Embodied Learning through Virtual/Augmented Realities in the K-12 Classroom

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May 2018

Final Inquiry Project

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Need

Embodied learning is a more recent model of learning that is gaining attention. The concept of embodied learning is that students who fully use their bodies and their senses to learn are found to be more engaged in the content than they would be if they were sitting at their desks passively (Bock, 2012, p. 1). According to Kontra et al (2012), "developmental psychologists have long recognized the extraordinary influence of action on learning" (p. 731). Virtual reality (VR) and augmented reality (AR) are gaining attention among educational leaders as having the potential to become valuable assets within K-12 classrooms, and both are considered to be tools to increase the use of embodied learning as an education model. VR and AR can improve learning outcomes by strengthening the memory trace of whatever is learned by adding touch and audio to the VR/AR experience (Johnson, 2017, p. 1), which is one of the main features of embodied learning.

In this paper, I propose that there is a need for an increased use of embodied learning within K-12 classrooms, and that virtual reality and augmented reality are tools that can help educators with incorporating embodied learning within their own classrooms.

Guiding Question

- Is virtual/augmented reality a valuable tool in increasing embodied learning within K-12 classrooms?
    - What are some examples of how VR/AR is currently in use in K-12 education, or could be used in the future?
    - What are the challenges when incorporating VR/AR in K-12 education?

Method of Inquiry

I conducted research using the online databases provided through the Auraria Library at the University of Colorado-Denver. I also sourced articles from the reference lists of articles I found through the online databases. I utilized the Google Scholar search engine, as well as Google for finding non-scholarly articles.

Narrative

Due to previous inquiries about VR/AR and embodied learning, I was already knowledgeable about both and was prepared to conduct a deeper look into how these can complement each other within K-12 education. I conducted further research to provide evidence of how they can be utilized, but also to detail their limitations as well.

Embodied Learning

According to Lindgren and Johnson-Glenberg (2013), human cognition "is deeply rooted in the body's interactions with its physical environment" (p. 445). In our history, the dominant mode of knowledge acquisition was in the form of learning with our entire bodies, including our senses, a term called *embodied learning* (Hreha, 2016, p. 1). According to Hreha (2016), learning has evolved into a sedentary activity, with the rise of book-based education that has reduced students' motivation to learn (p. 1). Embodied learning was historically done out of necessity (Hreha, 2016, p. 1). The concept of learning through movement and physical activity was not ignored in modern times, however. Maria Montessori, the famed educational thought leader, said "movement, or physical activity, is thus an essential factor in intellectual growth, which depends upon the impressions received from outside. Through movement we come in contact with external reality, and it is through these contacts that we eventually acquire even abstract ideas" (Johnson-Glenberg, 2017, p. 194).

Lindgren and Johnson-Glenberg (2013) state that increasing attention as of late towards instructional methods that incorporate the body through the use of meaningful connections between physical movement and the important principles and relationships in standard learning is occurring (p. 445). The trend has been supported by emerging technologies that make use of physical movement as input into digital environments (Lindgren & Johnson-Glenberg, 2013, p. 445). Recent studies have shown that "learning activities that involve high levels of embodiment lead to a greater chance of retrieval and retention" (Lindgren & Johnson-Glenberg, 2013, p. 446).

Virtual Reality/Augmented Reality

There are some similarities between virtual reality and augmented reality. Both are described below in detail:

Virtual Reality (VR)

Virtual reality is "computer-generated environments that simulate the physical presence of people and/or objects and realistic sensory experiences" (2017 K-12 Horizon Report). VR utilizes headsets that focus on visual and audio stimuli with some haptic (touch) interfaces (Dede, Jacobson, & Richards, 2017, p. 3.). The user turns and moves, like in the real world, and the interface responds to "maintain the illusion of presence of one's body in a simulated setting" (Dede et al., 2017, p. 3). The user is immersed into virtual worlds and can experience situations or places that might be impossible otherwise for that individual.

Augmented Reality (AR)

Augmented reality is "a technology that layers computer-generated enhancements on top of an existing reality in order to make it more meaningful through the ability to interact with it" (Shrock, 2017, p. 1). AR overlays digital information on the perceived physical world (Schneider, 2017, p. 217).

The 2017 K-12 Edition of the NMC/CoSN Horizon Report gave virtual reality two to three years until it is widely adopted in classrooms. Embodied learning experiences in K-12 education do not require VR/AR technology, but these technologies are very well suited for adoption into the curriculum because they combine physical motion and sensory use coupled with rich experiences that students may not be able to experience outside of the classroom. Educators should adopt VR/AR not because it's an exciting new toy, but because it has the potential to enhance the curriculum by providing rich content.

Embodied Learning Experiences Using VR/AR

As VR/AR improves over time, the amount of content-rich interactions available to users is growing rapidly. These immersive experiences can be very powerful as it allows for the ability to experience interactions and activities that may not be possible in the real world (Dede et al., 2017 p. 7).

One of the most discussed learning experiences using VR technology is virtual field trips. Virtual reality allows for activities and trips that are infeasible in the real world. Examples cited by Slater (2017) include learning about geology, archeology, and geography, where students can virtually visit locations (p. 23). Wadhwa (2017) envisions the future of education involving VR where students can participate in the construction of the pyramids to learn how geometry and mathematics were used to construct them (p. 1), thus blending a history lesson and mathematics lesson into one.

