Digital Worlds and Transformative Learning: Google Expeditions, Google Arts and Culture, and the Merge Cube

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Abstract

Virtual and online learning arrived through a *force majeure* (French for "superior force"), the global COVID-19 pandemic. Google Expeditions, Google Arts and Culture and the Merge Cube are classified as simulated learning environments. Virtual Reality (VR) and Augmented Reality (AR) create simulated learning environments with the potential to increase student presence and engagement, thereby facilitating inquiry-based learning through location-independent meaning-making. The use of multisensory approaches in AR and VR enables additional pedagogical strategies for personalized content and differentiated instruction while connecting to learners' diverse intelligences. In addition, such simulation environments provide pathways for training learners in 21st century core skills such as agility, complex problem solving, critical thinking, creativity, collaboration, and digital literacy. Transformative pedagogical approaches are called for to develop, implement, and deliver teaching for 21st-century curricula. Twenty-first century curricula needs to enable students to actively engage, explore, and experiment with contemporary technology and engage with lifelong learning processes. This article briefly traces the conceptualization of three tools particularly well suited for 21st century skills engagement: Google Expeditions, Google Arts and Culture, and the Merge Cube. More broadly, the article also explores the challenges and educational use cases of digital worlds and transformative learning experiences.

Keywords: virtual reality, augmented reality, Google Expeditions, Google Arts and Culture, Merge Cube, multiple intelligences, experiential learning, e-learning ecologies, simulation environments

Virtual and online learning arrived through a force majeure (French for "superior force"), the global COVID-19 pandemic. Teaching took a leap into the digital world as educational institutions closed locally and globally, forcing teachers, instructors, facilitators, and businesses to deliver classes or training completely online. Schooling went online to suddenly home-based students (from the prekindergarten level to the graduate level) and adults involved in corporate training and education. At the same time, there emerged an explosion of new apps, virtual classrooms, video platforms, and digitized learning activities with new learning management platforms that swarmed the EdTech market. Much hype and many broken promises litter the educational tech space of online teaching, with the demise of often-immature apps and discontinued, failed, or merged distance-learning tools. Even Google Hangouts and Google Expeditions will disappear in their current version. Other failed ventures are inBloom,

ConnectEDU, KNO, and SharpScholar, to name but a few.

The pandemic forced educators to adjust to hybrid or fully online learning environments and update their teaching toolbox with digital tools and educational technology. After months of at-home instruction, screen fatigue struck learners and educators alike. Experiential learning where students learn through socially engaging hands-on experiences and inquiry-based learning which aims to trigger student curiosity, became more important than ever for an online engaged student learning experience.

Prior to COVID-19, the epitome of inquiry-based learning was the student-favored field trip to an exciting location away from school or college. Merriam-Webster defines *field trip* as "a visit (as to a factory, farm, or museum) made (as by students and a teacher) for purposes of firsthand observation" (Merriam-Webster, n.d.). Beyond the obvious joy of getting out of an institutional setting, field trips complemented in-class learning through a wide range of activities from musical performances to tours of historical sites, from museum visits to science demonstrations in real laboratories such as the currently closed Sony Wonder Technology Lab in New York City. The goal of field trips is to actively engage students by stimulating curiosity, emotion, and a change in perspective. Educator and philosopher Herbert Spencer introduced laboratory teaching in 1911, stating that the study of "surrounding phenomena is immensely superior to the study of grammars and lexicons" (Spencer, 1911, p.8).

Virtual trips through Google Expeditions, Google Arts and Culture and Merge's digital three-dimensional (3D) objects (holograms) are accessible, low-cost ways for educators to create student experiences that "act as a common experience for instructors and students making abstract concepts and ideas tangible and vivid" (Parmaxi A., 2017, p. 368). Virtual fieldtrips allow introduction of dynamic learning experiences, high-quality content, interactive views and interactive synchornous experiences.

Virtual Reality (VR), Augmented Reality (AR), and the Merge Cube

In my experience, virtual reality is a computer-generated simulation of images or environments allowing user interactions within a seemingly real or physical setting. Merriam-Webster (n.d.). defines *virtual reality* as "an artificial environment which is experienced through sensory stimuli (such as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment." Google Expeditions, Google Arts and Culture, and the Merge Cube hold the promise that students will learn through engagement and experience through immersive learning. Jean Lave, an anthropologist, in his treatise *Situated Learning: Legitimate Peripheral Participation* takes a closer look at established immersive technologies with a positive view of their educational potential while pointing out drawbacks in the context of immersive student interaction (Lave, 1990).

