and acceptance of DE as a valid form of educational provision.
Micro level: Teaching and learning in distance education.
13. Instructional design: Issues that refer to the stages of the instructional design process for curriculum and course development. Special emphasis is placed on pedagogical approaches for tutoring online (scaffolding), the design of (culturally appropriate) study material, opportunities provided by new developments in educational technology for teaching and learning (e.g. Web 2.0 applications and mobile devices), as well as assessment practices in DE. **14. Interaction and communication in learning communities:** Closely related to instructional design considerations is course design that fosters (online) articulation, interaction, reflection, and collaboration throughout the learning and teaching process. Special areas include the development of online communities, gender differences, and cross-cultural aspects in online communication. **15. Learner characteristics:** The aims and goals of adult learners, the socioeconomic Background of DE students, their different learning styles, critical thinking dispositions, and special needs. How do students learn online (learner behavior patterns, learning styles) and what competencies are needed for distance learning (e.g., digital literacy)?

One of the major systematic reviews carried out by Turkish researchers (Bozkurt et al, 2015) included 861 articles published during 2009 and 2014 in the 7 peer-reviewed and indexed by the major well-known indexes: The American Journal of Distance Education (AJDE), Distance Education (DE), The European Journal of Open, Distance and e-Learning (EURODL), The Journal of Distance Education (JDE), The Journal of Online Learning and Technology (JOLT), Open Learning: The Journal of Open, Distance and e-Learning (OL) and The International Review of Research in Open and Distributed Learning (IRRODL). The authors also conducted content analysis and social network analysis. Their main goal was to see if there were any changes in terms of trends and issues in ODL research after the Zawacki-Richter's study (2009). Their study concluded that distance education and open and distance learning terms are being used more frequently than before, which is considered as a paradigm shift in education.

Purpose and Research Questions

Although it is possible to find studies showing trends and issues in DE field on international basis from 1990s to 2014, there are no studies showing the trends of Turkish research domain published in a Turkish journal. It is also possible to find some similar studies showing the current trends about education technology (Göktaş et al., 2012, Bozkaya et al., 2012) but none of them has a specific focus on open and distance education. This study was carried out to fill the gap and also to show the research areas most frequently used in the Turkish research domain. In addition, this study aims to provide comprehensive information for further research and to set light to recent ODL trends that might be useful for researchers.

To be able to provide comprehensive information and to brighten the research domain following research questions were used:

What are the most frequent/ly

1. indicated keywords,
2. chosen research areas,

3. emphasized theoretical/conceptual backgrounds,
4. employed research designs,
5. used data collection instruments and data analysis techniques,
6. focused variables,
7. targeted population and/or participant groups,
8. cited references,
9. cited authors in ODL research articles between 2010 and 2015?

Method

This descriptive study was conducted with the same methodology as the study by the Bozkurt et al. (2015) due to the fact that both were conducted as a part of a doctoral level course offered by the same professor, Cengiz Hakan Aydin. So, a content analysis was employed to analyze the articles for the purpose of answering the questions identified. Berelson (1952) defined content analysis as a systematic and replicable technique for classifying many words of text into fewer categories based on explicit rules of coding. After choosing the research design, a set of criteria was developed for the themes to be studied and the content of articles in the selected journals was coded according to these pre-set categories. Journals that are published by a Turkish institution in Turkish, a publication history of 10 years or more, a specific focus on DE and open and distance learning context, and indexed by the web of science indexes included into the study. Total four journals met the criteria: Hacettepe University's College of Education Journal (Hacettepe Eğitim Fakültesi Dergisi-HEF), Theory and Practice of Educational Sciences (Kuram ve Uygulamada Eğitim Bilimleri Dergisi-KUYEB), Journal of Education and Science (Eğitim ve Bilim Dergisi), and Türkiye ve Orta Doğu Amme İdaresi Enstitüsü Dergisi (TODAIE). Two of these journals (KUYEB and TODAI) were excluded the web of science's indexed after this study. Also, during analyses, no articles directly related to the field of ODL was found in one of these four journals, namely in TODAIE. So, it was excluded from the study.

Table 2. Journals and number of articles included into the study

JOURNALS	2011	2012	2013	2014	2015	2016	Total (N)
HEF	3	2	4	3	1	4	**19**
KUYEB	1	4	4	3	2	1	**13**
Education and Science	1		4	5	3	7	**20**
TOTAL	**5**	**6**	**12**	**12**	**6**	**12**	**52**

All articles published between 2011 and 2016 (N=1349) were reviewed thoroughly by each author individually. Total 52 articles were identified as research articles and others which are either irrelevant to ODL research or identified as other (editorials, book reviews, interviews, concept papers, position papers, reflection papers, field notes, technical notes, etc.). For this study, only the research articles were used. Zawacki-Richter's (2009) classification was adapted due to the fact that the research categories and areas schema were more rigorous and based upon the views of international experts in the field of ODL. Categories related to methodology for coding largely follow those identified in Creswell (2012). When a study did not fit into the categories identified by Creswell, the name of the method that the writer of the article used was added into an existing category based on similarity of method with others in that category.

Findings and Discussion

In this study 1349 articles were used (Table 2). A total of 52 articles were examined through content analysis and the criteria determined.

Keywords Indicated

In this study totally 162 keywords were included and ranked according to their frequency. Figure 1 shows the most frequent keywords used in the articles examined. It can be seen in the figure that distance education, e-learning and blended learning are the most frequently used keywords in these articles. It may be concluded that as parallel to the change in the international ODL research area, Turkish research area is also under the effect of online technologies. This conclusion is also in line with Bozkurt et al's (2015) study.

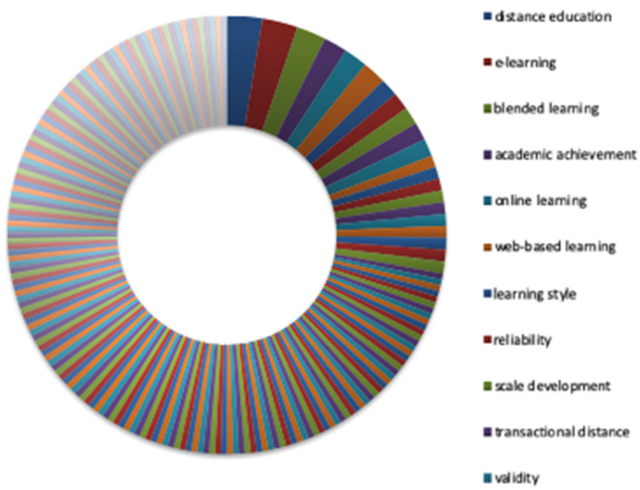

Figure 1. Most Frequent Keywords

Terms like web-based instruction, e-learning styles, learning object, learning styles, academic success and interaction are other mostly used keywords that this study concludes. This may show that the focus in the articles has been changed into learners. That is, with the development of open and distance learning instructional pedagogies change their shift from instruction to learners and how do they learn as an individual.

Research Areas

As has been mentioned before, this study used the classification developed by Zawacki-Richter (2009) to define the research areas in ODL. Among the micro level topics, interaction and communication in learning communities, and the learner characteristics are the most frequently studied ones. In the meso-level, educational technology is the only topic examined so often. Related to macro level, theories and models is the one investigated most often.

These results support the literature such as Zawacki-Richter (2009) and Bozkurt et al (2015). Namely, it may be concluded that in the last 15 years trends and issues have changed in the same line globally. In other words, the researches conducted and published in Turkey show similar results in terms of trends and issues in the field of open and distance education.

This current study examined totally 39 articles which are focused on open and distance learning research because of this limited number of articles the categories that are not mentioned above such as costs and benefits, quality assurance, innovation and change and so on are not researched in the articles that were published in these 4 journals. This lack of research may be starting point for future researchers.

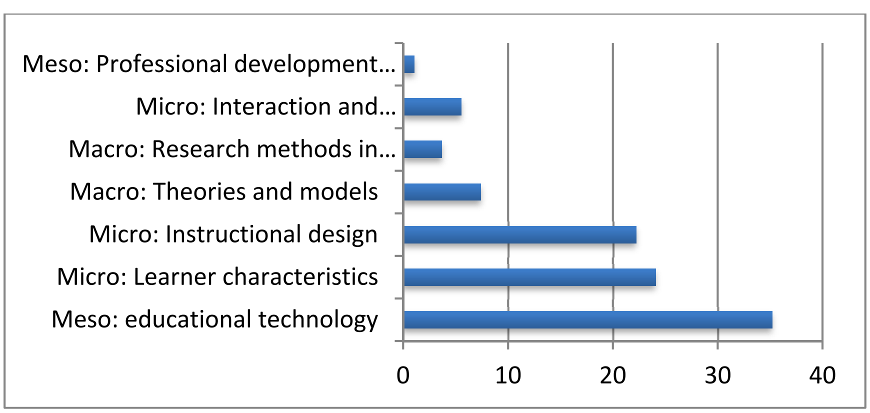

Figure 2. Research areas

Theoretical/Conceptual Backgrounds

Figure 3 shows the most frequent theoretical/conceptual backgrounds that were used in the studies conducted in Turkey. It is clear in the figure that blended learning, hybrid learning, and web-based learning are very common among researchers in Turkey. It can be concluded that the integration of technology to traditional education has also gained importance as a new trend.

What is more, theories such as community of inquiry, collaborative learning, social learning theory and activity theory that explain how learning occurs on networks through collaboration in community cannot find a place themselves in the studies. However, Bozkurt et al (2015) stated that these theories are favoured by ODL researchers in their study. That means there is a different trend in terms of theories between researches abroad and researches in Turkey. This may also serve as a starting point to the researchers in Turkey and may help them to find a research area to be examined.

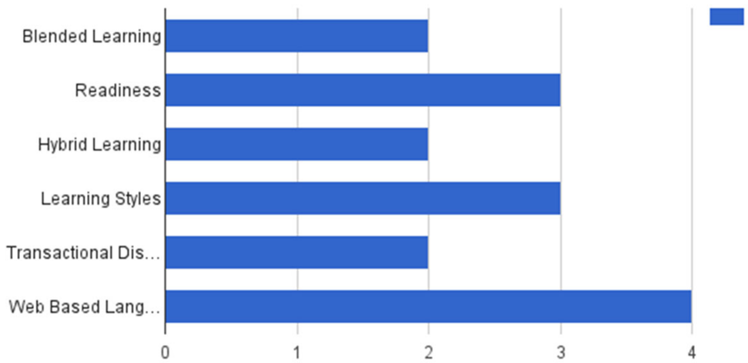

Figure 3. Theoretical background

Research Designs

Figure 4A and 4B shows the research methods and designs used in the articles examined. Qualitative, quantitative and mixed research designs are also used in this study that is the same in many other similar fields. As shown below, quantitative (55,3%) studies are the most conducted ones and then qualitative (34,2%) studies take the second place and as last research design Turkish researchers employed mixed (10,5%) research design as a method.

These results are not in the same line previous study (Bozkurt et al., 2015) which shows qualitative (47%) studies in the first rank and then quantitative (37%) studies except for mixed (16%) research design. On the other hand, Zawacki-Richter et al's study (2009) reported similar results in terms of ranking. It is interesting to note that, in all these 3 studies mixed research design remains as the least frequent research design. That is, from 2000 to 2015 there is no significant change in the research design trends of the articles.

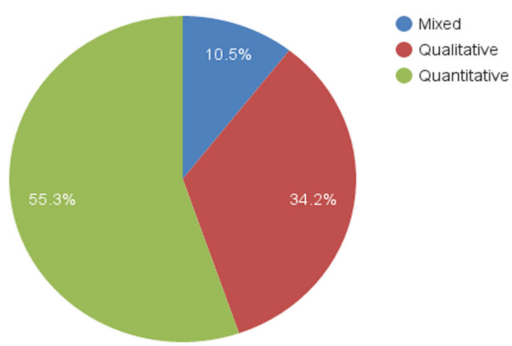

Figure 4. Research method

Of all researches experimental, descriptive and case study designs are the most frequent research design models in the articles examined. This data reveals that there is a need to conduct more studies employing different research design models.

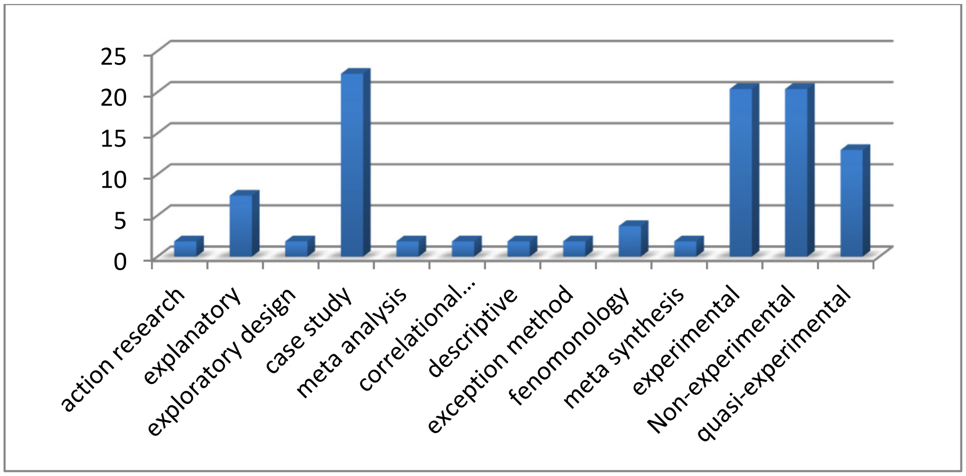

Figure 5. Research designs employed

Data Collection Tools and Strategies

This study also investigated data collection instruments and tools. It is clear in the figure that scale is the most frequent data collection tool. Questionnaire, achievement tests and interviews are also in common. Bozkurt et al (2015) also reported questionnaires and interviews as the most frequent data collection tools. In other words, the research trends somehow follow a similar path in the field of open and distance education.

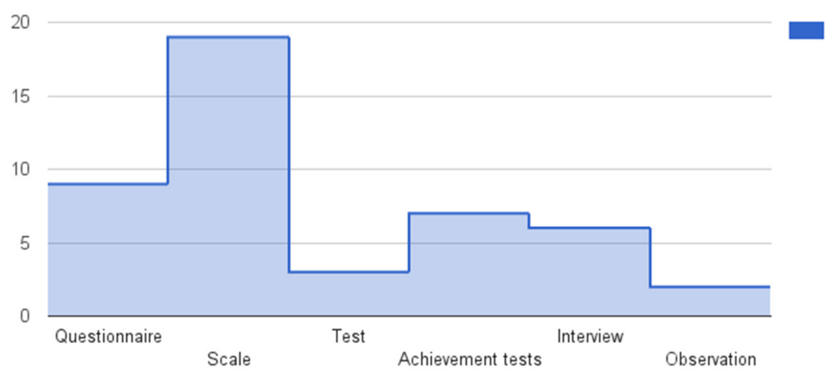

Figure 6. Data Collection Tools

Variables

As it can be seen in Figure 8, student achievement (29,2%) is the most frequent variable of the studies. On the other hand, these results overlapped with the results of keyword analysis which reports the change in the focus from teachers to learners. As students are in the center of research, their success and feelings are also become important. This may be concluded as a trend of Turkish research filed.

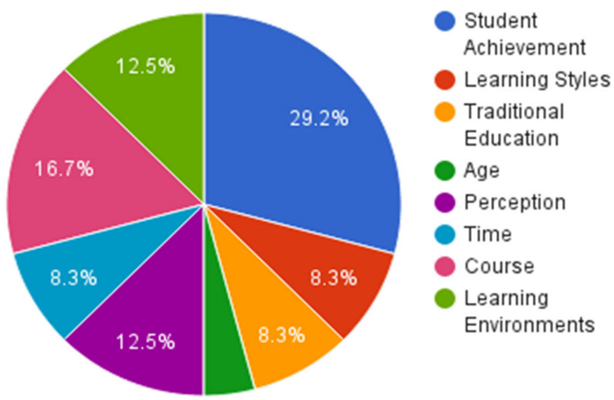

Figure 7. Variables

Participant Groups

The research question regarding to participants reveals a very clear result. According to this result, learners (75%) are the most frequent participants of the studies conducted in Turkey. Of all studies, very few studies benefited from teachers, managers, graduates or so on. This result is also in the same line with other studies conducted abroad.

It is also interesting to note that, K-12 learners are not so common in the studies. Although there is an open education high school which has 945.390 students in Turkey, there is no study conducted or published in the Turkish journals. This may also be a point of interest in the future studies to be conducted in Turkey.

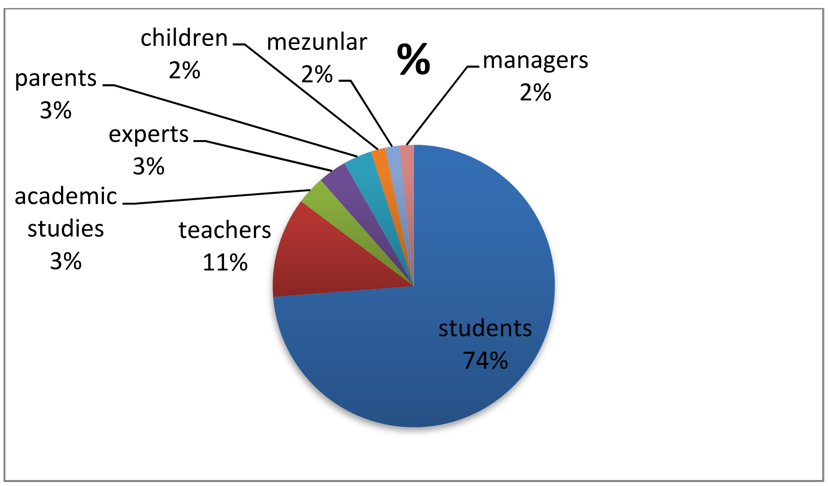

Figure 8. Participants

Authors Cited Often

This study also determined the leading contributors in the field according to their number of citations. Totally, there are 3106 citations.22 authors who have been cited at least 7 times are included in the table.

Table 3. Authors cited the most

The First Author of the reference	Frequency of citation
Moore, M.G.	22
Büyüköztürk, Ş.	19
Garrison, D.R.	19
Brusilovsky, P.	17
Fraser, B.J.	17
Tsai, C.C.	17
Horzum, M.B.	16
Aşkar, P.	15
Akkoyunlu, B.	13
Gunawardena, C.N.	12
Anderson, T.	11
Baki, A.	11
Jonassen, D.H.	11
Chen, Y.J.	10
Jung, I.	10
Trinidad, S.	10
Yıldırım, A.	10

References Cited Often

In order to provide a comprehensive list for further research, this part of content analysis presents the most cited works (articles, books, web cites, etc.) within the articles analyzed in this study. It also presents a good reading list that may help researchers as a reference guide. This table was created by filtering 1635 references that have been cited at least 1 time. Studies that have the same rank were ordered according to their publication dates. It was interesting to note two points: First, the Turkish researchers cited the references related to the research methods more often than the references related to the field of ODL. Second, the references are quite diverse. Namely, the researchers used variety of resources in their studies.