Virtual reality is not just for virtual field trips and experiencing past historical time periods. It can also be used for traditional academic subjects as well. Virtual reality has been shown to promote the comprehension and understanding of abstract concepts. In Hwang and Hu's study (as cited in Slater, 2017) it was shown that using VR was advantageous in comparison to standard paper and pencil techniques when learning mathematics (p. 24). A study conducted by Roussou in 2009 (as cited in Slater, 2017) "used a 'virtual playground' for the teaching of mathematics by 50 eight to twelve year olds, where children watched a virtual robot illustrating concepts leading to enhanced enjoyment, better conceptual understanding, and reflection" (p. 23).

When these virtual activities can be enhanced by natural physical movement, such as touch, gesturing, body positioning, and motion, a meaningful connection can be made through this physical activity to the concepts that are being taught (Lindgren & Johnson-Glenberg, 2013, p. 445).

Barriers to VR/AR Adoption in Education

The issues that surround the adoption of VR/AR in K-12 education settings mostly surround the cost of the technology. Virtual reality has, up until 2015, been void of affordable equipment at scale necessary for classroom settings (Dede et al., 2017, p. 2). Fortunately, VR headsets are coming down in price, and due to multiple companies developing headsets, there is more competition, thus decreasing prices and better availability. Decreasing cost and an increase in performance could likely lead to their wider adoption by K-12 schools. Companies such as ClassVR have focused their development of VR and AR technology to be used in classrooms. Their platform encompasses everything a school would need to integrate VR/AR into the curriculum, including standalone headsets, central headset management, curriculum-aligned content, installation and training, and secure storage and charging. However, accessibility to these and other VR headsets by many schools will remain an issue, as some schools simply do not have the funding for the newest technology.

Liu, Bhagat, Gao, Chang, and Huang (2017) detail the issues and potential problems surrounding the implementation of virtual reality in education. They state that there are many challenges that need to be faced within all facets of it: the technology, its application to teaching, and the experience of the learner (Liu et al., 2017, p. 123). The following is a list of issues that Liu et al. (2017) have found:

Technology

- **Device cost and portability:** VR systems need to become more portable and lower in cost, and have the ability to connect to communication systems such as smart phones.
- **Improvement of environmental simulations:** VR products need to improve in accuracy, reaction speed, and providing feedback information, especially the sense of touch, force, and smell.
- **Improvement of interaction experience:** VR devices need to improve on the experience between the device, the user, and the environment and develop methods to communicate in real-time to improve cooperation between users.

Teaching

- **Certify system content and teaching strategy:** The challenge of ensuring the teaching objects fits virtual reality technology, and to design suitable content, and to seek out effective teaching strategies in VR learning environment.
- **The avoidance of cognitive overload:** The environment design and organization of learning materials will avoid creative cognitive overload.
- **The supervision and evaluation of learning effects:** Tracking, supervision, and evaluation of the learning behaviors is important. The authors stress a need for more empirical research which focuses on VR and the teaching effects.

Learner

- **The reduction of difficulty in using technology:** Training for both teachers and students regarding technology use. The potential issue of products lacking in ability to edit and regulate the content on their own.
- **Adapting to identity transformation and promoting identity:** To promote identity transfer between the learners's real life identity to their virtual identity,

which in turn promotes motivation. This would entail improving the identity of virtual avatars.

- **The protection of the privacy and data of users:** In concern of open VR platforms, the security and protection of users' personal data is very important. The authors believe that product development should be regulated.

Another issue is that the devices are not recommended for use by children under 13 years of age (Freina & Ott, 2015, p. 4). Researchers believe that as they are still growing, their vision, hand-eye coordination, and balance are still under development, and the devices are unsuitable for them (Freina & Ott, 2015, p. 4). The Oculus Rift device has a health and safety warning that states children 13 years and younger should not use it.

Another challenge to their adoption is that virtual reality headsets can cause motion sickness. Motion sickness involving the use of virtual reality has its own name: virtual reality sickness (Mason, 2017, p. 1). This could be especially problematic among younger students. Another issue is that injuries may occur from users colliding with objects or other users. Many manufacturers urge the user to remain seated while using, which can prevent injury from colliding with another user. This could be problematic when focusing on embodied learning through movement.

As the main barrier surrounding VR seems to be cost, one way of getting around this is by using Google Cardboard. Google Cardboard is known as one of the lowest cost ways to experience VR. Users can either purchase Cardboard for as low as $5.71 (the Irusu V2 model), or they can build their own from everyday household items. However, the user will still need a smartphone to use Google Cardboard. Not every child has a smartphone, and not every school allows phones in their classrooms.

Conclusion

The future of K-12 education has a lot of promise through the adoption of virtual reality and augmented reality into classrooms. Virtual and augmented realities are valuable tools that are increasingly accessible by schools as a method to incorporate embodied learning into the curriculum. VR/AR headsets will continue to decrease in price, and content will continue to increase in variety, which will hopefully allow this technology to be included in many classrooms. Educators should be mindful of when to use VR/AR within their lessons, and ensure they are doing it meaningfully without merely wanting to use the latest gadget. While VR/AR has the potential to add value to the curriculum, they are certainly not intended to replace traditional methods of learning. However, they have the potential to replace outdated teaching methods

and allow learners to cross virtual cultural and geographic boundaries and create experiences for them that might otherwise be impossible.

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