Augmented reality (AR) experiences such as Pokémon Go and social media apps like Snapchat create interactive experiences by layering digital elements over the real world in a live environment around the viewer, who uses AR glasses or a smartphone camera. According to

"*What's the Difference Between Virtual Reality and Augmented Reality?*" (Bardi, 2020, para. 2), in Augmented Reality, the computer uses sensors and algorithms to determine the position and orientation of a camera. AR technology then renders the 3D graphics as they would appear from the viewpoint of the camera, superimposing the computer-generated images over a user's view of the real world.

The soft foam Merge Cube features unusual patterns on each of its six sides. When one of the sides is scanned with a compatible app, the Merge Cube enables an interactive AR experience. Moving and rotating the Cube in the hand can shift the AR object in every possible way. The Merge Cube requires apps to be used on either iOS® or Android devices. It can be used with or without a set of VR goggles, depending on how many free hands are needed to manipulate it. Smartphones and tablets with iOS 9+ and Android 4.4+ can be used to view content on the Merge Cube with the CoSpaces Edu mobile app (Al-Gindy, 2020). The Merge cube, an add-on to the CoSpaces platform gives developers the opportunity to create holograms in CoSpaces. CoSpaces is a Microsoft Education Partner that is "working to help teachers across the world upgrade their learning tools by integrating Microsoft technology like Immersive Reader and Teams with Merge EDU" (eSchool News Staff, 2020, para. 2). Merge's app store titled the 'miniverse,' hosts around 50 apps, more than a dozen of which were created in-house (Carnett, 2020).

The Merge Cube is an AR experience which involves multiple sensory modalities. Other AR examples include AR Ruler, BBC Civilizations AR, Amikasa Design, Knightfall, and the Merge Cube. AR offers students the opportunity to apply their knowledge and skills to combine digital information with real-world environments (Wojciechowski, 2013). The study "The Effect of Augmented Reality Applications in the Learning Process" by Ozdemir (2018) analyzed learning and student engagement, coming to positive conclusions when using AR applications as compared to other educational resources. The study found greater achievement in AR relative to the use of traditional learning methods.

Cauldrons of Content

Following the initial launch of Google Arts and Culture in 2011, the Paris-based Cultural Institute opened in 2013 using Google's Street View technology to capture the interiors of acclaimed museums and the artwork on display. More than 1,200 museums spanning 70 countries, ranging from the Metropolitan Museum in New York City to the State Tretyakov Gallery in Moscow, participate. Google's Cultural Institute has been able to "put the world's cultural heritage in the hands of the world" (Marsh, 2020). Beyond museums and artwork, Google Arts and Culture offers virtual visits to more than 10,000 places, ranging from Ecuador to Saudi Arabia. Users can maximize and zoom in on any aspect of a famous painting and study every detail (Boyd, 2019) or experience cultural heritage sites through 360-degree photos or videos. Such free and universally accessible content is possible by partnering with and accessing the Smithsonian, The Wildlife Conservation Trust, and the Royal Collection Trust, and other

cultural institutions (Craddock, 2018).

Google Arts and Culture offers a wide range of interactive experiences and activities for learning beyond the classroom. These include doing virtual puzzles, coloring in art books, comparing cultural monuments across time, doing visual crossword puzzles, and projecting 3D models into real-world environments using a phone camera. In addition, it is possible to explore ancient artifacts and objects, visit museums across the globe, and see their entire collections in high definition. Google Expeditions offers exploratory, realistic, and first-person perspectives in life-like experiences (List of available expeditions, 2020). With Poly, Google's 3D asset library, users can create 360-degree panoramic images, sound, narration, points of interest, and image overlay, allowing for collaboration and knowledge sharing. Asset libraries are organized collections of digital files, vectors, icons, images, color palettes, fonts, and other available resources.

Authentic Experiences and Transformative Learning

Virtual field trips lend themselves to the acquisition of subject-specific skills and enable learners to relate existing knowledge to new tasks while developing multiple viewpoints and cross-pollination to other areas in their studies and life. Virtual fieldtrips also improve epistemic knowledge and procedural knowledge acquisition. Epistemic knowledge involves knowing how to think and act like a practitioner, showing the relevance and purpose in students' learning. Procedural knowledge is the understanding of how a task is performed, and how to work and learn through structured processes. Procedural knowledge is particularly useful for solving complex problems.