Table 4. References cited the most

Reference	Frequency of citation
Sosyal bilimlerde nitel araştırma yöntemleri	11
Sosyal bilimler için very analizi el kitabı	7
Distance education: A systems view	7
Theory of transactional distance	6
Principles and practice of structural equation modeling	6
Hamanlanmış öğrenme ve çevrimiçi öğrenme ortamlarının …	5
Distance education, in handbook of research in educational communications and technology	5
Yapısal eşitlik modelleri: Temel kavramlar ve örnek uygulamalar	4
Qualitative data analysis: An expanded source book	4
Internet-based distance education bibliography	4
How to design and evaluate research in education	4
Case study research: Design and methods	4
Bilimsel araştırma yöntemleri	4
Adaptive and intelligent web based educational systems	4
Verifying the key theoretical concepts in a dynamic model …	4
Web-based teaching and learning control: A research review.	3

Summary and Future Implications

The results of this study try to reveal the research trends and issues in open and distance learning emerging from scholarly publishing four national journals. This study also intended to present the current research direction for future research. The results, or lessons drawn from this study can be summarized as follows:

- Technology integration to traditional education is gaining importance.
- The focus of the research studies has shifted from teachers to learners.
- Educational technology, learner characteristics as well as theories and models are the most common research areas.
- Achievement is the most focused variable among Turkish researchers.
- Quantitative research method is also the most popular research method.
- The references and authors cited in the articles are quite diverse from all over the world.

Overall as one can easily conclude that the quantity of the articles directly related to ODL published in Turkey in Turkish is limited compare the long history of ODL practices in the country. Especially finding no articles directly related to ODL in one of the major Turkish journals was very disappointing. In terms of quality, there are also several issues need to be addressed: First, the keyword analysis has shown that blended learning, hybrid learning, and web-based learning are among the most frequently used concepts. It may be inferred as that the ODL literature in Turkey is still in awareness phase where the researchers and the practitioners are trying to differentiate the ODL implementations. Another interesting finding is about the research areas: Educational technology as a meso level issue, instructional design and learner characteristics as micro level issues seem to be the most often studies topics. Although, ODL is considered as a subset of the field of educational technology in some countries, many believe in (Aydin, 2011) that it is a separate and mature field whose roots lies in the openness in education movement (Ozkul, 2014). In Turkey, both in research and in practice it does not really considered as a separate field although the Universitelerarası Kurul (UAK), an agency established to facilitate the cooperation among the higher education institutions in Turkey, listed ODL as a separate Associate Professorship Field. In the same list ODL is also listed as an expertise area in two different Professorship Fields: Computer Education and Instructional Technology (namely educational technology) and Higher Education Studies. A field simultaneously cannot be considered as a separate field of study and as subset of other fields. This even shows that the nature of ODL has not been understood by the academic community in Turkey.

Regarding the results of the study, following implications can be taken into consideration for future studies and practices:

- More systematic review of literature type of studies needed to be able to understand the trends in the field in Turkey
- Especially doctoral research studies should focus more on mixed methods to train future researchers in the field with experience in diverse research methods.
- More studies should be done on the macro level issues, such as equal education opportunity, social inclusion, etc.
- Studies should also concentrate on faculty/facilitators/instructors.
- Comparison studies (face-to-face vs distance/online) should be avoided and more studies should rather take the effective online pedagogies into consideration.
- The practitioners should employ different and more innovative ODL strategies and tools into their ODL offerings.

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Examining the Effectiveness of BlendFlex Instruction in Relation to Student Academic Outcomes in Mathematics

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Abstract

The study was to examine the effectiveness of BlendFlex instruction in relation to student academic outcomes in mathematics. BlendFlex instruction offers additional flexibility for students to choose between face-to-face, online asynchronous and online synchronous instructions according to their needs and change delivery methods at any time. Final grades for students who enrolled in a math course that was offered using three different delivery methods, BlendFlex, face-to-face and online, during the AY 2016-2017 and AY 2017-2018 were collected. Course success rates including grades A, B and C were calculated to indicate student academic outcomes. Chi-square analysis was performed to examine if statistically significant differences existed between students who chose BlendFlex, face-to-face and online instructions when compared course success rates. The results showed that the course success rate of online instruction was significantly lower than BlendFlex and face-to-face instructions. In addition, gender was a significant factor influencing course success rates of these instructions. The course success rate of online instruction for female students was significantly lower than BlendFlex and face-to-face instructions. The results implicated that BlendFlex instruction produced positive student academic outcomes. Instructors do need to consider gender differences when offering courses with different delivery methods.

Keywords: BlendFlex Instruction, Blended Instruction, Academic Outcomes, Course Success Rates, Mathematics

Introduction

Blended instruction is getting popular and offers several advantages over face-to-face and online instructions. As with face-to-face instruction, blended instruction provides direct contact with instructors and other students. Unlike face-to-face instruction, blended instruction allows students to work in a self-paced environment that accommodates other scheduling needs (Currie, 2017). Blended instruction, also referred to as hybrid instruction, was defined in varying degrees of specificity (University of Washington, 2012). Gomes (2015) stated that in blended instruction, instructors provide content via a combination of face-to-face and online instructions, delivering between 30 percent and 79 percent of the course content online, with the remaining contact delivered through face-to-face or other non-Internet mediums.

The online portions of blended instruction can be completed on the student's schedule; however, the face-to-face portions are at a set time and location, and therefore have the potential to create scheduling conflicts. Students who need the instantaneous feedback provided in the face-to-face portions may struggle in the largely self-guided online portions that afford little to no direct interaction with the instructor. Additionally, the required face-to-face portions of blended instruction can potentially negate any cost savings in travel, room and board, and the accommodation of employment schedules that are typically associated with online instruction.

To better accommodate the evolving needs of students, BlendFlex instruction was pioneered predominantly by a technical college in Georgia. The college received a $2.622 million grant from the United States Department of Labor Employment and Training Administration on September 25, 2013 and developed the BlendFlex instruction to provide services to those students who would not have local access to the instructional content but might not be comfortable with the self-paced format and demands of an online instruction. BlendFlex is a form of blended instruction that melds the face-to-face, online and telepresence methods into a single methodology. Rather than being restricted to only one delivery method of interaction for the duration of a course, students enrolled in BlendFlex courses can, at any time, participate in as many, or as few, of the delivery methods as they wish. To further clarify, a student registered for a BlendFlex course can choose to attend an in-class session during the pre-determined class meeting times on one day, attend an in-class session at a different campus the next day, then completely bypass the scheduled meeting times and participate online on another day. The student need only inform the instructor of their wish to change their delivery method and continue completing assignments according to the course syllabus.

The college has presented its BlendFlex instruction at various higher education conferences such as the 2016 Southern Association for Community College Research conference (Quinn & Lee, 2016) and has been featured in the University Business Magazine as an honoree in their Model of Excellence recognition program (Durso, 2017). At the time of the current study there is very little research focused on BlendFlex instruction. With the attention that BlendFlex instruction is receiving, and in consideration of the fact that other institutions could replicate the instruction, a complete analysis of the academic outcomes is critical.

The Current Study

The purpose of the current study was to investigate student academic outcomes in BlendFlex instruction at a large two-year technical college in Gegoria as compared to face-to-face and online instructions. The college offers over 120 programs of study that include short-term certificates, diplomas, and associate degrees. Subject range from traditional college courses such as English, Math, History, and Psychology to trade and industry focused courses such as Automotive Technology, Air Conditioning Technology, and Welding Technology. The college has averaged 6,008 students per term since fall of 2016. The student population has averaged almost 35% male and just over 65% female since fall of 2016.

BlendFlex instruction was launched on September 25, 2013 to provide multiple pathways for students in the college to take courses for healthcare training. Since its inception, BlendFlex instruction has expanded from healthcare-related courses to credit courses in other programs, non-credit adult education programs, and preparation classes for the GED® high school-equivalency test. The current study focused on general education courses, specifically Math XXXX due to the high number of sections offered by the college and the diverse student population registered for the course since it is a requirement for several different majors offered by the college.

During AY 16-17 and 17-18, 2,749 students who registered for MATH XXXX that was offered using three different delivery methods, BlendFlex, face-to-face and online instructions. Of those 178 students participated in BlendFlex instruction while the rest were in either face-to-face ($N = 1485$) or online instructions ($N = 1086$). Among the students who chose BlendFlex instruction, 49 were male (27.5%) and 129 were female (72.5%). In face-to-face instruction, there were 543 male students (36.6%) and 941 female students (63.4%). One student did not indicate his or her own gender. In addition, 274 male students (25.2%) and 812 female students (74.8%) chose online instruction (see Table 1). The average age of BlendFlex group ($M = 27.29$) was slightly younger than face-to-face ($M = 27.59$) and online groups ($M = 29.96$) (see Table 2).

Table 1. Gender of Students by Delivery Method during AY 16-17 and 17-18

	Gender		
Delivery Method	Male	Female	Other
BlendFlex	49 (27.5%)	129 (72.5%)	0 (0%)
FTF	543 (36.6%)	941 (63.4%)	1 (0.1%)
Online	274 (25.2%)	812 (74.8%)	0 (0%)
Total	866	1882	1

Table 2. Age of Students by Delivery Method during AY 16-17 and 17-18

Delivery Method	Age			
	M	*SD*	*Min.*	*Max.*
BlendFlex	27.29	8.96	17	62
FTF	27.59	9.47	16	67
Online	29.96	9.31	15	70

Final course grades were collected to examine student academic outcomes between BlendFlex, face-to-face and online instructions. The following grading scale was used in the college (see Table 3). Most courses require students to earn a minimum grade of C to receive graduation credit for the course. Therefore, course success rates including grades A, B and C were calculated as student academic outcomes to answer the following two research questions.

1. Were there any differences in course success rates between BlendFlex, face-to-face and online instructions?
2. Was gender a significant factor influencing course success rates between BlendFlex, face-to-face and online instructions?

Table 3. Grade Scale

Letter Grade	Description
A	100-89.5
B	89.4-79.5
C	79.4-69.5
D	69.4-64.5
F	64.4 and below
W	withdrawn before the middle of the semester
WP	withdrawn with a passing grade at the time of withdrawal
WF	withdrawn with a failing grade at the time of withdrawal
I	incomplete

Results

During AY 16-17 and 17-18, 178 students participated in BlendFlex instruction; 114 of them received grades A, B and C. According to the descriptive statistics shown on Tables 4 and 5, the course success rate of BlendFlex instruction (64%) was higher than face-to-face (60.6%) and online instructions (51.3%). A chi-square test was performed to examine if there were any statistically significant differences in course success rates between BlendFlex, face-to-face and online instructions. The *p*-value of the chi-squared test was .000 < .05, X^2 (2, N = 2749) = 25.931, which indicated that course success rates between BlendFlex, face-to-face and online instructions were not equal. Based on the z scores using the bonferroni's method for comparison of column proportions, the course success rate of online instruction (51.3%) was significantly lower than BlendFlex (64%) and face-to-face instructions (60.6%). Students who chose BlendFlex instruction (64%) performed slightly better than face-to-face instruction (60.6%), but there were no significant differences found between these two delivery methods.

Table 4. Final Grades for Students by Delivery Method during AY 16-17 and 17-18

Delivery Method	Final Grades								
	A	B	C	D	F	WP	WF	W	I
BlendFlex (N = 178)	29 (16.3%)	50 (28.1%)	35 (19.7%)	7 (3.9%)	28 (15.7%)	17 (9.6%)	5 (2.8%)	5 (2.8%)	2 (1.1%)
FTF (N = 1485)	331 (22.3%)	301 (20.3%)	268 (18.0%)	90 (6.1%)	187 (12.6%)	110 (7.4%)	117 (7.9%)	47 (3.2%)	34 (2.3%)
Online (N = 1086)	242 (22.3%)	172 (15.8%)	143 (13.2%)	48 (4.4%)	202 (18.6%)	103 (9.5%)	123 (11.3%)	31 (2.9%)	22 (2.0%)

Table 5. Course Success Rates for Students by Delivery Method during AY 16-17 and 17-18

	Course Success Rates		
Delivery Method	No (W, WP, WF, D, F, I)	Yes (A, B, C)	Total
BlendFlex	64 (36%)	114 (64%)	178
FTF	585 (39.4%)	900 (60.6%)	1485
Online	529 (48.7%)	557 (51.3%)	1086

According to the descriptive statistics shown on Table 6, the course success rate of BlendFlex instruction for female students (65.9%) was higher than face-to-face (64.2%) and online instructions (50.5%). For male students, the course success rate of BlendFlex instruction (59.2%) was also higher than face-to-face (54.5%) and online instructions (53.6%). Chi-square tests were performed to examine if gender was a significant factor influencing course success rates between BlendFlex, face-to-face and online instructions. First, the *p*-value of the chi-squared test for female students was .000 < .05, X^2 (2, N = 1882) = 36.849, which indicated that course success rates for female students between BlendFlex, face-to-face and online instructions were not equal. Based on the z scores using the bonferroni's method for comparison of column proportions, the course success rate of online instruction for female students (50.5%) was significantly lower than BlendFlex (65.9%) and face-to-face instructions (64.2%). Female students who chose BlendFlex instruction (65.9%) performed slightly better than face-to-face instruction (64.2%), but there were no significant differences found between these two delivery methods. Second, the *p*-value of the chi-squared test for male students was .774 > .05, X^2 (2, N = 866) = .513. It indicated that there were no significant differences in course success rates for male students between BlendFlex, face-to-face and online instructions.

Table 6. Course Success Rates for Female and Male Students by Delivery Method during AY 16-17 and 17-18

		Course Success Rates		
Gender	Delivery Method	No (W, WP, WF, D, F, I)	Yes (A, B, C)	Total
Female	BlendFlex	44 (34.1%)	85 (65.9%)	129
	FTF	337 (35.8%)	604 (64.2%)	941
	Online	402 (49.5%)	410 (50.5 %)	812
Male	BlendFlex	20 (40.8%)	29 (59.2%)	49
	FTF	247 (45.5%)	296 (54.5%)	543
	Online	127 (46.4%)	147 (53.6%)	274

Discussion

Several findings were discovered from the current study. First, according to the descriptive statistics, the course success rate of BlendFlex was higher than the other two instructions, which confirmed the positive results from the previous studies related to the comparison between BlendFlex and non-BlendFlex instructions (Durso, 2017; Quinn & Lee, 2016). These two studies found that BendFlex students have achieved slightly higher course success rates than their peers. BlendFlex instruction combines the benefits of both face-to-face and online instructions to enhance student learning with additional flexibility.

Second, the chi-squared test results showed that the course success rate of online instruction was significantly lower than BlendFlex and face-to-face instructions. This was similar to the results of previous studies comparing face-to-face and online instructions (Amro, Mundy, & Kupczynski, 2015; Flanagan, 2012). Amro et al. (2015) examined course final grades in face-to-face versus online college algebra courses at a college in south Texas and found that the average grade of face-to-face students was higher than that of online students. Flanagan (2012) had a similar finding. She compared final course grades between face-to-face and online courses using one-way single factor ANOVA and found that without considering gender, face-to-face students scored significantly better than online students did. In addition, in the current study, students who chose BlendFlex instruction performed slightly better than students who chose face-to-face instruction, but there were no significant differences found between these two delivery methods. This was similar to the results of previous studies comparing face-to-face and blended instructions (Adams, 2013; Blissitt, 2016; Tseng & Walsh, 2016). For example, Adam (2013) implemented a quasi-experimental, mixed-method, posttest design to compare academic outcomes and course satisfaction between students who received face-to-face (face-to-face lectures and lab sessions) and blended instructions (web-enhanced CD-ROM lectures). She found that there were no significant differences in academic outcomes related to cognitive and psychomotor domains between these two delivery methods. Blissitt (2016) used a quantitative, quasi-experimental, nonrandomized control group, pretest-posttest design to compare academic outcomes and course satisfaction between face-to-face and blended instructions in an introductory nursing pathophysiology course. She discovered that there were no significant differences found in posttest scores between these two delivery methods. Tseng and Walsh (2016) compared students' motivation, level of learning outcomes and skills, and learning achievements (final grades) in an undergraduate English literacy course using two different delivery methods, face-to-face and blended instructions. Although students in blended instruction reported significant higher motivation and higher levels of learning outcomes, Tseng and Walsh (2016) found no significant differences in final grades of students between these two delivery methods.

Third, in the current study, gender was a significant factor influencing course success rate between BlendFlex, face-to-face and online instructions. The chi-squared test results showed that the course success rate of online instruction for female students was significantly lower than BlendFlex and face-to-face instructions. Female students who chose BlendFlex instruction performed slightly better than the ones who chose face-to-face instruction, but there were no significant differences found between these two delivery methods. No significant differences were found in course success rates for male students between these three instructions. This was similar to the results of Flanagan's (2012) and Paden's (2006) studies. Flanagan (2012) compared the gender differences in academic outcomes in a junior-level business statistics course that was offered using two different delivery methods, face-to-face and online. She included 53 females and 36 males in face-to-face instruction, and 68 females and 77 males in online instruction. She discovered that the academic outcomes (final grades) for female students significantly decreased from face-to-face to online instructions. However, there were no significant differences in academic outcomes found for male students between these two instructions. In addition, Paden (2006) examined the impact of three delivery methods (blended, face-to-face and asynchronous online) on student retention rates and academic outcomes in an introductory undergraduate mathematics course at a large private university. The results showed that females retained at a significantly higher rate than males in the blended instruction.

Conclusions

To conclude, there were three main findings from the current study. First, the descriptive statistics showed that the course success rate of BlendFlex was higher than the face-to-face and online instructions. Second, the chi-squared test results showed that the course success rate of online instruction was significantly lower than BlendFlex and face-to-face instructions. Students who chose BlendFlex instruction performed slightly better than students who chose face-to-face instruction, but there were no significant differences found between these two delivery methods. Third, the chi-squared test results showed that the course success rate of online instruction for female students was significantly lower than BlendFlex and face-to-face instructions. Female students who chose BlendFlex instruction performed slightly better than female students who chose face-to-face instruction, but there were no significant differences found between these two delivery methods. In addition, no significant differences in course success rates were found for male students between these three instructions.

The academic outcomes of BlendFlex instruction were positive when compared to face-to-face and online instructions. The course success rate of BlendFlex instruction was slightly higher than face-to-face instruction and significantly higher than online instruction. BlendFlex instruction combines the benefits of both face-to-face and online instructions, which helps produce positive academic outcomes and enhance student learning. In addition, instructors do need to consider gender differences when offering courses with different delivery methods. The data collected for the current study were quantitative, so directions for future research could employ qualitative research methods (e.g., observation, interview and focus group) to explore more about BlendFlex instruction related to 1) student learning process, 2) student perception and satisfaction, and 3) gender differences.

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A Classification Framework for Research on Learning Analytics and a Literature Review with a Focus on Professional Learning

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Descriptors: Learning Analytics, Classification Framework

Abstract

Many researchers have studied learning analytics during the last decade. However, obstacles still exist that impede enhancement of the field. These include a conceptual misunderstanding of learning analytics, an imbalance of research scope, and an inclusion of unrelated research. In this study, we suggest a classification framework for research on learning analytics. We analyzed 608 articles from the literature and found patterns regarding the definitions of learning analytics, contexts of the studies, methodologies utilized for the studies, and scopes of the studies. Based on the patterns, we developed a classification framework, consisting of four layers: Foundation Layer, Environment Layer, Development Layer, and Application Layer. We classified articles on learning analytics for professional learning and identified research gaps. The results show that the research on learning analytics for professional learning is not balanced in terms of scope. The conclusions and limitations are discussed.

Introduction

Analytics as the science of analysis is not a new concept. Even before anno domini, people analyzed patterns of clouds and winds to predict weather. However, modern analytics can be interpreted differently. With the development of computing systems and advancement of statistics, analytics is based mostly on proven statistical models and data collected by computing systems. Given these technological and technical changes, it is generally taken for granted that modern analytics refers to "the process of developing actionable insights through problem definition and the application of statistical models and analysis against existing and/or simulated future data" (Cooper, 2012, p.3). Modern analytics began in the 1980s. Though some companies started to use computing systems to manage customer data in the 1970s, database marketing and customer relationship management software in the 1980s were the beginning of modern analytics.