The use of AR digital teaching aids helps teachers to find alternative means of providing hands-on learning in science, technology, engineering, and mathematics (STEM) subjects with a deepening of students' epistemic and procedural knowledge. Current health guidelines recommend that objects are not to be physically shared in classes, thereby limiting students' hands-on experiences in STEM projects. In response to these concerns, Merge Cube has released unique AR tools that allow users to hold digital 3D objects, including "rocks, minerals, animal teeth and skulls, cells, and more that cover a wide range of science topics" (eSchool News Staff, 2020, para. 6). Merge offers a curated and robust selection of digital teaching aids for every student, with multisensory, interactive simulations and engaging activities for remote or in-class use (Learn Science-Master STEM, 2020).

Transformative learning, a term coined by Jack Mezirow (Lulee, 2009), the father of the transformative learning theory, is the idea that learners can adjust their thinking based on new information. Therefore, setting a purpose for students as they explore their virtual field trip environments is important to foster robust student engagement with the experience. Interdisciplinary knowledge can be encouraged through virtual field visits of specific locations and targeted task setting such as identification of similarities or creating timelines to identify key events. For example, students can compare cultural moments in time to learn not only about

culture and history but also about timelines and disciplinary thinking (Buttet, 2020).

Students can also be directed to pick photos or artwork on the Google Arts and Culture site and delve deeper into their historical context (Bristol, 2020). Educators might be interested in the 'Favorites' feature of Google Arts and Culture, which allows teachers and students to create personalized resources by using bookmarks. Students can then create custom galleries for assigned topics, whether they be historical figures, art movements, or cultural heritage sites. Such student-created custom galleries can serve as a portfolio or backdrops for other school projects.

Virtual field trips lend themselves to jigsaw cooperative learning strategies. The jigsaw grouping strategy rearranges groups to collaborate and share their learning. Jigsaw grouping is an outstanding method for improving students' teamwork and communication skills. Teachers can divide virtual field trips into subtopics, with students working collectively to gather information for a final presentation or project. Such an instructional approach allows for information sharing and synthesis of the collected information through synchronous learner interactions in the virtual environments. Groups can also join forces to create what-if adventures based on Google slide presentations ("Resources teachers can use today," 2020).

Virtual field trips might engage English Language Learners (ELLs) in language learning through visually rich environments, prompting the use of content-specific academic vocabulary, information recall, and purposeful conversations. Immersed in virtual field trips, ELLs can develop their ability to convey the meaning and intent of content while clarifying and evaluating information from multiple perspectives. Building student vocabulary might be another goal as an ELL language objective. Teachers, as virtual guides, can point out different objects in the panoramic views or ask students to find certain features or items. For example, imagine students are learning about ancient civilizations and their agriculture and food. A virtual field trip to Machu Picchu would concretize vocabulary like Incan citadel, and introduce food vocabulary such as maize, potatoes, grains, legumes, and fish.

Merge Cube Experiences

Howard Gardner's theory of multiple intelligences (MIs) states that MIs appear with varying degrees in each person. His book *Intelligence Reframed* lists these MIs as verbal/linguistic, logical/mathematical, visual/spatial, bodily/kinesthetic, musical, interpersonal, intrapersonal, and naturalistic, with existential/spiritual added later. The theory of MIs holds that human beings use, learn, and understand information in different ways and to varying degrees (Gardner, 1999). The Merge Cube incorporates multisensory learning experiences through which students can engage with digital content intuitively by using their visual, auditory, kinesthetic, and tactile senses. Spatial intelligence is fostered through the manipulation and inspection of digital 3D objects. Integration with free online software such Paint 3D and Tinkercad enables 3D creation and printing. Using these tools, students can hold 3D designs in their hands or preview their creations before 3D printing, allowing faster design iteration and easier collaboration

(Learn Science-Master STEM, 2020). The Merge Miniverse features free content on topics from dinosaurs to active volcanoes and from waking up in a space station to experiencing a museum remotely in 3D (Minverse Categories, 2021).

Merge experiences provide students with opportunities to learn about earth science; life cycles and traits; ocean animals; space systems; the structure and properties of matter, energy, waves, light, and sound; and more. Such virtual learning simulations are designed to replace or amplify real-world learning environments by allowing users to manipulate objects and parameters in a virtual environment (Makransky, 2019). Using the Merge cube, students can view and manipulate a virtual solar system on a classroom table or visualize the process of photosynthesis from a variety of perspectives. One of these science experiences is INCELL VR, an action/racing game that explores the microworld of a carefully recreated human cell while unlocking technology that can stop the spread of a virus (Minverse Categories, 2021).

Science labs have a long history in science education, "so it is reasonable that the advances in computer-based learning would include the development of computer-based simulations of science labs and learning experiences" (National Research Council, 2011, p. 35). Merge Explorer's free components enable students in kindergarten through Grade 8 to investigate the anatomy of the human body, the solar system, the inner earth, matter and chemical reactions, ecosystems and the food web, water cycles, weather and the atmosphere, and the life cycles and traits of plants—they can even dissect a frog virtually. These interactive experiences are aligned with the Next Generation Science Standards (NGSS) a multi-state effort in the United States benchmarking science content standards that set expectations for what students should know and be able to do in science. The NGSS standards emphasize students to learn science by doing what scientists and engineers do. When students both understand how scientists and engineers practice their craft and have opportunities to carry out investigations and design solutions, they become more engaged in their science learning. Planning and carrying out investigations through a variety of sources including simulations supports learner engagement and transformative learning experiences. (DCI Arrangements of the Next Generation Science Standards, 2013). The science content standards for kindergarten through Grade 12 were developed to strengthen and define science standards as part a multistate effort of the National Research Council, the National Science Teachers Association, the American Association for the Advancement of Science, and other critical partners (Improving Science Education Through Three-Dimensional Learning, 2021).

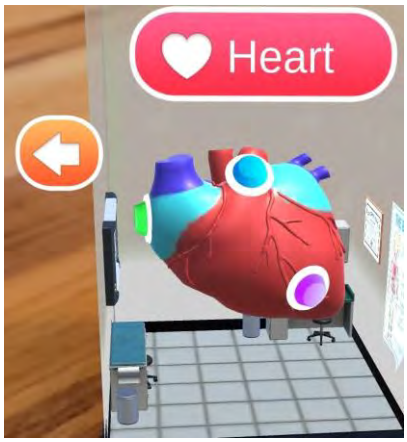
Other educational applications of the Merge cube include uses in the social sciences, architecture, and STEM (such as coding). In the social sciences, students can create infographics with CoSpaces using a special grid canvas for object alignment and creating charts using premade building blocks. In architecture and interior design, students can design and model floor plans or build a virtual 3D house or apartment. In STEM and coding, they can recreate and manipulate lab experiments, such as those that demonstrate and test Newton's laws of motion.

Four free filters are available using Merge Cube:

1. The human body: features a pulsing, beating heart, skull, brain, or lungs.
2. Cells: up-close explorations of microscopic plant, animal, fungal, and neural cells.
3. Viruses: viruses such as the common cold and COVID-19 with a 360 view.
4. The solar system: axial tilt, rotation, and revolution of the earth and moon. (Carlton, n.d.)

Figure 1

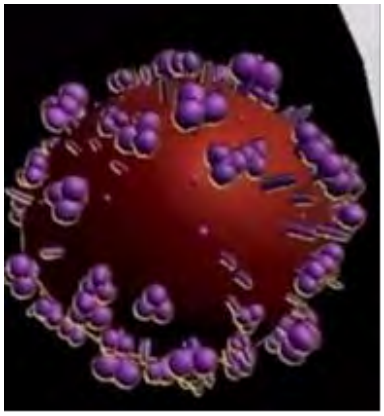
Mr. Body - Merge Cube Anatomy



Source: Photo credit: Jasmin Cowin, Ed.D.

Figure 2

Merge Cube Viruses: The Corona Virus



Source: Photo credit: Jasmin Cowin, Ed.D.

Further Instagram content is abundant, such as 57° North, an AR Merge branching narrative conceived, designed, and created by The Mighty Coconuts, an animation, and visual effects studio. A branching story structure is a story graph, featuring directed graph of nodes connected by arcs that represent user choices. Every possible path through the graph represents a

story that can be told depending on user choices. 57° North tells a spellbinding story about surviving in the wilderness with hundreds of decisions for users to make and multiple endings that depend on those individual choices (Mighty Coconut, 2017).

Engagement in Learning

Virtual field trips are most effective when "partnered with [a] unit's content as a means to provide students with a more in-depth understanding of the subject matter by presenting it in an interactive and engaging way" (Brownridge, 2020, p. 98). Google Expeditions (scheduled to merge with Google Arts and Culture in June 2021) features several hundred virtual field trips, from Ancient Rome, in which students can experience the daily life of a Roman citizen, to ocean acidification (What is Expeditions?, 2020).

Google Expeditions, Google Arts and Culture, and the Merge Cube use elements of constructionism, an inquiry-based approach to knowledge creation (Constructivism as a Paradigm for Teaching and Learning, 2021) with topics of Google AR tours ranging from the animals of the Mesozoic to space stations. Both Google Arts and Culture and Google Expeditions lend themselves to practical digital skill acquisition in domains such as the arts, social studies, communication and collaboration, and critical thinking. Google Arts and Culture can be integrated to unit and lesson planning aligned with the National Core Arts Standards for dance, media arts, music, theater, and the visual arts such as anchor standard 8: "Interpret intent and meaning in artistic work." (National Core Arts Standards, 2020) Using Google Arts and Culture, teachers can assign art and performance aligned with artists, media, or movements in teacher-directed lessons. Studio art courses can simulate modeling different styles that students will learn about and practice in virtual environments (Bristol, 2020).