Technologies, such as the Internet, to increase accessibility of various people and reduction in costs associated with using analytics contributed to the expansion of the usage of analytics to educational contexts and made many researchers and practitioners in the field interested in analytics for education. To reflect such interests, researchers have introduced academic analytics (Campbell, DeBlois, & Oblinger, 2007; Goldstein, 2005; van Barneveld, Arnold, & Campbell, 2012) and learning analytics (Ferguson, 2012; Long, Siemens, Conole, & Gašević, 2011). While academic analytics supports decision-making in regard to an academic organization and its performance, learning analytics more focuses on an individual student's learning and performance.

Learning analytics (LA) is analytics for supporting decision-making regarding learning and learning environments. During the past decade, researchers from various disciplines have studied LA. While the diversity of disciplines has the advantage of expanding the research and introducing different viewpoints, it can be an obstacle to interdisciplinary collaboration if the interpretation of a particular concept varies from discipline to discipline. For example, researchers in one field regard LA as an automated tool that supports learning, whereas researchers in another field see LA as a process to analyze data on learning and learning environments. Another problem is that there are imbalances. For example, researchers have paid less attention to the LA for professional learning. At this point, it seems meaningful to try to find patterns and gaps in LA research to overcome those problems.

This study has three purposes. The first is to find patterns of research on LA in the following respects: 1) how researchers have defined LA, 2) in what contexts researchers have conducted their research, 3) what methodologies researchers have used, and 4) what the research scopes are. The second is to develop a classification framework for LA research based on the patterns. The last purpose is to identify gaps in research on LA for professional learning. The following section introduces a literature review on LA and classification frameworks for LA research.

Literature Review

In this section, we provide a review of the literature on classification frameworks for LA or LA research, consisting of three viewpoints. We discuss studies on the classification frameworks for LA or LA research based on these viewpoints. Later in this section, we introduce the research questions of this study.

Environment Viewpoint

The environment viewpoint focuses on environmental factors and conditions related to LA. Some researchers (Greller & Drachsler, 2012; Peña-Ayala, 2018) investigated LA or LA research from the environment viewpoint. Peña-Ayala (2018) proposed a classification framework for LA research, for which the researcher explained three key areas: profile, applications, and underlying factors. In the framework, the researcher viewed legal issues, theoretical topics, and learning paradigms and settings as underlying factors influencing LA. The researcher also classified the definition of LA, stakeholders, field evolution, underlying domains, related domains, specialized lines, and prior reviews of the LA field as profile that reveals "an overall perspective of what LA is" (Peña-Ayala, 2018, p. 4). Greller and Drachsler (2012) also considered the environment factors and conditions in designing a framework for the domain of LA. Their framework consists of six dimensions: stakeholders, internal limitations, external constraints, instruments, data, and objectives. The first five dimensions are associated with environments surrounding LA while the objective is closely related to the application of LA. The frameworks of Greller and Drachsler (2012) and Peña-Ayala (2018) well reflect theoretical fundamentals of LA research as well as environmental factors and conditions related to LA.

Development Viewpoint

The development viewpoint focuses on elements that are necessary for developing LA. Aljohani et al. (2019), Muslim, Chatti, Bashir, Varela, and Schroeder (2018), Yassine, Kadry, and Sicilia (2016, April), and Ifenthaler and Widanapathirana (2014) studied frameworks for LA and we categorized them as the framework reflecting the development viewpoint. While the framework by Ifenthaler and Widanapathirana (2014) covers a broader scope and more elements of LA, the others emphasize the core functions of LA.

Aljohani et al. (2019) proposed a course-adapted student learning analytics framework, which consists of four levels: instructor, data, data analytics, and presentation levels. This framework focuses on the analytical process from collecting data on learning and learning environments through presenting information such as feedback. Muslim et al. (2018) also focused on the analytical process in developing a modular framework for open learning analytics, but their framework includes more detailed processes and interactions among modules of the analytical process. The modular framework consists of four modules: analytics engine, analytics modules, analytics methods, and visualizer. Yassine, Kadry, and Sicilia (2016, April) considered user activities and learning outcomes in addition to data analysis and visualization in their framework. Their framework contains the definitions of data on user activities, mapping activities with learning outcomes, analysis of data on activities and learning outcomes, and information visualization.

Unlike the aforementioned researchers, Ifenthaler and Widanapathirana (2014) introduced a holistic framework for LA, in which three core engines (learning analytics engine, personalization and adaptation engine, and reporting engine), use various data generated by different sources (individual characteristics, social web, physical data, curriculum, and online learning environment), to provide information to the stakeholders including institution or governance. Though the holistic framework includes only institution and governance as stakeholders and the three engines in the framework are overlapped (e.g. visualization) and less relevant to the core features of LA (e.g. gamification), it has contributed to the field of LA in that it covers various data sources (e.g. social web and physical data) and separates functions of LA into learning analytics engine, personalization and adaptation engine, and reporting engine.

Application Viewpoint

The application viewpoint focuses on the uses and practical applications of LA. Many researchers in the field of LA studied the applications of LA and their studies highlighted specific purposes of LA, such as prediction of learning performance and retention (Hicks, 2018; Lu et al., 2018; Marbouti, Diefes-Dux, & Madhavan, 2016; Yu et al., 2018) or understanding of learners' behaviors (Berland, Martin, Benton, Smith, & Davis, 2013; Martín-Monje, Castrillo, & Mañana-Rodríguez, 2018; Ruipérez-Valiente, Muñoz-Merino, Leony, & Kloos, 2015), rather than discussing classification of applications of LA. There is not enough research on classification frameworks for LA seen from the application viewpoint. For this reason, we expanded our literature review to other data analytics areas.

Some researchers (Fleckenstein & Fellows, 2018; Kumar, 2017; Skourletopoulos, Mastorakis, Mavromoustakis, Dobre, & Pallis, 2018) argued that analytics can be classified as descriptive, diagnostic, predictive, and prescriptive analytics based on the types of analytics applications. Their studies classified the types of analytics applications based on what kinds of information analytics can provide. Descriptive analytics shows information describing what happened or what is happening. Diagnostic analytics explains causal relationships by reporting information on why it happened or what it is happening. Predictive analytics provides information on what might happen. Prescriptive analytics recommends interventions based on the prediction.

Rationale of the Research and Research Questions

While there have been a few articles on classification frameworks for LA, frameworks for LA research remain under-researched. To promote the advancement of research on LA, it is necessary to develop a classification framework for LA research. Given the purposes of the study mentioned in the previous section, we addressed the following research questions: 1) what patterns exist in the definitions of LA, 2) what patterns exist in the contexts of research on LA, 3) what patterns exist in the methodologies used for research on LA, 4) what patterns exist in the scopes of research on LA, 5) how can the classification framework for LA research be developed, and 6) what are some gaps in research on LA for professional learning? In order to answer these research questions, we employed the research methodology illustrated in the following section.

Research Methodology

This study is a mapping review, which is a type of study that seeks "to map out and categorize existing literature on a particular topic, identifying gaps in research literature from which to commission further reviews and/or primary research" (Grant & Booth, 2009, p. 97). For the mapping review, we searched multiple academic databases to find articles to be reviewed. In this section, we explain our research methodology by describing articles selection process, information sources and search strategy, and exclusion criteria.

Articles Selection Process

For this mapping review, we searched for articles from five academic databases: ERIC from EBSCOhost, PsycINFO, Academic Search Complete from EBSCOhost, Education Research Complete from EBSCOhost, and Web of Science from Clarivate Analytics. We searched these databases on August 1st, 2018 and found 1,467 articles in total. After removing 754 duplicates, 713 articles remained. By applying the exclusion criteria explained later in this section, 608 articles remained for review. *Figure 1* illustrates a summary of articles selection process for this study.

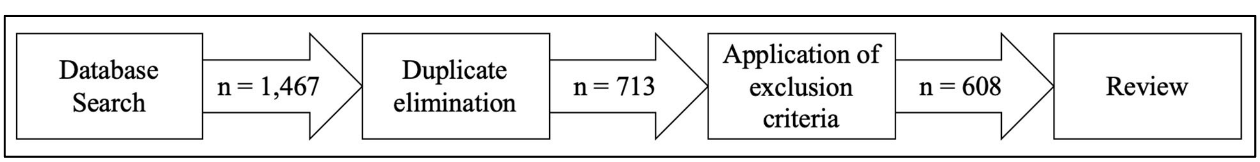

Figure 1. Summary of articles selection process

Information Sources and Search Strategy

As mentioned above, we used five academic databases as information sources for this study. Since the search feature of each database is slightly different, we used different search conditions for each database. Table 1 shows the respective search conditions for each database.

Table 1. Search conditions for each database

Database	Search conditions	No. of articles
ERIC from EBSCOhost	- Search keywords: 'learning analytics' for title or 'learning analytics' for KW identifiers - Only peer reviewed - Only journal articles for publication type - Find all my search terms	157
PsycINFO	- Search keywords: 'learning analytics' for title or 'learning analytics' for keywords - Only peer reviewed - Only journal articles for document type	167
Academic Search Complete from EBSCOhost	- Search keywords: 'learning analytics' for title or 'learning analytics' for KW Identifiers - Only peer reviewed - Only journal articles for document type - Find all my search terms	249
Education Research Complete from EBSCOhost	- Search keywords: 'learning analytics' for title or 'learning analytics' for KW Identifiers - Only peer reviewed - Only journal articles for document type - Find all my search terms	378
Web of Science from Clarivate Analytics	- Search keywords: 'learning analytics' for title (TI) or 'learning analytics' for topic (TS) - Only Articles for document type - Only from Web of Science Core Collection - Only from SCIE, SSCI, A&HCI, and ESCI (Emerging Sources Citation Index)	516

Exclusion Criteria

Given the purposes of the study, we adopted a comprehensive strategy in setting exclusion criteria. We did not include the quality of an article or a journal in the criteria. We excluded articles that are not written in English, not related to LA, or not research (e.g. editorial, commentary, or book review). Based on the exclusion criteria, we excluded 26 articles not written in English, 38 articles not related to LA, and 41 articles that are not research.

Results

Research Question 1: What patterns exist in the definitions of LA?

Among 608 articles, we analyzed 185 articles that defined LA or used existing definitions of LA and found 31 different definitions of LA. We included only six definitions in our analysis based on the frequency of the definition usage and excluded 25 definitions as they have been used only one time. Table 2 illustrates the definitions of LA that have been used in the articles we reviewed more than one time.

Table 2. Definitions of learning analytics and frequency

Author(s) and publication year	Definition	No. of usage
Society for Learning Analytics Research (2011)	Measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs	n = 154 (77%)
Siemens (2010)	Use of learner-produced intelligent data and analysis models to discover information and social connections and to predict and advise on learning activities	n = 12 (6%)
Slade & Prinsloo (2013)	Collection, analysis, use, and appropriate dissemination of student-generated, actionable data with the purpose of creating appropriate cognitive, administrative, and effective support for learners	n = 3 (1.5%)
Lawson, Beer, Rossi, Moore, & Fleming (2016)	Collection and analysis of data in education settings in order to inform decision making and improve learning and teaching	n = 2 (1%)
Willis, Zilvinskis, & Borden (2017)	Process of using live data collected to predict student success, promote intervention or support based on those predictions, and monitor the influence of that action	n = 2 (1%)
Brown (2011)	Collection and analysis of usage data associated with student learning and its purpose is to observe and understand learning behaviors in order to enable appropriate interventions	n = 2 (1%)

The most used definition of LA is "the measurement, collection, analysis and reporting of data about learners and their contexts, for the purpose of understanding and optimizing learning and the environments in which it occurs" (Society for Learning Analytics Research, 2011). 77% of the used LA definitions referenced the definition of the Society for Learning Analytics Research. Siemens's definition of LA (2010) is the next most frequently used definition (6%), followed by Slade and Prinsloo's definition (1.5%), Lawson, Beer, Rossi, Moore, and Fleming's definition (1%), Willis, Zilvinskis, and Borden's definition (1%), and Brown's definition (1%).

These definitions share commonalities. All the definitions consist of three components: data type, process, and purpose of LA (see Table 3). First, the definitions, except for the definition by Willis et al. (2017), clearly indicate that the data for LA are associated with learners, their learning, or their contexts. Second, the definitions describe the process related to LA. The process includes collection, analysis, and reporting steps. While the definitions by Siemens (2010) and Willis et al. (2017) do not specify steps during the process, the other definitions indicate each step during the process in a sequential manner. Lastly, all the definitions include purposes of LA. While the definitions by Siemens (2010), Slade and Prinsloo (2013), Willis et al. (2017), and Brown (2011) include purposes that are directly associated with functions of LA, the definitions by the Society for Learning Analytics Research (2011) and Lawson et al. (2016) include indirect purposes, such as 'optimizing learning and the environments' and 'improving learning and teaching.'

Table 3. Data types, processes, and purposes in LA definitions

Author(s) and publication year	Data type	Process	Purpose
Society for Learning Analytics Research (2011)	Data about learners and their contexts	Measurement, collection, analysis and reporting	Understanding and optimizing learning and the environments in which it occurs
Siemens (2010)	Learner-produced intelligent data	Use of … data and analysis models	To discover information and social connections and to predict and advise on learning activities

Slade & Prinsloo (2013)	Student-generated, actionable data	Collection, analysis, use, and appropriate dissemination	Creating appropriate cognitive, administrative, and effective support for learners
Lawson et al. (2016)	Data in education settings	Collection and analysis	In order to inform decision making and improve learning and teaching
Willis et al. (2017)	Using live data	Process of …	To predict student success, promote intervention or support based on those predictions, and monitor the influence of that action
Brown (2011)	Data associated with student learning	Collection and analysis of	To observe and understand learning behaviors in order to enable appropriate interventions

Research Question 2: What patterns exist in the contexts of research on LA?

We found 612 contexts from 608 articles and classified the contexts into five categories: higher education, K-12, MOOC-based learning, professional learning, and others. The 'Others' category includes articles that did not clearly indicate a context for research. Table 4 presents the results of our classification. As shown in Table 4, the most frequently studied context for LA research is higher education, occupying 300 out of 612 contexts, followed by K-12 context (n=69), MOOC-based learning context (n=25), and professional learning context (n=11).

Table 4. Changes of contexts in LA research

Context\Year	2011	2012	2013	2014	2015	2016	2017	2018*	Total
HE	1	6	9	20	52	62	91	59	300
K-12	0	0	3	7	17	16	18	8	69
MC	0	0	0	0	4	9	8	4	25
PL	0	0	2	0	1	3	3	2	11
Others	0	1	3	2	7	4	5	3	25
Total	1	14	27	51	110	147	170	92	612

Note. HE = Higher education; PL = Professional learning; MC = MOOC-based learning. The figures for 2018 are the number of contexts found in the articles published between January and July 2018.

Figure 2 illustrates changes in the relative ratio of the contexts in LA research reviewed. The results revealed that there is a significant imbalance in research on LA in terms of research contexts. Many researchers have studied LA in higher education contexts, but relatively few researchers have studied LA in other contexts, notably professional learning. The ratios for the higher education context have always been or higher than 64.3%. On the other hand, the ratios for the professional learning context have been less than 3.4%, except for 2013 (14.3%).

In addition to the imbalance of contexts, the results discovered another pattern regarding the research context. Since 2015, researchers in the field have studied LA in the MOOC-based learning context. The relative ratios for the MOOC-based learning context in LA research have been 5.4% or higher. The last pattern found in the results is that the K-12 learning context has been steadily decreasing since 2014.

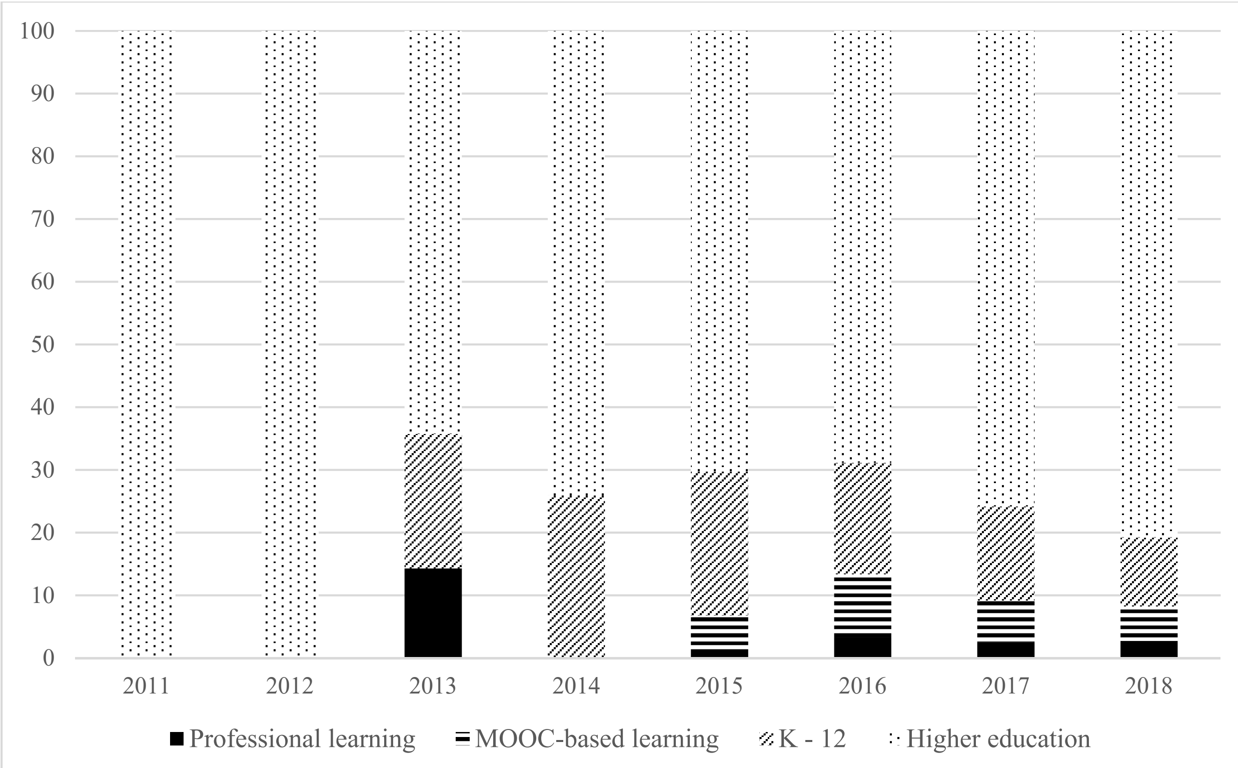

Figure 2. Changes in relative ratios of contexts in LA research reviewed

Research Question 3: What patterns exist in the methodologies used for research on LA?

We used a classification system of the SERVE Center (2008) to classify research methodologies that have been used for LA research. During the analysis of the research methodologies, we found articles that are hard to be classified by the classification system of the SERVE Center. Thus, we modified the classification system (see Table 5).

Table 5. Classification of research methodologies

Research methodology	Description
Descriptive-qualitative	Detailed descriptions of specific situation(s) using interviews, observations, and/or other qualitative data collection methods
Descriptive-quantitative	Numerical descriptions (frequency, average)
Correlation/regression/and other association analyses	Quantitative analyses of the strength of relationships between two or more variables using correlation analysis, regression analysis, likelihood ratio test, cluster analysis, random forest, path analysis, principle component analysis, analysis of variance, or other association analysis techniques
Quasi-experimental	Comparing an experimental group with a control group that is similar in characteristics but did not receive the intervention. Random assignment is not used to assign participants to an experimental group and a control group.
Experimental	Comparing an experimental group with a control group that is similar in characteristics but did not receive the intervention. Random assignment is used to assign participants to an experimental group and a control group.
Meta-analysis	Synthesis of results from multiple studies to determine the average impact of a similar intervention across the studies

Note. Adapted from the SERVE Center. (2008). Types of research methods. Retrieved from http://www.doe.virginia.gov/support/school_improvement/training/dta_student_support_sys/dropout_prevention/webinars_9-12/w2_s2_types_of_research_methods.pdf

Table 6 shows the frequency of research methodologies found in LA research reviewed. The results revealed that substantial research on LA employed the descriptive qualitative methodologies (n=254) or association analysis (n=200). Less research on LA employed experimental (n=47) or quasi-experimental (n=35) methodologies. *Figure 3* illustrates changes in the relative ratio of the methodologies in LA research reviewed.