History courses, often heavily text based, can be connected to meaningful virtual tours of historical sites or museum exhibits related to an event, thereby bringing content-specific knowledge, academic vocabulary, and meaning-making to life (Bristol, 2020). In classes on environmental science, teachers might assign experiences such as the #CleanSeas AR or deep dives into subject-specific artifacts. As a result of such realistic experiences, "the gap between the virtual and real world in terms of realism and accuracy is rapidly diminishing and at some point, in the near future, those lines will start to become blurred" (Cliffe, 2017, p.10). Training learners to function in these tech environments boosts learner's mental agility preparing them for 21st Century challenges.

Discussion

John Dewey, an influential educational reformer in the 19th Century, developed a model of structured, experience-based training and education programs. In his model of experiential learning, students of all abilities take on new active roles. Dewey emphasized that students should participate in real activities with real consequences. Today, there is general pedagogical agreement by educators on the value of experience-based learning such as field trips. Dewey as

the initiator of the "hands-on learning" movement opposed the "lecturing" approach. He created a laboratory school where teachers functioned as guides, and students learned by doing (Tim, 2012). Google Expeditions, Google Arts and Culture, and the Merge Cube are a contemporary answer to Dewey's hands-on philosophy.

While technological innovation is in and by itself pedagogically neutral, it fundamentally transforms education through offering ubiquitous and universal access to experiences while changing the ways learning communities interact and work. New digital tools such as AR and VR need to become part of 21st century curricula. Current educational curricula cannot remain static, as digital ideations happen ever faster, in a non-linear trajectory. Educational institutions, vocational schools, technical training centers, and higher education need to provide both in-depth subject knowledge and opportunities for learners to create inter-disciplinary connections. Simulation environments provide pathways to train for 21st-century core skills such as complex problem solving, critical thinking, creativity, collaboration, and digital literacy.

Conclusion

One of the main functions of education is to broaden and deepen students' interest in life-long learning. To ignite this spark, teachers must become experienced at incorporating tools into their instruction "that allow for student exploration of, manipulation of, and immersion into subject matter to increase comprehension, enthusiasm, and engagement with the instructional material" (Gregory, et al., 2016, p. 222).

William Winn (1993), in *A Conceptual Basis for Educational Applications of Virtual Reality*, states that immersive VR furnishes first-person, non-symbolic experiences that are specifically designed to help students learn material. The development of VR and AR simulations, games, and other digital tools by both Google and Merge has great potential to catalyze and support inquiry-based approaches to learning. According to MIT Press' Digital Humanities the implementation of playful, imaginative, participatory work is learnings exuberant and vital engine. (MIT Press, 2012, p. 24).

Simulation environments, virtual and augmented worlds, and games have the potential to enhance science learning in both formal and informal contexts (National Research Council, 2011) as many of the abstract concepts in natural science courses can be concretized in an AR learning environment. Both VR and AR facilitate students' access to content in 3D or 360-degree panoramic images while creating opportunities for ubiquitous, shared, and situated learning. Ubiquitous learning refers to always accessible opportunities for learning. In addition, learners' senses of presence, immediacy, and immersion are engaged by visualizing the invisible with technology that bridges formal and informal learning (Wu, Lee, & Liang, 2013, p. 43). Google Expeditions, Google Arts and Culture, and the Merge Cube promote application of 21st-century skills such as agility, decision making, problem solving, creating, innovating, and critical thinking.

Teaching with AR and VR develops students' 3D knowledge, creating experiential

learning experiences that would be impossible or unfeasible in real world scenarios. By opening up new avenues for creativity in learning through role play and mentoring (Dalgarno & Lee, 2010), students come to feel more connected to the content through personal interaction with the possibility of spatial manipulation, 3D visualization of complex ideas, and the creation of personal content. Collectively, these tools are a starting point for creating 21st-century learning spaces while providing to learners safe places of discovery, experimentation, combined with rich content.

In conclusion, adopting, mastering, and implementing digital content, digital aids, and digital teaching techniques with a thoughtful, student-centered curriculum requires analysis, planning, and practice. Simulation environments such as Google Expeditions, Google Arts and Culture, and the Merge Cube empower learners to take ownership of their learning by allowing them to collaborate, work at their own pace, access a variety of resources, and extend their learning beyond the four walls of the classroom.

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