Table 6. Frequency of research methodologies in LA research reviewed

Method	2011	2012	2013	2014	2015	2016	2017	2018*	Total
DQL	1	9	15	21	46	69	71	22	254
DQN	0	2	7	7	8	19	17	12	72
CRA	0	3	5	18	38	43	58	35	200
QEX	0	0	0	0	5	7	14	9	35
EXP	0	0	0	4	11	8	10	14	47
Total	1	14	27	50	108	146	170	92	608

Note. DQL = Descriptive-qualitative; DQN = Descriptive-quantitative; CRA = Correlational/regression analysis and other association analyses; QEX = Quasi-experimental; EXP = Experimental. The figures for 2018 are the number of research methodologies found in the articles published between January and July 2018.

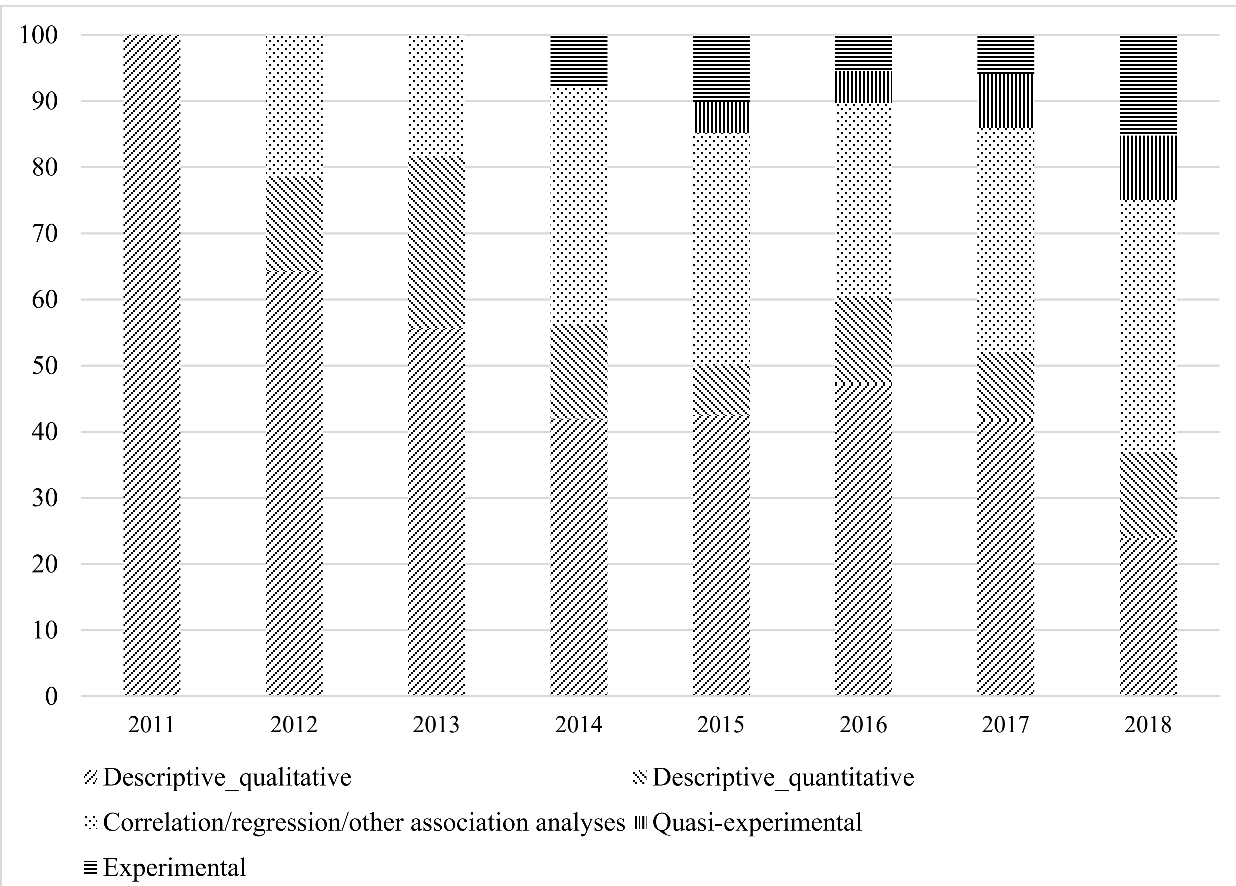

Figure 3. Changes in relative ratios of research methodologies in LA research reviewed

As shown in *Figure 3*, the majority of LA research (> 79% each year) between 2011 and 2013 employed descriptive methodologies, but the relative ratios of other research methodologies have steadily increased since 2016. In particular, research using experimental or quasi-experimental methodology has been increased noticeably.

Research Question 4: What patterns exist in the scopes of research on LA?

To classify the scopes of 608 research articles on LA, we developed an initial version of a classification framework based on our review of literature on the classification frameworks for LA or LA research. In developing the initial version of the classification framework, we included three layers: 1) Environment Layer, 2) Development Layer, and 3) Application Layer. During our review, however, we found scopes that are less relevant to these layers. Thus, we modified the classification framework and the final version of the classification framework consists of four layers: Foundation Layer, Environment Layer, Development Layer, and Application Layer. The Foundation Layer includes two scopes: 1) theoretical foundations of LA and 2) educational findings that can be used for LA. The Environment Layer includes three scopes: 1) legal and ethical environments, 2) technological environments, and 3) user's perception and behaviors. The Development Layer includes four scopes: 1) algorithm; 2) information presentation; 3) data collection, measure, and modeling; and 4) development methodology and process. Lastly, the Application Layer consists of four scopes: 1) descriptive LA, 2) diagnostic LA, 3) predictive LA, and 4) prescriptive LA.

Table 7 presents the frequency of the scopes in LA research reviewed. The results indicate that the three most studied scopes of LA research are user's perception and behaviors (n=102), theoretical foundations of LA (n=103), and educational findings that can be used for LA (n=108). On the other hand, the three least studied scopes of LA research are diagnostic LA (n=3), prescriptive LA (n=5), and predictive LA (n=12) in Application Layer.

Table 7. Frequency of scopes in LA research reviewed

Scope	2011	2012	2013	2014	2015	2016	2017	2018*	Total
APSC	0	0	0	2	0	0	2	1	5
APRD	0	0	0	2	3	1	3	3	12
ADGN	0	0	1	0	1	0	0	1	3
ADSC	0	1	0	2	11	6	13	7	40
DALG	0	0	2	2	18	15	18	21	76
DNPR	0	2	5	1	10	11	15	8	52
DDCM	0	2	3	3	9	9	13	5	44
DDMP	0	2	1	2	4	8	10	4	31
ELEE	0	0	1	2	1	15	2	2	23
ETEN	1	1	3	7	14	15	17	13	71
EUPB	0	2	2	8	16	25	29	20	102
FTFL	0	6	8	15	20	19	26	9	103
FEFL	0	1	3	7	14	38	33	12	108
Total	1	17	29	53	121	162	181	106	670

Note. APSC = Application Layer_Prescriptive LA; APRD = Application Layer_Predictive LA; ADGN = Application Layer_Diagnostic LA; ADSC = Application Layer_Descriptive LA; DALG = Development Layer_Algorithm; DNPR = Development Layer_Information Presentation; DDCM = Development Layer_Data Collection, Measure, Modeling; DDMP = Development Layer_Development Methodology and Process; ELEE = Environment Layer_Legal and Ethical Environment; ETEN = Environment Layer_Technological Environment; EUPB = Environment Layer_User's Perception and Behavior; FTFL = Foundation Layer_Theoretical Foundations of LA; FEFL = Foundation Layer_Educational Findings that can be used for LA. The figures for 2018 are the number of the scopes of research found in the articles published between January and July 2018.

Figure 4 illustrates changes in relative ratios of scopes in LA research reviewed. As shown in *Figure 4*, research dealing with Foundation Layer or Environment Layer has always counted for more than half of the scopes. Relatively less research studied the scopes in Development Layer, but the interest in these scopes has continued since 2012. Lastly, little research investigated Application Layer.

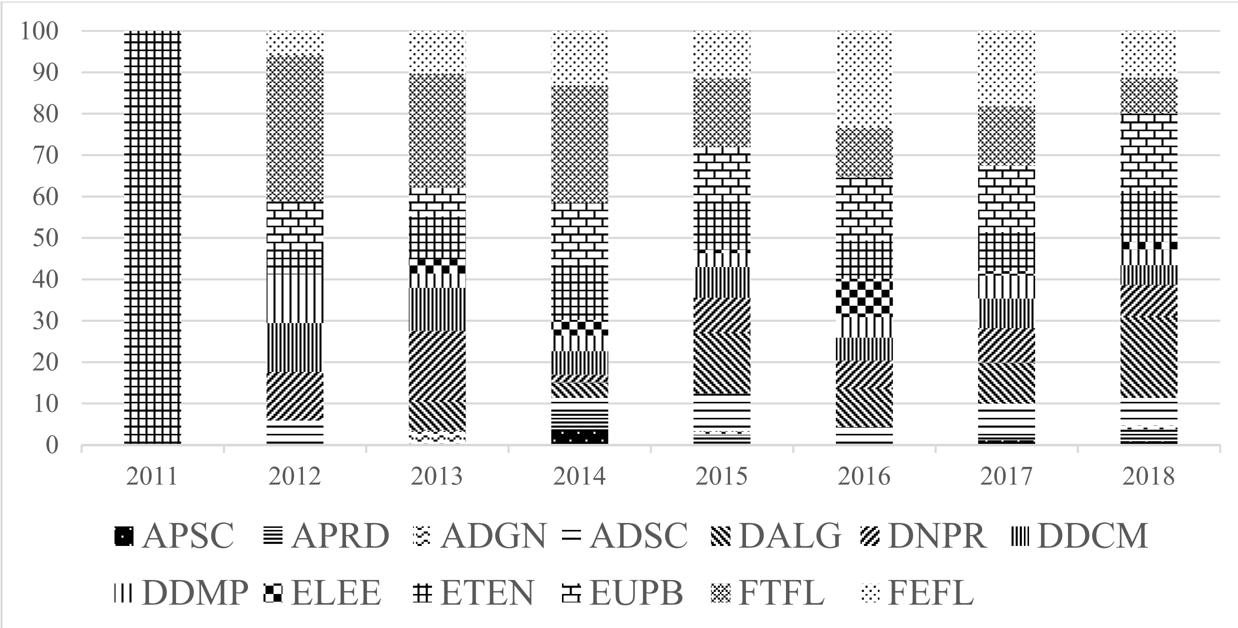

Figure 4. Changes in relative ratios of scopes in LA research reviewed

Research Question 5: How can the classification framework for LA research be developed?

After developing an initial version of a classification framework for LA research, we improved it to accommodate new types of research scopes in LA research. In improving the framework, we focused on flexibility and universality to adapt to and accommodate the theoretical and technological changes in future. *Figure 5* illustrates the classification framework for LA research. To validate the classification framework, we classified 670 scopes found from 608 articles into four layers and 13 types.

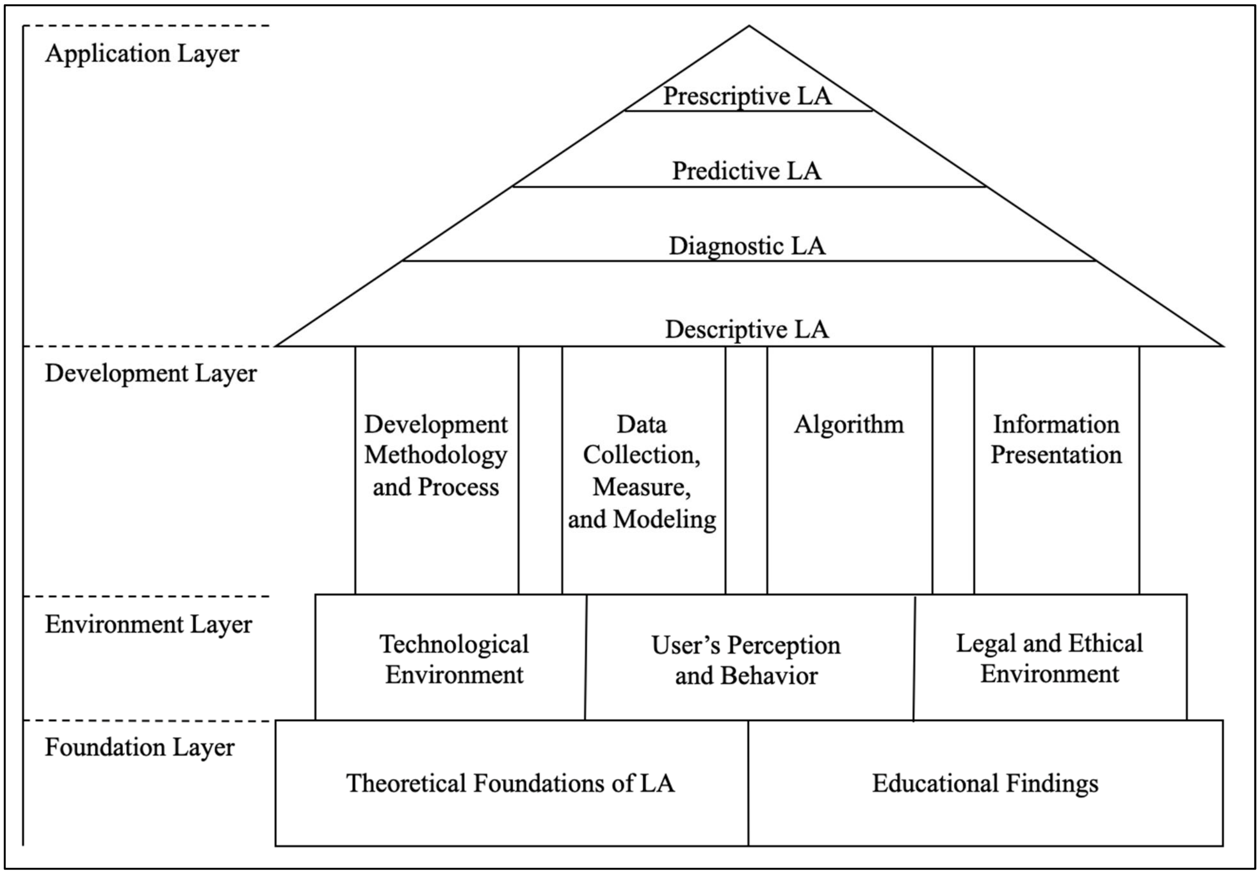

Figure 5. Classification framework for LA research

Research Question 6: What are some gaps in research on LA for professional learning?

We mapped each of the research articles on LA for professional learning (n=11) with the classification framework for LA research. The results revealed that there are many research gaps in LA for professional learning (see Table 8). No research included in our review studied predictive LA, diagnostic LA, descriptive LA, algorithms for LA, development methodology and process, legal and ethical environments, and theoretical foundations of LA for professional learning.

Table 8. Frequency of scopes in research on LA for professional learning

Classification of LA research	Frequency of scopes
Application Layer_Prescriptive LA	1
Application Layer_Predictive LA	0
Application Layer_Diagnostic LA	0
Application Layer_Descriptive LA	0
Development Layer_Algorithm	0
Development Layer_Information Presentation	1
Development Layer_Data Collection, Measure, Modeling	2
Development Layer_Development Methodology and Process	0
Environment Layer_Legal and Ethical Environment	0
Environment Layer_Technological Environment	1
Environment Layer_User's Perception and Behavior	3
Foundation Layer_Theoretical Foundations of LA	0
Foundation Layer_Educational Findings that can be used for LA	3

Discussions

Definition of LA

We found 31 different definitions of LA from our review. Though there are some differences in the definitions of LA, the definitions share a few commonalities. However, there is a big difference between disciplines in defining LA. While researchers in the field of education take a broad approach to defining LA, ones in the field of engineering and business take a narrow approach. The former include analyzing data by human or a tool separated from a system that stores target data in LA research, but the latter consider LA research as one studying an automated tool that collects, analyzes, and provides data or information. Ifenthaler and Widanapathirana (2014) used the term 'engine' to mean the functions of the automated tool, but it is not sufficient to reflect the different views from the various disciplines. It seems there is a need to use the broad definition and narrow definition separately.

Another issue regarding the definition of LA is that the most frequently used definition, the definition of Society for Learning Analytics Research (2011), has the following problems:1) It includes 'measurement' though measurement is not necessary for LA (Knight & Littleton, 2015) and 2) it includes 'optimizing' though the optimizing can be interpreted in different ways. At this point, thus, it seems there is a need to redefine LA to clarify its scope and purpose.

We propose a broad definition and a narrow definition of LA. For example, a broad definition of LA refers to collection, analysis, and reporting of data or information on learners and their learning experiences to understand and improve learning. A narrow definition of LA refers to an automated system that collects, analyzes, and reports data or information on learners and their learning experiences to provide information supporting decision making regarding learning.

Research context

There is a significant imbalance in LA research in favor of the context of higher education. We assume that the imbalance probably occurred due to the relative ease of accessing data within the context. Thus, it seems necessary for researchers to collaborate with the stakeholders who are in the under-researched contexts. For example, researchers in the field of LA can study LA for professional learning more actively by collaborating with stakeholders in corporations.

Research methodology

Though there seemed to have been an imbalance of LA research in terms of research methodology in the early years of LA, the imbalance seems to be resolved by the researchers who employed experimental or quasi-experimental methodologies for their LA research. Comparing the contexts and scopes of LA research, the research methodology in LA research seems balanced.

Research scope

There is a significant imbalance in LA research in terms of the research scope. While considerable research dealt with the scopes in Foundation Layer and Environment Layer, little research covered the scopes in Application Layer. Thus, researchers in the field of LA can find relatively many opportunities for research.

In addition, in the field of Multimodal Learning Analytics (MMLA), researchers have been interested in using a variety of types of data that can be used as input sources for LA. Some researchers (Abrahamson, Shayan, Bakker, & van der Schaaf, 2015; Lau et al., 2018; Lu, Zhang, Zhang, Xiao, & Yu, 2017; Munoz et al., 2018; Prieto, Sharma, Kidzinski, Rodríguez-Triana, & Dillenbourg, 2018; Zaletelj & Košir, 2017) used data from sensors; such as electroencephalogram (EEG) sensors, motion sensors, and eye-tracking sensors; as data to be analyzed by LA engines. However, the multimodality can be applied for reporting information as well as collecting data. For example, future research on MMLA may focus on application of text-to-speech technologies and sonification to report information.

Lastly, researchers might benefit from expanding the types of collected data for LA. Currently, many researchers in the field focus on LMS data on learners' activities. However, this approach will limit the understanding of learners' learning experiences as there can be many other factors, such as learning materials, content of instructor's feedback, and contents of conversations between peer learners, influencing the learners and their learning experiences. Thus, expanding the types of collected data for LA seems a good approach. Such expanded data types include social learning analytics (de Laat & Prinsen, 2014; Shum & Ferguson, 2012), learners' gestures (Viswanathan & VanLehn, 2018; Zaletelj & Kosir, 2017), eye movement tracking (Abrahamson, Shayan, Bakker, & van der Schaaf, 2015), and electroencephalography (Lau et al., 2018).

Classification framework for LA research

We developed the classification framework with a focus on flexibility and universality to respond to possible changes in regard to theory and technology in the future. However, other researchers in the field may find some chances to improve the framework. For example, the scopes in the Foundation Layer of the framework could be divided into more detailed scopes or add newly discovered scopes.

For this review, we included articles only from academic databases. It might be meaningful to use Google Scholar, a search engine for scholarly literature, to include more research articles to validate our classification framework for LA research.

LA research for professional learning

As shown in Table 8, there are many research gaps in LA for professional learning. There might be many reasons regarding such gaps, but we assume that the relative ease of accessing higher education data for research is one of the most influential factors on this phenomenon. To resolve this, as mentioned earlier, it is necessary for researchers to collaborate with the stakeholders who are responsible for professional learning in various organizations.

In addition, to promote research on LA for professional learning, studying relationships and interactions between LA and other systems, such as talent management system or succession planning system. Based on the understanding of the relationships and interactions, researchers may find more research opportunities.

Limitations

Though we conducted iterative analyses for classifying articles that couldn't be clearly classified into a category, there can be a different view for the classification. Therefore, a further discussion needs to be made with regard to the validation of the classification framework for LA research we developed.

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Examining Types of Online Student Engagement and Their Contribution to Student Satisfaction and Perceived Learning in Online Graduate Courses

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Introduction

Online learning has grown exponentially due to its flexibility and rapid development of the Internet technology in the past decades. According to a recent report (Seaman, Allen, & Seaman, 2018) over six million students are taking at least one distance course, representing 31.6% of all students, and over three million students are taking exclusively distance courses, representing 14.9% of all students. However, retention rate and graduation rate in online programs have become a concern (B. Smith, 2010; Herbert, 2006; Heyman, 2010; James, Swan & Daston, 2016, Xu & Jaggars, 2014) and need further investigation. Online courses require high levels of self-regulation, motivation, time management and engagement from students in order to be successful in online learning (Azevedo, Cromley & Seibert, 2004; Yen & Liu, 2009). If students are fully engaged and actively involved in course learning activities and stay connected with other stakeholders in online learning, it is likely they will achieve the desired learning objectives, complete their courses, and finish their online programs. Therefore, it is critical to investigate which types of student engagement in online courses contribute to student satisfaction and their perceived learning.

The findings of this study revealed that some of the student engagement factors contribute positively to student satisfaction and perceived learning in online courses. The findings provided online faculty and instructional designers insights to consider incorporating different engagement factors when designing and revising their online courses.

Student Engagement in Online Courses

Student engagement has been defined in the literature as investment or commitment (Marks, 2000), participation (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2007), or effortful involvement in learning (Pekrun & Linnenbrink-Garcia, 2012; Reschly & Christenson, 2012). Literature on student engagement has been focused on three aspects: behavioral engagement, emotional engagement, and cognitive engagement (Fredricks et al, 2004). Behavioral engagement refers to student participation in learning. In online courses, students actually complete certain online learning activities such as participating in discussions by responding to the original questions, peers' posts, and/or asking challenging questions about the topic being discussed. Emotional engagement refers to positive and negative reactions to professors, peers, academics, and schools (Lee & Smith, 1995; Stipek, 2002). In online courses, students are emotionally associated themselves toward learning. They may simply like the topics, the activities, the instructor, and the students who interact with them or deeply appreciate the knowledge and skills gained in the learning process. Cognitive engagement refers to student effort, to what extent students are engaged in their course work to master complex ideas and difficult skills (Fredricks, Blumenfeld, & Paris, 2004). In online courses, students utilize varied strategies and efforts in online learning activities. Strategic students use metacognitive strategies to plan, monitor, and evaluate their cognition when completing tasks (Pintrich & De Groot, 1990; Zimmerman, 1990). Students who are cognitively engaged use strategies associated with deep learning (Fredricks et al, 2004) such as reflective learning, live cases, group work, simulations etc. Reflective learning and live cases are among the most engaged learning activities that result in deep learning.

Social engagement has also been proposed in the literature. It refers to the social aspect in a student's collegiate experience (Knight, 2013). It is similar to the social presence as described in the three presence (Garrison, Anderson, & Archer, 2000) of online learning. In online courses, faculty can encourage students to participate in online forums such as "water cooler" or create "personal profiles" and share with the entire class to enhance social engagement. Social engagement in online learning can also be further enhanced through "virtual clubs" or "virtual events". All online students can choose to participate in campus events at a distance.

Recent studies also identified additional aspect relevant to online learning that is collaborative engagement. This aspect is relevant to "the development of different relationships and networks that support learning, including collaboration with peers, instructors, industry, and the educational institution" (Redmond, et al, 2018). In online courses, many learning activities such as collaborative projects, peer journaling etc. can be utilized to promote student collaboration. Tools like groups and Wikis in an LMS can be used to support these types of learning activities.

Instrument of Online Student Engagement

Students' engagement in online learning has been measured in many different ways, ranging from self-report survey to observational measures. Since among these methods, self-report method is a cost-efficient and flexible way to gather a large quantity of data efficiently (Fowler, 2013), it was used widely in measuring students' engagement in online context. Many instruments, such as surveys, questionnaires, or scales, have been established and used to assess the extent to which students engaged. For example, Dixson (2010) created the Online Student Engagement Scale to assess students' behavioral, emotional, and cognitive engagement in online learning; and Coates (2006) established the Student Engagement Questionnaire to measure students' engagement in aspect of behavior, emotion, and cognition.

Although many instruments were created and used to measure students' engagement in online learning, students' engagement were measured in different aspects since these instruments were created according to different definitions of student engagement (Henrie, Halverson, & Graham, 2015). For example, Fredricks et al., (2004) set behavioral, cognitive, and emotional engagement as the indicators of the student engagement, while Handelsman, Briggs, Sullivan, and Towler (2005) constructed student engagement in skills engagement, emotional engagement, participation/interaction engagement, and performance engagement. Such examples highlight the unstructured construct of student engagement and the importance of providing well-defined construct.

The Study

This study attempted to validate the instrument to measure online engagement and determine whether relationships between types of online engagement and student satisfaction and student perceived learning exist and to what extent these online engagement factors contribute to student satisfaction and perceived learning.

A variety of measures have been used to measure student engagement in literature. Student self-reporting in online surveys is used for this study as it provides data on how students are engaged in online courses and their satisfaction toward online courses and their perceived learning. A questionnaire was sent to all students taking four online graduate Educational Technology courses taught by one of the investigators in Fall 2018 and Spring 2019 semester to collect data. Thirty-one responses were received from 36 students enrolled in those courses with a response rate of 86 percent. Many of the participants, 81% were female and 19% were male; 39% of them were master's and 61% were doctoral students. All respondents had online learning experience as 87% of them had taken over 4 online courses before.

Instrument Validation

Upon reviewing student engagement instruments available, an instrument with five Likert- scale was created. The Liket-scale questions sought online student engagement level of each engagement aspect, and their satisfaction and perceived learning. Five questions regarding participants' demographics were also included in the questionnaire.

Prior to instrument evaluation, SPSS was used to screen the data. Each of the participant was assigned an ID number. Through checking the responses to 24 items of the OSEQ, the response of the ID #10 to the item 15 and the response of the ID #22 to the item 17 were missing. Therefore, these responses were coded as a missing data, which was coded as blank spaces in the data file.

The OSEQ used in this study to measure online students' engagement contained 24 items (Items 1 -24), each with four response options: 1 = "Strongly Disagree", 2 = "Disagree", 3 = "Agree", and 4 = "Strongly Agree". The direction of the rating scale suggest that higher scores represented higher levels of engagement in online learning. To ensure instrumentation quality, a standard Rasch analysis utilizing the WINSTEPS computer program was employed to evaluate both item functioning and dimensionality of engagement in online learning. The instrument performance was examined from the perspective of separation, categorical functioning, dimensionality, item hierarchical order, fit statistics, which provided decisive information on the reliability and validity of the instrument used in this study.

The instrument demonstrated a Rasch reliability of .92, which is high. High item reliability indicates that the sample size is large enough for stable comparisons between items. Hight item reliability also suggests that the instrument represented a clear line of inquiry, in which some items were more difficult and some items were easier, and that the confident could be placed in the consistency of the inferences of person ability, if these same items were given to another sample with comparable ability levels, is warranted (Bond & Fox, 2015).

Separation is a measure of the spread of the estimates relative to their precision (Linacre, 2012a). The item separation value for the 24 items was 3.48, which was transformed into a strata index [Strata = (4G+1)/3; Wright & Masters, 1982] of 4.97 (rounded down to 4). This indicated that the four response categories were able to separate the participants endorsement of engagement into four statistically different groups. Good separation reflects small error, and the higher the separation is, the more confidence we can place in the replicability of item placement across other samples (Bond & Fox, 2015).

To evaluate the reliability statistics, the non-extreme person estimates were used because it is more conservative (Wright & Stone, 1979). There were three participants classified as extreme respondents. WINSTEPS summary statistics of the 28 measured non-extreme participants shows that the real-person reliability was .86 and the model-person reliability is .88, which is not large difference from the real-person reliability. The Rasch reliability was considered to be 'good' (Miller et al., 2003) among participants. The real-person estimates were used to interpret the data because these estimates are more conservative.

The Rasch person separation index is a reliability index determined on the basis of how many statistically different levels of engagement were distinguished by the items. The person separation of 2.49 transformed into a strata index [Strata = (4G +1)/3; Wright & Masters, 1982] of 3.65 (rounded down to 3). This indicates that three statistically different groups of participants on the OSEQ variable and it provides evidence that there is a quantifiable engagement measure.

Rating scale functioning also contribute to instrument performance. If the rating scales function well, the step values should be arranged distinctively and monotonically. The summary of measured steps shows that step calibrations for Categories 1, 2, 3, and 4 progressed from the base line to -2.17, to -.52, and to 2.69. That means that the step difficulty between the response 1 (i.e., Strongly Disagree) and the response 2 (i.e., Disagree) is 2.17 logits, the step difficulty between the response 2 and the response 3 (i.e., Agree) is 1.65 logits (2.17-.52 = 1.65 logits), and the step difficulty between the response 3 and the response 4 (i.e., strongly agree) is 3.21 logits (2.69 – (-.52) = 3.21 logits). Therefore, the step threshold increase met the recommended guideline of being above 1.4 logits meaning that respondents reliably distinguished between the rating scale categories. In addition, the average measure ranged between -3.39 logits to 3.81 logits, which increased with the category value. Overall, these findings suggest that the rating scale used on the instrument was functional for students. The step values were arranged monotonically along the linear measure and the scales were functioning reasonably well. However, the number of participants selecting category 1 was only 1% leaving almost a break, which may threaten the usefulness of this category. In addition, the probability curve shows that the peak of Category 2 was not distinctive enough.

The difficulty difference in category "4" (Strongly Agree) between the easiest item and the most difficulty item was about three logits, and the difficulty difference between the steps of each item was not equal. The difference in step difficulty between "3" (Agree) and "4" (Strongly Agree) was more than five logits, while the difference in step difficulty between "2" (Disagree) and "3" (Agree) is about two logits. Thus, qualitatively, the raw score 4 of Item 1 (Explore online course site) was not equal to the raw score 4 of Item 18 (Build learning community to create sense of belongs), and category values were not intervals, because $(4\text{-}3) \neq (3 - 2)$.

Item Fit Statistics show that the measured infit mean square values (MNSQ) fell within the range of .60 and 1.4 suggested as acceptable for Likert-type rating scales and the measured outfit MNSQ values fell within the range of .60 and 1.4 also suggested as acceptable for Likert-type rating scales (Bond & Fox, 2015). In addition, another statistic -Z-Standardized score (ZSTD) fell within the range of -2 and +2 also suggested as acceptable with a sample size of between 30 and 300 (Linacre, 2012a). Moreover, the point-measure correlation (PT-MEASURE) must be positive and larger than .3 were suggested as acceptable (Linacre, 2012a) because negative or 'nearly zero' values of PT-MEASURE correlations is the signal that items are problematic and are not consistent with the construct. Looking at the four indicators (Infit mean square, Outfit, mean square, Infit ZSTD, and Outfit ZSTD) and the point-measure correlation, item 1 (Infit MNSQ = 2.54 > 1.4, and Infit ZSTD = 3.5 > 2), item 3 (Infit MNSQ = 2.23 > 1.4, and Infit ZSTD = 2.9 > 2), item 4 (Infit MNSQ = 2.10 > 1.4, and Infit ZSTD = 2.5 < 2), item 2 (Infit MNSQ = 2.07 > 1.4 and Infit ZSTD = 2.4 > 2), item 23 (Infit ZSTD = -2.0), and item 22 (Infit ZSTD = -2.1 < -2.0) were detected as misfitting items and needed to be further investigated.

According to Bond and Fox (2007), when the MNSQ >1.4 or ZSTD > 2, it suggested that there is more variation than modeled; when the MNSQ < 0.7 or ZSTD < -2, there is less variation than modeled. So by looking at the item 1, 3, 4 and 2 closely, these items' ZSTD is larger than 2, so these items are underfitting (i.e., the response pattern is too haphazard and the response to this item is too deterministic), which may degrade the quality of the ensuring measures. In addition, both item 22 and item 23's ZSTD is less than or equal to -2, therefore, item 22 (I will take a similar online course again) and item 23 ("I have achieved the stated learning objectives for this course") are overfitting (i.e., the response pattern is too determined and the responses to these items are too erratic), which might mislead us into concluding that the quality of our measures is better than it really is. Although item 1, 2, 3, 4, 22 and 23 are misfitting according to the ZSTD, by investigating these items' meaning, they are consistent with the theory. Therefore, these items were retained.

To examine the dimensionality of the instrument used in this study, a Rasch Principle Components analysis of Residuals were conducted. The purpose of this analysis is not to construct variables, but to explain variance. The Rasch dimension explained 46.4% of the variance in the data. The explained variance is low (the cutoff value is 60%). So, there is something else that influences the responses. Therefore, the analysis of the residuals was checked to find out if it is a random noise or systematic influencing. The largest secondary dimension, "the first contrast in the residuals" explained 13.6% (larger than 10%) of the variance, and the strength of the first contrast was 6.1 eigenvalues, indicating that there was some unexplained variance.

From the item-person map shows that the mean of measure of the student engagement rested about 2.5 logits above that of the items, suggesting that the items were easy to agree with. The higher end of the distribution of students higher than the highest levels of items. This indicates that there are a group of students who are much more engaged than this instrument can measure with these items. Thus, more items that can measure the higher levels of engagement as needed, in order for students' engagement to be measured more accurately. The difference in difficulty between the easiest item and the most difficulty item was about five logits (between -2.2 logits to 3 logits). The easiest item to say 'Strongly Agree' was located at the bottom of the item hierarchy, and it was item 2 ("I participate in online activities (online discussions, online chat etc.) according to the course schedule."), 4 ("I log onto to the course and view course materials on a regular basis according to the schedule."), and 9 ("I review my coursework for mistakes to improve it before submitting to the course site."). The most difficult item to say 'Strongly Agree' was located at the top of item hierarchy, and it was 18 ("I build or join learning communities to create a sense of belonging."). Reviewing course material and completing course work were easy for participants to endorse, while creating sense of belongs was relatively hard for this group to endorse. In addition, there were 4 students located on the top of the item hierarchy with engagements measures near 6 logits. This indicated that these students were likely to endorse all the items in this questionnaire.

Data Analysis and Results

Following the psychometric analyses of the data (i.e., the Rasch rating scale analysis), WINSTEPS person measures and category measures (logits) were used in place of standard raw scores for hypothesis testing to avoid methodological flaws associated with the use of raw scores. Person measures and category measures were intervals generated from the interactions of student endorsability, item difficulty, and step difficulty, and varied with item to item.

Since the spearman's correlation calculates a coefficient, which is a measure of the strength and direction of the association/relationship between two continuous or ordinal variables, in this study, this test was used to assess potential relationships between the five types of student engagement and student satisfaction and perceived learning in online courses, given the variables (i.e., behavioral engagement, emotional engagement, cognitive engagement, collaborative engagement, social engagement, student satisfaction, and perceived learning) are continuous. Figure 1 presents the statistics and level of significance illustrating nonparametric correlations between the variables.

In this study thirty-one participants were recruited. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was no statistically significant correlation between behavioral engagement and students' satisfaction, $r_{(s)} = .301$, $p = .099 > .05$. However, there was a statistically significant, moderate positive correlation between behavioral engagement and students' perceived learning, $r_{(s)} = .542$, $p = .002 < .05$.

Nonparametric Correlations

Correlations

			Behavioral_Engag	Emotional_Engag	Cognitive_Engag	Collaborative_Engag	Social_Engag	Satisfaction	Perceived_Learning
Spearman's rho	Behavioral_Engag	Correlation Coefficient	1.000	.158	.180	.140	.303	.301	.542**
		Sig. (2-tailed)	.	.396	.333	.452	.097	.099	.002
		N	31	31	31	31	31	31	31
	Emotional_Engag	Correlation Coefficient	.158	1.000	.505**	.476**	.214	.733**	.756**
		Sig. (2-tailed)	.396	.	.004	.007	.248	.000	.000
		N	31	31	31	31	31	31	31
	Cognitive_Engag	Correlation Coefficient	.180	.505**	1.000	.489**	.365*	.306	.427*
		Sig. (2-tailed)	.333	.004	.	.005	.044	.094	.017
		N	31	31	31	31	31	31	31
	Collaborative_Engag	Correlation Coefficient	.140	.476**	.489**	1.000	.620**	.486**	.428*
		Sig. (2-tailed)	.452	.007	.005	.	.000	.006	.016
		N	31	31	31	31	31	31	31
	Social_Engag	Correlation Coefficient	.303	.214	.365*	.620**	1.000	.338	.258
		Sig. (2-tailed)	.097	.248	.044	.000	.	.063	.161
		N	31	31	31	31	31	31	31
	Satisfaction	Correlation Coefficient	.301	.733**	.306	.486**	.338	1.000	.773**
		Sig. (2-tailed)	.099	.000	.094	.006	.063	.	.000
		N	31	31	31	31	31	31	31
	Perceived_Learning	Correlation Coefficient	.542**	.756**	.427*	.428*	.258	.773**	1.000
		Sig. (2-tailed)	.002	.000	.017	.016	.161	.000	.
		N	31	31	31	31	31	31	31

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 1

This test was also run to assess the relationship between emotional engagement and students' satisfaction and perceived learning. Preliminary analysis also showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was a statistically significant, strong positive correlation between emotional engagement and students' satisfaction, $r_{(s)} = .733$, $p <.001$. Furthermore, there was a statistically significant, strong positive correlation between emotional engagement and students' perceived learning, $r_{(s)} = .759$, $p <.001$.

In addition, this test was run to assess the relationship between cognitive engagement and students' satisfaction, and perceived learning. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was no statistically significant correlation between cognitive engagement and students' satisfaction, $r_{(s)} = .306$, $p = .094 > .05$. However, there was a statistically significant, moderate positive correlation between cognitive engagement and students' perceived learning, $r_{(s)} = .427$, $p = .017 < .05$.

The Spearman's rank-order correlation was run to assess the relationship between collaborative engagement and students' satisfaction, and perceived learning. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was a statistically significant, moderate positive correlation between collaborative engagement and students' satisfaction, $r_{(s)} = .486$, $p = .006 < .05$. Furthermore, there was a statistically significant, moderate positive correlation between collaborate engagement and students' perceived learning, $r_{(s)} = .428$, $p = .016 < .05$.

The test was also run to assess the relationship between social engagement and students' satisfaction, and perceived learning. Preliminary analysis showed the relationship to be monotonic, as assessed by visual inspection of a scatterplot. There was no statistically significant correlation between social engagement and students' satisfaction, $r_{(s)} = .338$, $p = .063 > .05$. There was no statistically significant correlation between social engagement and students' perceived learning either, $r_{(s)} = .258$, $p = .161 > .05$.

Discussion, Limitation, and Future Studies

As discussed in the instrument validation section, the instrument demonstrated a Rasch reliability of .92, which is quite high. The item fit statistics within the range of 0.6 and 1.4 indicated these items were acceptable for

Likert-type rating scales. However, some of the items with misfit score of 1.58 and 1.39 need to be revised. When further examining the items for cognitive engagement, some of those items actually resemble the theme of behavioral engagement. New items to better measure cognitive engagement need to be added. For example, “I integrate ideas from multiple sources when completing course assignments” “I justify my decisions with educational framework when completing course assignments” “I monitor my learning progress when completing my course work” and “I reflect on the course work I completed” need to be added to further investigate the cognitive dimension of student engagement.

Figure 2 illustrate the relationships between each of the engagement factors and student satisfaction and perceived learning.

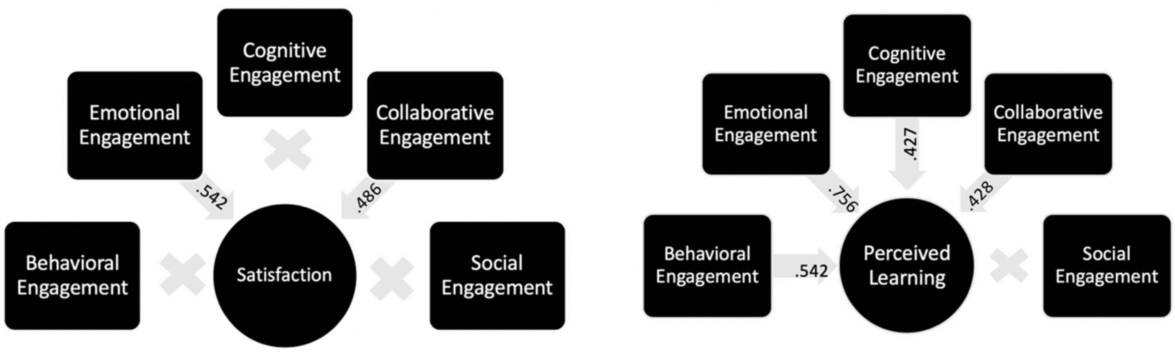

Figure 2

Limitations of this study include small sample size and some items in the instrument do not quite measure a specific type of engagement. We will add more items to measure each type of engagement, and revise the items for the cognitive dimension and administer the survey to more online courses for analysis.

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A Literature Review: Fostering Computational Thinking Through Game-Based Learning in K-12

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Introduction

Computational thinking (CT) is defined as an analytical thinking approach and problem-solving process that breaking problems into small pieces, designing systems for possible solutions, and understanding the relationship among the pieces by drawing fundamental concepts (Wing, 2006, 2008; National Research Council, 2010a).When Wing's (2006, p. 33-35) pronouncement that "[computational thinking] represents a universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use" (p. 33), following this trend, the number of studies related to computational thinking and its' implementations shows a huge increase. However, researchers are usually confused with the difference between CT and computer science (CS) concepts. Even though CT consists of some concepts that are the core of computing and computer science, it also includes efficient practices such as abstraction, decomposition, pattern generalization, and prediction. These concepts are also used by scientific and mathematical disciplines for modeling, reasoning, and problem-solving (National Research Council, 2008). According to Henderson et al. (2007), CT has been shown as the core of all science, technology, engineering, and mathematics (STEM) disciplines and it leads the idea of teaching computing in K-12 education. Also, most of the studies show teaching programming and CT skills is an effective method to cope with the challenging science and math concepts (Hambrusch et al., 2009, p. 183-187; Blikstein and Wilensky, 2009, p. 81-119).

After Wing's call to action for teaching CT skills to prepare students for being a productive member of the society, two National Academy of Sciences workshops were organized to find out the nature of computational thinking and its cognitive and educational interventions on K-12 curriculum (National Research Council, 2010b). These workshops also aimed to explain the pedagogical aspects of CT (National Research Council, 2011). In the first CT workshop, procedural thinking and programming (Papert, 1980, 1981, p. 82-92) were discussed as early concepts of CT. Even though this workshop seemed like a beginning process, it added significant value to examine and evaluate many concepts from computer science discipline to take CT beyond the idea of "just programming". On the other hand, the workshop found out the lack of consensus that looks like to have bedeviled this field. Besides, it led to many unanswered questions: "How can CT be recognized? What is the best pedagogy for promoting CT among children? Can programming, computers, and CT be legitimately separated?" (National Research Council, 2010)

While earlier researchers focus on the definitions of CT, since 2012, research interests related to CT have been shifted to work on these unanswered questions. Graver and Pea (2013, p. 38-43) explain that researchers have started to interest more practical questions such as how to encourage the implementation of CT in K-12 education and how to assess students' CT abilities. In the last three decades, issues of how to teach and learn programming and CS constitute a large amount of the literature. Much of what we collectively know is largely based on Papert's studies in the 1980s by using game-based learning environments using languages such as LOGO and BASIC. He indicates that "[we] can give children unprecedented power to invent and carry on exciting projects by providing them with access to computers, with a suitably clear and intelligent programming language and with peripheral devices capable of producing on-line-real-time action" (Papert, 1972, p. 245-255). Yet, providing all sources without knowing how to implement them in K12 settings to increase students' motivation and learning achievement should be answered. However, the bulk of this CS education research is set in the context of undergraduate classrooms; little is known about how applications of game-based learning foster computational thinking in K-12, especially in elementary schools.

Therefore, the purpose of this study is to obtain a better understanding for educators and researchers by systematically reviewing and synthesizing recent research since 2010 on CT regarding applications of game-based learning (GBL) in K-12.

The following research questions are addressed in this study.

RQ1: What range of topics does the current literature cover?
RQ2: What kind of game-based learning environments and tools have been shown effective in promoting CT?
RQ3: What are the reported outcomes related to students' engagement, motivation, and achievement in CT?
RQ4: How was the CT skills assessed in recent literature?

Methodology

Data Sources

The main data sources include journal articles, conference papers, and doctoral dissertations. However, due to language barriers, only articles written in English were included. Also, the discipline criteria are limited to the field of education because of researchers' academic background. The following keywords and their combination were used with regard to the main concepts of CT and GBL by using Boolean logic such as (Computational thinking AND (k12-K12 OR elementary school OR middle school)).

The search was conducted in databases that are well-known and well-established in the field of computational thinking and game-based learning: ERIC (Education Resources Information Center), PsycInfo, IJGBL (International Journal of Game-Based Learning), IEEE (Institute of Electrical and Electronics Engineers), and Summon. Besides, Google Scholar was used for additional searches.

Keywords:

- Computational thinking
- Computing education
- Game-based learning
- Games
- Gamification
- Digital games
- k12 or K12 or Elementary school or Secondary Education
- STEM education
- Non-STEM education

Coding and Analysis

The first step of the study identified 951 articles between 2010 and 2019 (see Table 1). At the beginning of the coding and analysis process, these studies were examined initially in regard to their titles, abstracts, and keywords. The initial review helped to see the relatedness of the studies at first. The criteria of relatedness were whether studies provided analytical results related to enhance computational thinking or not (see Table 2).

Table 1. Distributions of studies in each database

Database	Number of Articles Identified
ERIC	13
PsycInfo	3
IJGBL	649

IEEE	99
Summon	187
Total	951

In the selection stage, different frameworks were followed used by Zhang and Nouri (2019) and Sengupta et al. (2012).

Table 2. Selection criteria

Inclusion Criteria	Exclusion Criteria
K12 education (kindergarten through the 12th grade (1-12))	Other stages of education such as pre-university level, college students, and graduate students.
Empirical studies	Theoretical studies
Studies that provide evidence about students' learning outcomes	Studies do not provide information about students' learning outcomes
Using educational tools or technologies to foster computational thinking development	Studies not mention about any interventions

Findings

Computational Thinking Through Game Based Learning

Game-based learning is defined as implementing game elements such as core mechanics, challenges, and goals into real-life settings to enhance learning. According to the study of the National Purchase Diary Panel (NPD) Group, in the United States, %82 of children ages between 2 to 17, approximately 64 million children, play video games (N.P.D Group, 2009). This study reveals how much games are attractive to children. Therefore, GBL as a teaching method seems promising to enhance students' learning and motivation. Since an increase in implementation of CT pushes schools searching effective teaching methods (Gouws, Bradshaw, and Wentworth, 2013, p. 10-15), many researchers indicate that GBL, especially game design part, seems promising for teaching CT concepts in K-12 settings (Baytak and Land, 2010; Rowe et al., 2017, p. 45).

In the literature, different theoretical frameworks are promoted to guide students and teachers to improve CT skills through GBL. However, these frameworks show differences based on teaching or focusing particular skill(s): decomposition, pattern recognition, abstraction, algorithm thinking, and evaluation (for checking the CT skills see Selby and Woollard, 2013) in the development of CT. In Figure 1, Jiang et al., (2019, p. 29) suggest a theoretical framework for targeting coding environments to improve CT skills with regard to gameplay elements and design principles. In the framework, they put emphasis on computational problem-solving (CPS) that a basis aspect of CT, design of a puzzle game, and their relationship.

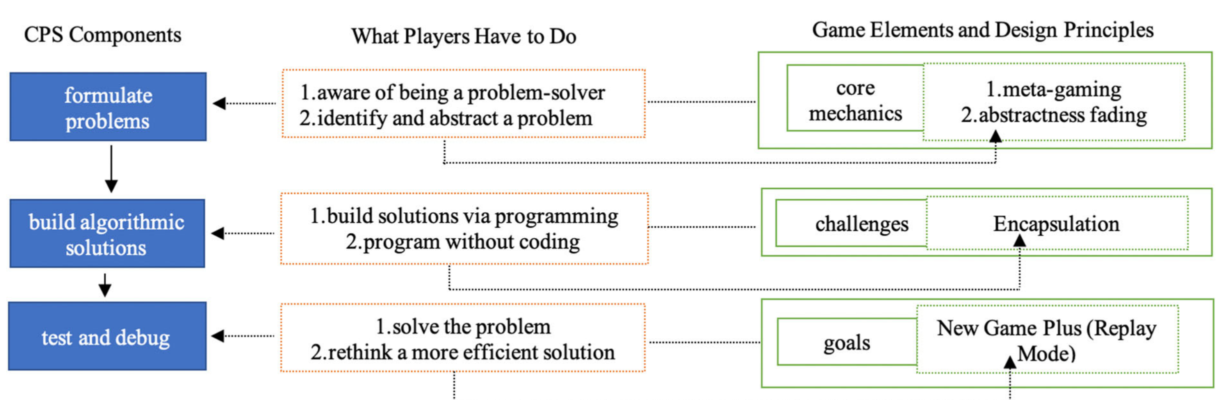

Figure 1. Computational Puzzle Design (CPD) Framework (Source: Jiang et al.,2019, p. 29)

Many studies especially focus on block-based coding game designs, follow similar structured frameworks like CPD, even though they do not specifically mention their theoretical framework. In these studies, players' tasks and game designs show differences but the relationship between CPS and game elements is similar (e.g. Troiano et al., 2019, p. 208-219;Kazimoglu et al., 2012, p. 522-531; Harrison et al., 2018, p. 134-138).

Following a structured theoretical framework is not solely enough for the development of CT skills, game elements and design in regard to the target audience play a significant role in students' learning outcomes. In the literature, many researchers develop their own game projects while others prefer to use already developed software such as LEGO Mindstorm, Scratch, and Light Bot. However, surprisingly, even though researchers develop their own game designs, still, they tend to use block-based game design methodology (e.g. Howland and Good, 2015, p. 224-240; Leonard et al., 2016 ;Bauer, Butler, and Popović, 2017, p. 26; Jiang et al., 2019, p. 29). Bauer et al., (2017, p. 26) explain their reason to develop their own game design as keeping a balance between exploration and guidance in the games. According to them, existing game designs (called Dragon Architect) that aim to improve CT include either open-ended exploration with little direct instruction or full of exploration with a lot of direct instruction. In their game design, players use code blocks to move the dragon character for solving the puzzle (see Figure 2). Similarly, Jiang et al., (2019, p. 29) promote the "LittleWorld" game that includes non-coding blocks and puzzle designs to foster students' computational problem-solving skills (see Figure 2). They indicate that puzzle game designs are appropriate for enhancing logical thinking, problem-solving skills, and pattern recognition which CT aims to promote.

Figure 2. Examples of block-based game designs (Dragon Architect and LittleWorld) (Source: Bauer, Butler, and Popovic, 2017)

Moreover, a few studies implement hands-on game-based methods and role-playing game designs to develop CT skills and to enhance student communication, reading, and writing skills. For example, Jagušt et al. (2018, p. 1-5) developed unplugged game-based activities to teach CT skills. In their study, four case studies were conducted with different age groups. However, only three of them are related to K-12 students, so the details of the fourth case study wouldn't be provided here. In the first case study, they redesigned the famous children games such as Battleship, the dot game, and Packman by using pencil and paper. In this CT activity, students completed basic paper programming activities like doing in Scratch. Similarly, in the second case study, students completed a life-size graph paper game by working either individualist or collaboratively. In the single player mode, a student should execute the given program (drawing a shape) in the playing board. In the two-player mode, one student takes a "programmer" role while other plays as "robot". The programmer writes the codes to complete the given programming task while the robot executes these written commands. Furthermore, the third case study is called "The Network". The purpose of this study is to integrate the networks problems and unplugged activities into the curriculum. 6th grade students completed these activities like in the first case study.

Figure 3. The photos from the case studies (Source: Jagušt et al., 2018)

In addition to Jagušt et al., (2018, p. 1-5), another GBL activity is conducted to explore the relationship between computational thinking and English literature in the K-12 curriculum by Nesiba, Pontelli, and Staley in 2015. In their study, existed English curriculum units are integrated with GBL methods and CT skills. For example, students practice their CT skills by telling the story of "Macbeth" novel, the story of a Scottish soldier who wants to be King without thinking any consequences during his journey (see Figure 4). At first, students select some scenes from the novel and sketch out them for preparing a storyboard. After they create their storyboard, they implement these scenes by using ToonDoo tool, online comic-creation tool. Even though this study does not include any problem-solving skills, students have to use their algorithmic thinking abilities to develop a detailed step by step scene based on their storyboard. In the literature, algorithmic thinking is described as a way of getting to the solution by defining clear steps (Selby and Woollard, 2013; Edwards, 2011, p. 58-67). Although students do not solve any problem in the study, they define each step clearly to complete their tasks. Thus, this study provides an exceptional example of how to foster algorithmic thinking without a problem-solving task. Besides, according to Nesiba, Pontelli, and Staley (2015, p. 1-8), students also use their abstraction skills while scanning their scenes and criticizing the significant passages. However, the abstraction component of CT skills is defined as identifying general principles to generate specific patterns (Shute, Sun, and Asbell-Clarke, 2017, p. 142-158). Therefore, their findings related to abstraction and decomposition is arguable since students do not focus on generating patterns in their study.

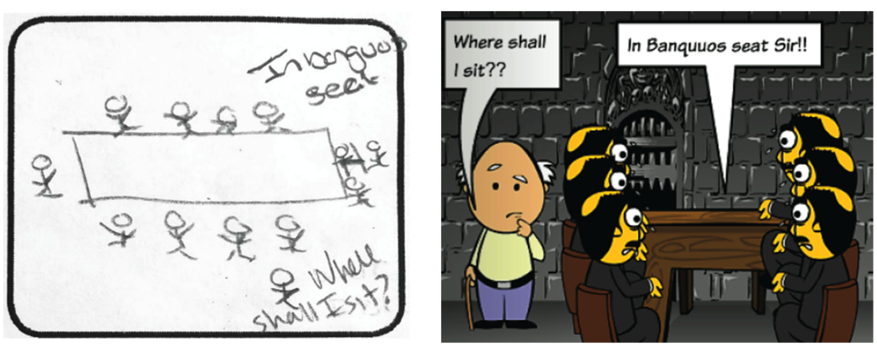

Figure 4. A student's work from Macbeth story (Source: Nesiba, Pontelli, and Staley,2015)

Overall, most of the studies in terms of implementation of CT through GBL in K-12 setting address coding-oriented education or STEM education by using block-based applications such as Scratch, LightBot, and Combats. Only a few studies aim to enhance students' CT skills in social science classes.

Students' Engagement, Motivation, and Achievement in CT

According to Kotini and Tzelepi (2015, p. 219-252), the way of enhancing students' CT skills is complex and is dependent on students' engagement and motivation. Also, they indicate that gamified learning activities aim to foster CT skills have a positive impact on students' achievement. Following this trend, many studies show integration of educational games into the K-12 curriculum help to increase students' attention, learning motivation, and positive attitude (Yang and Wu, 2012, p. 339-352; Bai et al., 2012, p. 993-1003;Triantafyllakos, Palaigeorgiou, and Tsoukalas, 2011, p. 227-242). However, only a few studies mention about improvements in students' motivation in the implementation of a game-based learning activity to foster students' CT skills. One example from these studies is conducted by Fogli et al. in 2017. They studied with 18 secondary school students to measure the effectiveness of a game-based system (TAPASPlay), which is designed as a block-based environment to enhance students' CT skills.

According to their study, there is evidence that TAPASPlay provides an enjoyable environment to improve students' motivation and CT skills with regard to collaborative learning. Moreover, a study also shows that primary school students are highly motivated to learn algorithmic thinking with tangible objects by using block-based environments like BYOB or Scratch (Futschek and Moschitz, 2011, p. 155-164). These two studies advocate that learning CT skills through GBL, or tangible objects can increase students' motivation and engagement. On the other hand, this kind of studies is insufficient to explain the source of students' motivation by showing evidence. In other words, studies in the literature do not provide detailed information about either student get motivated by involving a game-based activity or they are motivated because of improving their CT skills.

Furthermore, in terms of students' achievements in CT, most of the studies only put emphasis on decomposition, algorithm design, and abstract thinking (Harrison et al., 2018, p. 134-138; Kazimoglu et al.,2012; Bauer et al., 2017, p. 26). Surprisingly, current studies do not usually mention about pattern recognition and generalization while talking about students' CT skills. However, these two CT components are the basis for the development of other components like algorithm design (Ambrosio et al., 2014, p. 25-34). In general, more studies should be conducted to explain the effects of CT through GBL on students' engagement, motivation, and achievement in particular CT components.

Assessment and Evaluation Methods in CT

Adaptation of CT into the school curriculum is essential to prepare students for 21st-century skills and to be productive members of the society. However, it requires an assessment framework to understand in what extent K12 school students are successful in CT abilities and which kind of GBL methods can engage students' CT skills. Also, Nitko and Brookhart, (1996) indicate that assessment aims to improve the learning process with regard to needs of the students, schools, and curriculum. Besides, assessment tools play a critical role to bring CT through GBL to K-12 settings for supporting the use of programming in middle school (Werner et al., 2012, p. 215-220) (Grover and Pea, 2013, p. 38-43; Grover, 2015, p. 15-20). However, a widely accepted assessment method is missing to measure the effectiveness of CT interventions in the literature (Shute, Sun, and Asbell-Clarke, 2017, p. 142-158). According to Settle et al., (2012, p. 22-27), the needs for an appropriate assessment method is a critical step to control the reliability and validity of interventions in the CT area.

In the literature, most of the studies use interviews, pre and post-tests, project portfolio analysis, document-based analysis, design scenarios or the combination of these methods as assessment methods in the interventions of CT (Brennan and Resnick, 2012, p. 25;Bubica and Boljat, 2018; Mioto et al.,2019). These are the traditional ways to gain an understanding of students' learning outcomes related to CT concepts. Additionally, Shute et al., (2017, p. 142-158) present two assessment methods: Scratch-based and game/simulation-based. According to their study, Scratch-based assessment also includes portfolio evaluation, interviews, and design projects in addition to multiple choice and open-ended quizzes. On the other hand, they bring up pattern analysis and web-like graphic reports in the game/simulation assessment method. This evaluation method is based on visual analysis of students' progress.

Furthermore, Román-González, Moreno-León and Robles (2019) propose a comprehensive evaluation model to assess students' CT abilities in regards to Bloom's taxonomy (see Figure 5). They suggest several tools such as diagnostic, summative, and formative-iterative. Each tool specifically addresses one level of CT. For example, diagnostic tools aim to measure the understanding level of CT while summative tools focus on learning objectives. According to Mioto et al., (2019), since formative and summative assessments put emphasis on students' cognitive abilities, they are more efficient during the development of CT. However, a few studies use these evaluation tools and do not include concrete examples of how to combine these methods in educational settings (Román-González, Moreno-León and Robles, 2019)

To sum up, both qualitative and quantitative methods are preferable for the researchers in the field. Only, a few studies get benefits from data visualization reports to measure students' growth. The examples of how to implement different assessment methods into CT education can take place in the future studies.

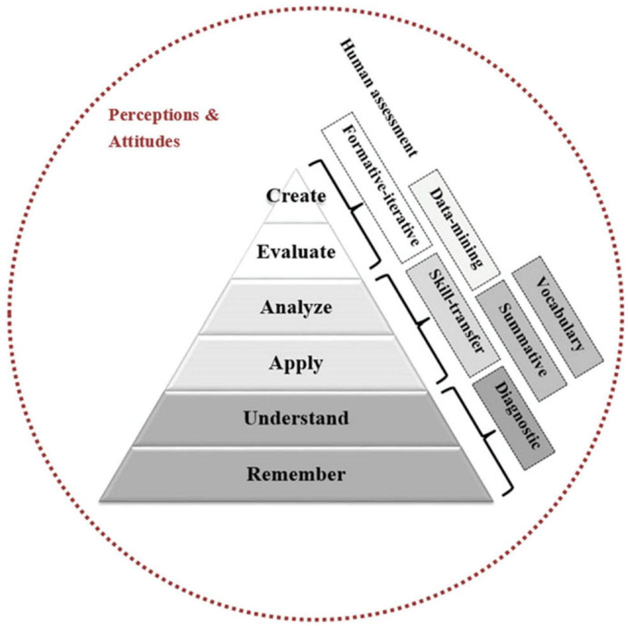

Figure 5. Bloom's taxonomy and CT assessment tools (Source: Gonzales, Leon, and Robles, 2019)

Limitations of the Study

This study has two main limitations. Firstly, the review is only conducted searches in five databases and Google Scholar. Also, studies are only written in English and the field of education was eligible. Therefore, it might not represent all works in the research area.

In addition, this review focuses on the studies which provide positive evidence to show how students' CT abilities can be enhanced through GBL. Thus, this scope may not present a complete picture of the improvement of CT skills in K12 education. It might lead to publication bias as a limitation of this study.

Conclusion and Discussion

Space limitations of this proposal limit our ability to discuss our synthesis in detail, which we intend to present at the AECT conference organized by the four research questions followed by recommendations for future research. Below are some of the highlights for each research question.

According to our findings, most studies have focused on either STEM education to children in regard to computational thinking. In other words, most of the studies consider STEM components to increase learning outcomes, students' confidence, and improve their capacities in terms of enhancing computational thinking. However, studies mainly put emphasis on the science component even though they come up with a generalization in STEM. For example, Jenson and Droumeva, (2016, p. 111-121) start with STEM as the main concern but then, they make narrow the study by putting a spotlight on science concept. On the other, a few studies only consider all of the STEM subjects in their research methodology. For instance, Tsarava et al., (2017, p. 687-695) focus on science, technology, engineering, and math subjects by building a bridge between real-life problems and CT-based solving. They design eight lessons that consider different problems related to each STEM subject for 3rd and 4th graders in primary schools. Their study is one of the few studies that show how to foster computational thinking through game-based learning in different subjects. Nevertheless, more study, especially related to technology and engineering in STEM, should be conducted to guide teachers or policy makers on how to enhance CT through GBL in these subjects. Besides, the number of studies in non-STEM disciplines like literacy or social sciences is also a few. Researchers can consider working on how to develop a CT curriculum to enhance students' communication, reading, and writing skills.

In addition, from a game-based learning perspective, our findings show that most of the studies regard block-based environments to support CT. Most common trends in the studies in terms of block-based environments are Scratch Jr, MIT AppInventor, Game Maker, Code Combats, ColoBot, and LEGO Programs. These environments are usually used for teaching algorithm or creating lesson plans to blend in an ongoing lesson for enhancing CT. For example, Baratè, Ludovico, and Malchiodi (2017) used the LEGO-based music notation program to foster primary school students’ CT abilities. The findings of these studies emphasize a strong relationship between basic object-oriented programming and computational thinking. Moreover, from a theoretical perspective, we found that several studies are based on constructionism, constructivism, project-based theory, and active learning theory. Future studies might want to consider the role of social cognitive theory, information processing theory, and cognitive learning processes on students’ CT abilities. Since CT includes relevant abilities such as decomposition, the process of debugging, testing and analysis, and control structures are related to these learning theories.

Most recent addressing the CT assessment has used either student-created, or pre-designed programming artifacts to evaluate students' understanding and use of abstraction, conditional logic, algorithmic thinking, and other CT concepts to solve problems. In addition, ideas of deconstruction, reverse engineering, and debugging was mostly used to assess children's understanding in computational contexts.

The findings of this study also pointed out to the use of gamification as a way to foster students’ computational thinking abilities, engagement and motivation in addition to their academic achievement at early ages.

The analysis of existing literature in this study demonstrates that using game-based learning as an interdisciplinary activity has the potential to foster computational thinking and develop 21st-century competencies such as critical thinking, problem-solving, creation, and innovation. However, current studies did not focus on the roles of complexity, metacognition, and fluid intelligence for facilitating CT abilities through GBL. Thus, we identified those areas for further studies.

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Promoting Young Managers' Entrepreneurial Creativity With Design Thinking in a Social Learning System

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Keywords: Entrepreneurial creativity, Entrepreneurial education, Creativity, Social Learning Platform

Abstract

Entrepreneurship education has received enormous interests since entrepreneurs are key drivers of business growth across the world. Entrepreneurial creativity is identified as core competency in large multinational corporations in Thailand because of unique combination of sense of ownership and innovative thinking. Thai government has launched Thailand 4.0 policy since 2016 to enhance creativity and technology competitiveness to towards innovation-driven or creative economy. However, the 2019 Global Innovation Index reported that Thailand ranked No. 43 from 129 countries in the world since Thai entrepreneurs and corporate entrepreneurs still have lower level of entrepreneurial creativity skill, judging from the fact that 90% of the products are not differentiated enough. An in-dept focus group of 8 respondents are conducted among young managers in a multinational company to understand the triggers and barriers of entrepreneurial creativity development and found that their entrepreneurial creativity skill is at moderate level since they are not confident with their skill, driven by current development activities, focusing on theoretical, one-way, passive learning experiences. They do not feel engaged, motivated and confident in transfer the knowledge to practice. Design thinking is well recognized as the creative problem-solving process though human-centered approach, simulating the journey of entrepreneurship and have been used in developing business education. Social media is one of the most used platforms for daily live and learning with a feature, delivering open and collaborative platform. Therefore, a learning design with design thinking process is recommended with social media technology to deliver engaging, experiential, and motivating learning experiences among young managers.

Introduction

Entrepreneurship and entrepreneurship education have received enormous interests among every national governments, academic institutions and business industry since entrepreneurs are key drivers of business growth, alleviating the slowdown of global economy. This is because entrepreneurs came into the business with unique mindsets and competencies from recognizing emerging business opportunities, initiating innovative ideas, creating business planning, gathering required resources and drive with full passion to achieve the goals with strong commitment and calculated risks. The results have proven in the developed nations like the United States, United Kingdom, Singapore and Japan where entrepreneurs in small and medium sized corporation contributed at least more than 50% of gross domestic products and generating more than 65-70% of the whole country's employment(Yıldırım, Trout, & Hartzell, 2019).

In the corporate world, entrepreneurial competency is identified as core competency in large multinational corporations like Coca Cola, P&G, Unilever, S.C. Johnson and Sons since this competency refers to the ability of executives, managers or employees to have strong ownership and continue innovating in their areas of responsibilities by weighing between opportunities and calculated risks to achieve impressive business results. This can be called "Corporate Entrepreneurship" to change the employees' mindset from traditional "wait and see" to more "proactive and aggressive" way of working(Barringer & Ireland, 2012). The expected skill within entrepreneurship is creativity and business ownership. While ownership is more the aspect of engagement and passion with roles and companies, creativity is one of the skills and attitude within the areas of entrepreneurship that can be cultivated within the organization. Creativity is part of the 4Cs' learning skill category in the 21st Century skill.

Creativity is regarded as one of the most important and key success competencies among entrepreneurs to become successful in their ventures. Burns and Burns (2014) mentioned about the 5 qualities of entrepreneurs which are (1) Creative thinking and innovation (2) Drive for achievement (3) Independency (4) Self-directed/control (5) Awareness of calculated risks. Creativity encompasses the process from recognizing the opportunities to creating an innovative business models to start new ventures. This is consistent with what Barringer and Ireland (2012); Bolton and Thompson (2013)and Kuratko and Hodgetts (2004) have included creativity as key essential component of entrepreneurs which includes creative problem solving, creative thinking as well as creative design.

Thai government launched Thailand 4.0 policy in 2016 to increase creativity and technology competitive advantage to deliver innovation with the intention to move the country from middle-income and efficiency-driven economy to become innovation-driven or creative economy(Murnpho & Unaromlert, 2018). However, the 2019 Global Innovation Index (developed by Cornell University, INSEAD and WIPO) indicates that Thailand ranked No. 43 from 129 countries in the world. The best-in-class in Asia is Singapore (8th), Korea (11th), Hong Kong (13th), China (14th) and Japan (15th). Another study done by Organization for Economic Cooperation and Development (OECD) in 2018 found that Thailand ranked No. 3, following Singapore and Malaysia from 10 countries in Southeast Asia on the aspect of innovation and technology outputs(The Secretary-General of the OECD, 2018). This identifies opportunity to improve the capability on creativity and innovation by tackling on the issue of entrepreneurial creativity development.

Design thinking is well recognized as the creative problem-solving process though human-centered approach. The process itself is a not linear with the strong focus on deeper understanding of users or customers to arrive with clear problem statement. The potential ideas emerge from different point of view brainstormed and transformed into prototypes for testing and retesting until they fully meet or exceed the customers' expectations. The process simulates the life cycle of entrepreneurs and can foster creative thinking among learners(Linton & Klinton, 2019).

Social media have been used to promote entrepreneurial education with variety of platforms (Line, WeChat, Facebook Messenger) all around the world due to its unique features to drive learners 'engagement, experiences and collaborations to ultimately improve learning outcomes(Wu & Song, 2019). However, there are limited knowledge and studies on how to use social media learning to improve entrepreneurship or entrepreneurial creativity. Teepapai and Karawek (2018) found that the company's culture and learning environment has a strong impact on creative ideas and innovative outputs of the employee; therefore, it is recommended to invest in the development of creativity by leveraging new connected technology that can promote learning among employees.

Therefore, this article will explore on the literature of entrepreneurial creativity, design thinking and social media learning, as well as an in-depth focus group study with young managers in a multinational company. The article ends with recommending a learning design to promote young managers' entrepreneurial creativity with design thinking in a social learning platform

Corporate Entrepreneurship (Intrapreneurship)

Successful innovation is one of the key success factors for companies to achieve business goals by growing revenue, profit margins, market share and corporate image(Miller & Bauer, 2017). Pinchot and Pellman (1985) are ones of the first inventors for "Intrapreneurship" (corporate entrepreneurship) by defining as the individual who has the vision above their responsibility with some creative ideas. Corporate entrepreneurship or intrapreneurship is another kind of entrepreneurship when employees drive the business with strong sense of ownership and will go extra mile to deliver success to the business with new creative ideas or innovations (Trifan, Guica, & Micu, 2012). Corporate entrepreneurs are the one who doesn't have intention to create their own venture but willing to work within an organization with the strong sense of ownership. For an entrepreneur to become successful, he needs to have managers with corporate entrepreneurship quality to deliver innovation(De Lourdes Prado, MacHado, Mafra, & Maria Campos, 2012).There are 3 components of corporate entrepreneurship; proactiveness, creativeness and risk bearing (de Jong et al., 2011) cited in (Miller & Bauer, 2017). Christensen (2011) cited in (Miller & Bauer, 2017) categorized 4 different type of creative entrepreneurs; (1) creative entrepreneurs are the one that introduce a new venture with differentiated products to capture unmet needs (2) creative intrapreneurs are the one who introduce a new business within a corporation (3) product creator are the one who creates new product or services (4) process creator are the one to continue to improve the efficiency or create new process. This reflects that there are 3 types of corporate entrepreneurship at 3 different aspects from business within organization, product innovation and process improvement. They are all centered around creating or innovating to increase the organization's competitive advantage. That's why corporate entrepreneurship is identified of core competency in the corporate world, especially in international firms e.g. Unilever, P&G, Nestle', and S.C. Johnsons & Sons, to generate innovation. Teltumbde (2006)said that corporate entrepreneur or intrapreneur can be more important than entrepreneur since an entrepreneur creates new venture while an intrapreneur work on it to success and achievement by adapting and reinventing the wheel based on the changes in business environment.

Menzel (2007) cited in (Hanns C. Menzel, Aaltio, & Ulijn, 2007) explains the process of corporate entrepreneurship that has 2 levels; the organizational and individual level meaning the corporate entrepreneur can occur as an individual employee or as a group of employee. The procedure commences with opportunity recognition, exploitation and ends with creative solutions or innovations as in products, services, technology and processes as the figure below.

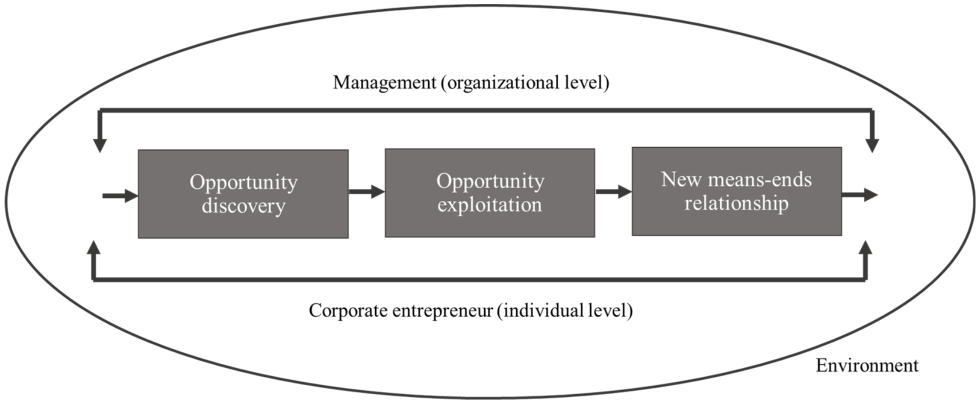

Fig. 1. Corporate entrepreneur process(H.C. Menzel, 2007)

Entrepreneurial Creativity

Creativity covers 2 dimensions; innovativeness and functional (Runco and Jaeger 2012) cited in (Liang et al., 2019). Innovativeness means being new, differentiated, and unexpected while functional means useful, handy and practical. Entrepreneurship requires creativity in making the new business venture innovative and functional for the market(Sternberg and Lubart,1999) cited in (Liang et al., 2019) Entrepreneurship and creativity are interrelated since creativity complements entrepreneurship in every stage from analyzing the opportunity gap in the market, think creatively on the potential solutions to address customer unmet needs, develop business plan and action plan to deliver the actual product to market. Creativity is considered to be a critical component of entrepreneurship in order to identify potential markets, create new ideas, and commercialize them(Saptono et al., 2019). In every stage, there are always uncertainties along the way which entrepreneurs or corporate entrepreneurs must employ creative problem-solving and innovative thinking to get through those situations. Entrepreneurial creativity was defined by Amabile (1997) cited in (Jing & Anja Svetina, 2014) as the creation and action of innovative business solutions or campaigns to launch new products or services. There are 2 key aspects of entrepreneurial creativity; creative problem-solving and creative innovation which are required skills in every process of entrepreneurship. Entrepreneurial creativity is not an inborn ability but can be developed from actual rea life situations. Researchers in the field of industrial psychology suggests nurturing an employee's creativity is one of the critical success factors to enhance to one step ahead of competition as innovative organization(Ahlin, Drnovšek, & Hisrich, 2014). This is because a creative employee is proactive and look for opportunities to improve their way of working and anticipate the consequences for every step of actions. Price, Stoica, and Boncella (2013) investigates the relationship between innovation, knowledge and performance in family and nonfamily firms and found that innovation and creativity drive superior firm performance; therefore, it's recommended to continue to come up with new product, services, processes to achieve business targets.

Jing and Anja Svetina (2014) investigates entrepreneurial creativity with the resource-based view that entrepreneurial creativity happens during the gathering and allocation of resources under the context of resource constraints. There are 4 types of corporate innovations.(Trifan et al., 2012)

1. **Product or service innovation** refers to the launch of new superior and differentiated products or services, comparing to the existing products in the market
2. **Process innovation** refers to the application of a novel process to improve the efficiency and effectiveness through the introduction of new technology and way of working
3. **Marketing innovation** refers to the launch of a novel marketing mix component of a product or services
4. **Organization innovation** refers to the application of organization arrangement, re-organization, and new organization structure
5.

In a corporation, each department or division can be managed like a venture which requires innovation to fuel the success; therefore, the organization required human resources with strong sense of entrepreneurial creativity. Trifan et al. (2012)mentions the 5 senses of corporate creator, explaining the behavior and attitude of employees with creativity

1. **Internal Sense** describes the behavior that the individual is aware of the firm's business performance, key issues and opportunities. The individual has a strong overall organizational network awareness and can get things done through collaborating with another functional team
2. **External Sense** refers to the behavior that the individual knows the market insight and competitors so well that he's able to analyze opportunities and threats that could happen in the future

3. **Positional Sense** describes the behavior that the individual can leverage strong competitive advantage of the company to generate new product ideas to achieve goals
4. **Strategic Sense** refers to the behavior that the individual has strategic thinking capability to evaluate various business decision choices and recommend the most appropriate one for the company with strong justification
5. **Value Creation Sense** describes the behavior that the individual has the strong sense of ownership, dedicated to creating value to the customers and the company by calculating on all risks before making or recommending decisions.

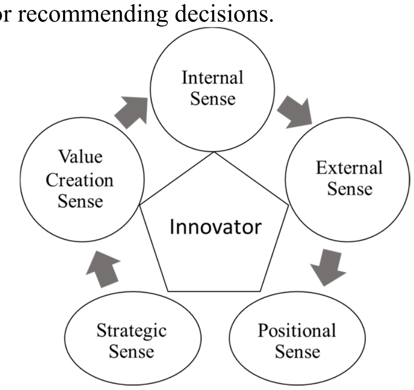

Fig. 2. 5 Senses of Corporate Innovators (Trifan et al., 2012)

Design Thinking Process

Design thinking has been used widely in the field of business, engineering and architecture to deeply understand the roots cause, define, redefine the problems to arrive with best-fit solutions through the process of prototyping and testing and now design thinking plays more role in education settings.(Koh, Chai, Wong, & Hong, 2015). Design thinking refers to a creative problem-solving method that's systematic and collaborative by focusing on human-centered approach from empathizing (understanding), identifying problems, ideating possible solutions, prototyping from ideas to tangible solutions and testing with the target customers(Luchs, Swan, & Griffin, 2015). The process itself is iterative and nonlinear that help improve the quality of solutions to ensure it best fit the customer's expectation. Design thinking will be best worked for the problem or opportunity that's not well-recognized and ill-defined and this process has been used with proven success for new business creation, new product development and internal process improvement(Luchs et al., 2015).

Jaitip promotes design thinking with research-based design namely: Digital Learning Design, Define Gap, Root cause analysis, Conceptualize, Learning Design, Rapid prototype, and Evaluation and Revision(Na-Songkla, 2018). Design thinking, originated from the research study of The Hasso Platter Institute of Design or D.school at Stamford University, refers to the thinking process to deeply understand the target groups from different perspectives to create new ideas, prototype and refine the output or process continuously and this process has been used to support instructional design to deliver learning outcomes among diverse learners fueling by technology. Design thinking process consists of 5 key steps;

1. **Empathize** is the first step to understand in-depth of target group through interviewing, observing as well as collecting the past success and failures including participating with target groups' activities.
2. **Define** is the step to collect and synthesize actual data and facts to identify the root cause of the problem.
3. **Ideate** is when people come in groups to brainstorm different ideas with tools to find solutions as many as possible to address the key root cause being analyzed in the prior step.
4. **Prototype** is the step to transfer idea to become tangible product or service prototype and trigger discussion and criticism from the team and this step needs to happen very fast to see the flaws, weaknesses of the idea for further improvement.
5. **Testing** is when to test the prototype with real customers to observe and evaluate the efficiency of the product and utilize the result to keep improving the prototype until it meets customers 'expectation.

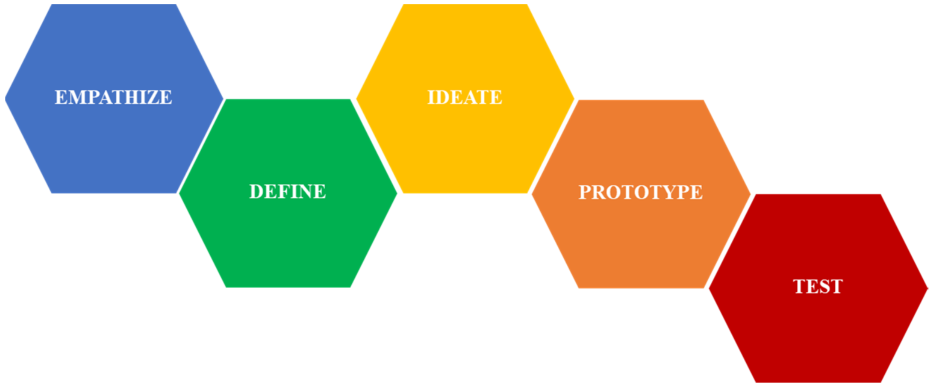

Fig. 3. Design Thinking Process (Stanford d.school)

Entrepreneur or corporate entrepreneur are daily facing with uncertainties with many ill-defined problems to cope with and survive in a competitive market environment; therefore, the life of them is very complex and nonlinear. In the past, the education for entrepreneurship is focusing on "about" which means teaching by focusing only the theoretical part of entrepreneurship while neglecting the "through" which is direct experiencing through the journey of entrepreneurship(Linton & Klinton, 2019). Design thinking process mirrors the key process of entrepreneurship and corporate entrepreneurship and the ultimate goal of design thinking process is to solve problem with creative ideas, products or services which is appropriate to nurture entrepreneurial creativity. Linton and Klinton (2019) investigated and found that a new teaching method with design thinking process can be effective approach to entrepreneurial education since the learners got a more practical experiences through experimenting in real life situation and this can help develop both skill and mindset of entrepreneurial creativity. Schiele and Chen (2018) study design thinking and digital marketing skills in marketing education and found that learners improved on key skills; understanding, creativity, communication skills, technology skills, critical thinking, and collaboration(Glen, Suciu, Baughn, & Anson, 2015).

Social Media Learning Platform

Na-Songkla (2018) said that connectivism paradigm emphasizes the learning from the connection with information technology and groups of people. The social connection is the integral part of knowledge creation and the more social connection, the more knowledge being generated. This paradigm has a strong impact on our way of living, communication and learning. There are 4 aspects of connections; social media, social network, cloud-based learning and open education.

Social media is the digital media as means for communication within social network by connection to the internet. The user interacts with each other by creating their own contents as well as consuming contents from others in the network and there are different types of social media for learning; (Na-Songkla, 2018)

1. Blogs
2. Collaborative Writing
3. Video blog
4. Photo Sharing
5. Podcast
6. Virtual Reality
7. Crowd Sourcing

Wu and Song (2019) discusses the benefits of social media learning as follows; (1) enhance learner engagement, participation and experience (2) integrate outside resources as part of learning environment (3) create a group of application practice among learners. The social media enables the learners to interact with other learners and teachers in an open and collaborative environment; hence, increasing the rate of participation among learners. By nature, social media is ubiquitous in all aspects of our lives, from personal, family, work and education. Social media is proven to be key facilitator and driver of creativity(Bhimani, Mention, & Barlatier, 2018). Social media is extensively used by entrepreneurs for marketing, business networking, information search, and crowd funding(Olanrewaju, Hossain, & Whiteside, 2019).

Thailand has the highest social media penetration in Southeast Asia with 74% vs. total Southeast Asia at 61%, translating to more than 51 million people are actively using social media and they use through mobile device. The average time spent at 3 hours 11 minutes per day. The top 5 social media in Thailand are Facebook, Youtube, Line, Facebook Messenger and Instagram, accordingly. The majority 34% of social media users are 25-34 years old.(source : we are social https://wearesocial.com) This identified that social media is the integral part of young working adults for both work and personal life. Therefore, social media can be an appropriate platform to promote entrepreneurial creativity among young managers in Thailand.

Social media for adult and higher education is getting higher attention for both content dissemination and evaluation and the research results demonstrated that there's favorable consequences of social media in driving in-depth learning experience and the uplift of certain skills like collaboration and organization(Stathopoulou, Siamagka, & Christodoulides, 2019). Al-Rahmi, Alias, Othman, Marin, and Tur (2018) investigated a model of factors affecting learning performance using social media in Malaysia higher education and found that social media enhances collaborative learning and engagement though group assignments. Furthermore, O'Boyle (2014) studied mobilizing social media in sport management education by focusing on facebook and twitter as part of blended learning and concluded that social media delivered strong learning platform that can increase student and staff engagement.

Young managers' Insights on Development Opportunities

Focus Group Discussion

One focus group of 8 young managers in multinational company were conducted to understand the need gaps of existing entrepreneurial creativity development to propose the future recommendation. The respondents are between 28 to 35year-old manager, with 5-10 years of working experiences in multinational companies. The discussion guideline covers perceived entrepreneurial creativity skill, past development activities, needs for future entrepreneurial creativity development.

Perceived Entrepreneurial Creativity

In terms of **perceived entrepreneurial creativity**, most young managers rated themselves at the moderate level and struggled to improve their skill set since they get used to working under the close supervision and guidance from their superiors and regional team. In a multinational firm context, there's always standard operating procedures (SOP) as patterns or ways of doing things and even template for each work to follow. This is because global and regional team will need to consolidate and compare between countries and regions; therefore, not allowed to deviate from the template or structure. If young managers are asked to work on things without template, they would find it difficult on how to start with. This can be called "Template Syndrome". Most of them come from sales and marketing team and what they need to do on a yearly basis is creating the marketing plan. However, they got a template from global and regional team to follow rather than having a blank sheet paper to start with. They ended up filling forms rather than thinking analytically and creatively on what strategy should be proposed.

Past Entrepreneurial Creativity Development

Entrepreneurial creativity has been part of their functional competency for sales and marketing and they are all evaluated in the performance review on this perspective; however, they are not clear what it means to their role and haven't got a chance to practice in the real settings. Most of the **past development** focused on theoretical framework in an e-learning module rather than real life experiential learning. This means that there's limited collaborative working session with other learners. They are requited to complete the session by deadline; however, they don't feel engaged with the materials since they mostly spend time alone with e-learning module and being tracked by human resources or training team. Training is more like a mandatory but not inspires them to develop themselves.

Need for Future Development

In terms of wish lists for **future entrepreneurial creativity development**, they are asking for a higher quality of development session by focusing on real-life case study where they can work with peers to learn how to transfer of knowledge to practice. They are not against e-learning; however, they think there should be mixed of e-learning and classroom where they can ask questions, discuss with trainers and peers. They are expecting a workshop session where they can even bring their real case at work to discuss with other learners and trainers in the workshop session. The e-learning platform shouldn't be one-way learning and should be able to access anywhere any time since now it can only access via laptops with VPN, not mobile friendly.

In conclusion, there's potential to revamp the entrepreneurial creativity development by enhancing experiential learning as well as engagement among learners. The learning design should stimulate deep and collaborative learning in real working situation; hence, giving the opportunity to think of the current work and apply to improve on the day to day work. Engagement, experiential, collaboration and inspiration are keys to success.

In conclusions

Promoting young managers' entrepreneurial creativity in social learning platform

From the literature and focus group discussion, I'd like to propose the learning design for entrepreneurial creativity by leveraging design thinking process to mimic the experiences of corporate entrepreneurship through empathize, define, ideate, prototype and test by using the case of new product development for market and sales function. Here's the proposed learning design with a combination of design thinking process, cognitive tools and enabling technology to support experiential, collaborative, real case learning design to develop entrepreneurial creativity. The case study content can be based on the product category that the company is competing in or the expansion plan in the future so that the team can have the basic understanding of the category and target customers insights.

Table 1 depicts the proposed learning design for entrepreneurial creativity

Design Thinking Process – Learning Design	Cognitive Tools	Enabling Technology
1. Empathize: - Interview and observe target groups to understand the customer journey and pain points for assigned product category	- Interview & Observe guide - Customer Persona - User profile canvas	Purpose: Interact with target customers - Line Video Call - Facebook Messenger
2. Define: - Define the key unmet needs of target customers and root causes	- Fishbone - WH questions (What, When, Where, Why How?)	Purpose: Collectively define customers paint points - Line Notes - Line Albums
3. Ideate: - Brainstorm with team as many as possible on solutions or product ideas	- Brainstorming sessions - Idea communication sheet - Creatively techniques	Purpose: Collaborative platform to gather ideas and discuss - Line Album and Notes
4. Prototype: - Create product concept and initial prototype	- Product Concept board - Boxing and shelfing	Purpose: Platform to display ideas and prototype - Line Album and Notes
5. Test: - Conduct a focus group interview to test with target customers to gain feedback and room for improvement	- Conduct A/B testing - Focus group discussion - Use feedback-capture grid	Purpose: Interactive forum to test ideas with target customers - Line Album - Line Messaging with groups of potential customers - Line Voting - Line Survey & Feedback

This is the initial thought of potential learning design and will need to go through a rigorous study to validate what will work for young managers to enhance the effectiveness of the entrepreneurial creativity development. For the future research study, it's recommended to

1. Conduct a survey in a larger scale on need assessment of entrepreneurial creativity among young mangers
2. Research and design the learning design, components, and technology for developing entrepreneurial creativity
3. Test and validate the learning design, components, and technology among young managers to propose the most appropriate learning design and platform

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Designing Inspired Learning in Non-Formal Educational Settings: A Case Study of Technology Use in the Kentucky 4-H Program

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Descriptors: emerging technologies, engagement, informal learning, technology integration

Abstract

Extension Agents across the country work to incorporate emerging technologies in their programming. Today's youth have grown up with technology as a major component in their lives. 4-H Extension Agents are teaching youth using the 4-H slogan, "Learn by Doing." The educational focus in 4-H is experiential learning (Borden, Perkins & Hawkey, 2014). However, Agents struggle to keep up with ever-changing technologies. A case study of Kentucky 4-H Extension Agents looked at technology use among Agents and how learner engagement is affected. The qualitative study included a focus group and questionnaire. Results showed technology is being used primarily in educational programming and marketing. Facebook and Instagram were the most used social media outlets. Barriers to technology use included the expense, lack of time by staff, and training needs. Results showed Agents feel technology use in programming promotes engagement if used properly. Tablets were listed as the most engaging technology, followed by laptops.

Introduction

"It is generally acknowledged that engagement plays a critical role in learning." (D'Mello, Dieterle, & Duckworth, 2017). "Efforts are made to enhance in-class learner engagement because it stimulates and enhances learning. However, it is not easy to quantify learner engagement." (Alimoglu, Sarac, Alparslan, Karakas & Altintas, 2014). Extension programs, and especially 4-H programs are known to be hands-on in nature. The more recent push for STEM programs has allowed for even more incorporation of technology in 4-H programming. Just as many schools have transitioned to laptops or tablets for all students, a few 4-H programs have obtained funding to be able to offer laptops or tablets to all participants during educational programs.

"Research shows that multifarious benefits occur when students are engaged in their own learning, including increased motivation and achievement. However, there is little agreement on a concrete definition and effective measurement of engagement." (Sinatra, Heddy, & Lombardi, 2015). Fredricks, Blumenfeld, and Paris (2004) further break down engagement into behavioral engagement, emotional engagement, and cognitive engagement.

Behavioral engagement includes actions such as following the rules and refraining from disruptive behaviors while emotional engagement includes the participants' reactions and feelings toward the learning experience (Fredricks, et al., 2004; Fredricks, 2011). Cognitive engagement refers to the learner's investment in learning (Fredricks, et al., 2004). There is overlap between the three areas of engagement. Fredricks, Bluemenfeld and Paris (2004) share types of individual needs: needs for relatedness, need for autonomy, and need for competence. These needs have been tested related to engagement. "Ultimately, although engagement might begin with liking or participating, it can result in commitment or investment and thus may be a key to diminishing student apathy and enhancing learning" (Fredricks et al., 2004, p. 82). Just as teachers love to see youth excited about learning, Extension Agents also love to have participants who are fully engaged and anxious to participate and learn. Schlechty (2011) defines five levels of student engagement: rebellion, retreatism, ritual compliance, strategic compliance, and engagement. In this order, the levels advance from least to most engaged.

Methodology

A case study was conducted to examine technology use among 4-H Extension Agents in Kentucky. The qualitative study included a focus group, as well as an open-ended questionnaire completed by five individual 4-H

Agents. The purpose of the study was to gather information about current technology use and barriers to technology use among 4-H Agents in Kentucky.

The focus group was conducted at the District 5 4-H Agent's Retreat. Thirteen 4-H Agents were present and participated in the open discussion. The entire discussion was recorded and notes were also taken during the focus group.

An e-mail invitation was sent to the distribution list of Kentucky 4-H Agents inviting them to participate in the questionnaire related to technology use among 4-H Agents. Four Agents or specialists volunteered to participate. Two additional Agents were specifically asked to participate due to their use of technology in their county program by the suggestion of the Assistant Director for 4-H Youth Development. A total of five questionnaires were collected. Four were Agents who volunteered to participate and one was specifically asked to complete a questionnaire.

Agents who completed questionnaires ranged in years of service as a 4-H Agent from 6 years to 26 years. The State 4-H Office, as well as Districts 1, 4, and 5 were represented. Three participants were female and two were male. Questionnaires were reviewed to look for common themes. Thematic coding was used and compared to the focus group discussion as well.

The questionnaire included ten open-ended questions and one final question where Agents were asked to rank four technologies in regards to learner engagement. Agents were asked to identify the county in which they work, as well as their years of service. The following is a list of questions asked:

1. What are the main ways you are currently using technology in your 4-H program?
2. Are you using technology in marketing? Please provide examples.
3. What other ways are you using technology in your 4-H program? Please list examples.
4. In your opinion, what are the strengths of technology use in the Kentucky 4-H program?
5. What do you see as opportunities for Kentucky 4-H in regards to technology?
6. What do you feel are the weaknesses in regards to technology use in the Kentucky 4-H program?
7. What do you feel are the barriers, if any, to technology use in your program?
8. How do you feel Kentucky 4-H is perceived in the area of technology use?
9. Do you feel the use of technology in educational programming affects learner engagement? Please explain.
10. Can you provide examples from your own technology use in programming of how you feel it has affected learner engagement?
11. Please rank the following items in terms of learner engagement. Rank #1 the technology you feel provides the most learner engagement and #4 to the least, ranking all four.
    _____Tablet (such as iPad, etc.) _____Projector _____Laptop _____Videoconferencing

Results

Kentucky 4-H Agents are using technology in a variety of ways. However, the most popular use of technology from this sample and focus group is in educational programming, followed by marketing. Most 4-H Agents are using a variety of social media outlets to market, as well as apps such as Remind. Social media use is most popular on FaceBook, but also Agents are using Instagram and Twitter.

When asked in an open-ended question about how they use technology, all respondents stated they use technology in educational programming. Marketing was listed as the next way Agents use technology most, followed by communications. When asked how Agents use technology in marketing, all respondents noted the use of Facebook. The second most noted technology used in marketing was Instagram.

When asked about the strengths of technology use in the Kentucky 4-H program, marketing and outreach are noted. Promotion of programs and interactions through social media are found to be strengths in Kentucky 4-H. Outreach to previously unreached audiences is also found to be a strength, as well as information outreach to teens.

When looking at opportunities for technology use in the Kentucky 4-H program, the use of emerging technologies and providing more learning opportunities for youth are reported. Virtual training is also listed as an opportunity.

Weaknesses of the use of technology in the Kentucky 4-H program include being slow to embrace changes in technology. There is a need for more curriculum developed with technology use in mind. The general feeling is that technology is not used enough and that more support is needed.

When looking at barriers to technology use in the Kentucky 4-H program, expense and lack of access are the number one barriers. Followed by a lack of time by employees to learn to use technologies or create new programs.

The perception of Kentucky 4-H in the use of technology by those Agents surveyed shows a common feeling that Kentucky 4-H is weak or behind the times in the use of technology. However, it was noted that Kentucky 4-H is a front runner in use of the National Youth Science Day experiment.

All Agents completing the questionnaire feel that technology contributes to learner engagement. Agents described incorporating technology as adding excitement to the program and improving the learning experience. One Agent noted that the variation in instructional design improves the experience and engagement. Another stated that new technologies must be carefully and deliberately worked into educational opportunities. Meeting youth where they are on the digital technology continuum was seen as a way to engage participants.

Respondents were asked to rank four technologies in terms of learner engagement. The technology the respondent felt was the most engaging would have been rated as number one. The least engaging technology was rated with number four. Tablets such as iPads were ranked as the most engaging by four out of five respondents. Laptops were ranked as the second most engaging. Videoconferencing and use of a projector had the same combined scores and tied for third.

The focus group included many of the same themes that were recognized in the Agent questionnaires. Social media was noted as a major use of technology by most Agents. Barriers included skill level and knowledge as well as different levels of resources in counties. Agents also noted expectations are that they automatically know how to use various technologies, which may not be the case. Opportunities noted included the use of more online training for Agents in order to cut costs associated with time and travel.

Conclusion

Extension Agents will continue to work to find ways to incorporate emerging technologies into their programs. A detailed study is needed to more clearly identify Agents' technology needs in Kentucky. Program participants will benefit from engaging programs built on solid instructional design principles. Engagement is difficult to measure, however, Agents note programs with incorporated technology are of interest to youth. One Agent described the process as meeting youth where they are with technology in order to engage them.

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