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Chapter 06. Instructional Applications of Augmented and Virtual Reality

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6. Instructional Applications of Augmented and Virtual Reality

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Key Points:

- Virtual and augmented reality can be used as another tool for educators to increase engagement and provide students with hands on experience.
- Many options exist for educators when choosing virtual and augmented reality programs, but caution is necessary in order to avoid selecting options that increase extraneous load through over stimulation.
- There are cost barriers associated with including these elements, but there are also options to alleviate those issues.
- The future of virtual and augmented reality is vast, but should still be approached with caution.

Abstract

Virtual and augmented reality are two examples of message design tools in the arsenal of educators that can be employed in order to create relations between content and the real life experiences of students. Virtual reality can take many forms and augmented reality may be an option that provides more relatable hands on experience for learners. As leaders in education are on a continual journey towards more innovative means of teaching, these two choices provide opportunities for educators to be innovative, while maintaining learning as the primary focus. Within the realm of both virtual and augmented reality, there are many options, which allows educators to

amend the tools to best meet the needs of their students. When referring to education, training for military and medical personnel is also included.

Introduction

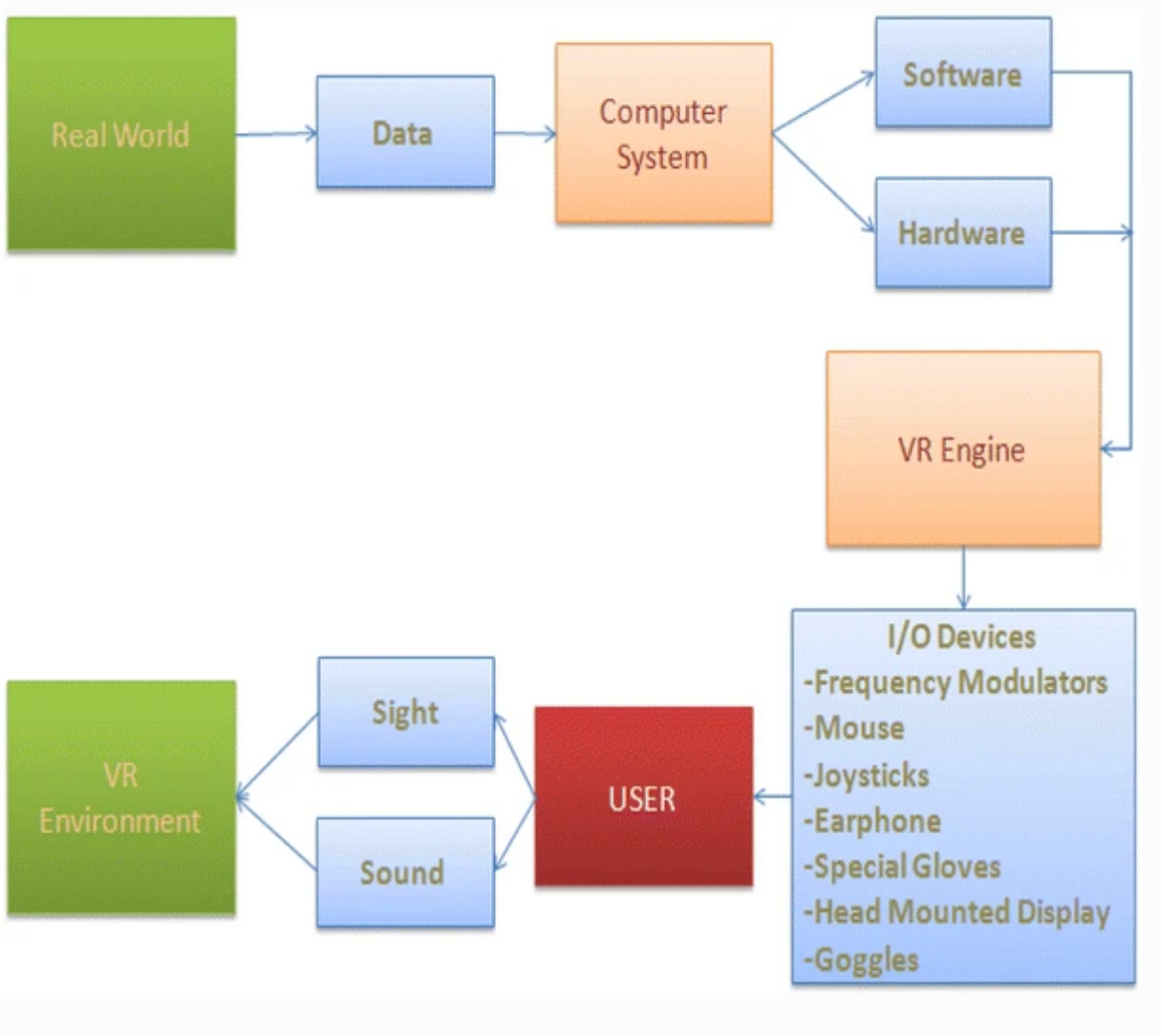
In the world of cinema, there are countless examples of a future where individuals have video phones, answer video calls in their vehicles, or even hold a screen up that superimposes an image into the parameters of an existing space. The distant future has arrived and although such examples may have been for entertainment, we now have the option of using such technology for the purpose of providing hands-on educational experiences. Many educators have lamented the fact that it has become more difficult to maintain the attention of their students (Dontre 2020)**.** They seem to be competing against technology that provides constant draws for attention in addictive and entertaining ways. Then, students come to classrooms where they have to focus on one individual who may use a projector screen and an online presentation program. The chasm is vast and difficult to bridge. Also, we are developing a more in depth understanding of the human body and because of this, there are advances in health care which require more precise tools. In order to be able to use those tools, students need opportunities for practice that reduce or eliminate the risk associated with learning on live patients. In comes the chance to engage students in lifelike simulations affording them the ability to physically practice these new skills. Within the military, there is also a great need for opportunities to hone in skills before applying them in high stakes situations. As with any innovation, there is cost associated with its inclusion. Through creative workarounds and enlistment of grants, groups can find a means to employ virtual and augmented reality opportunities for their learners.

Defining Virtual and Augmented Reality

Saposnik & Levin (2011) describe virtual reality as "...a computer-based technology that allows users to interact with a multisensory simulated environment and receive 'real-time' feedback

on performance" (p. 1380). Saposnik & Levin (2011) go on to explain that a virtual environment can take on a variety of appearances. Virtual reality is not limited to the game-like experience where users are completely alienated from their physical environment. Figure 1 shows a visual representation of the pieces of virtual reality. According to Ma & Choi (2007) the difference between augmented reality and virtual reality is that, "Augmented Reality never lets a user lose a sense of reality with virtual factors" (p.33). Virtual reality leaves the user completely immersed in a virtual environment, while augmented reality places the virtual elements into the actual reality of the users, both for the purpose of simulating an experience. A more encompassing term for virtual reality and augmented reality is called extended reality and these terms also compensate for the inclusion of mixed realities.

Figure 1
The Elements of Virtual Reality



Note. A visual representation of the elements of virtual reality, data derived from real world systems informs what becomes the virtual environment. From "Virtual reality and its military utility" by Ajey Lele (2013, p.20).

The Use of Virtual and Augmented Reality in Education

Public Schools

Teachers are notoriously strapped for time. It does not take much in the way of searching to find discussions in relation to teachers who have too many demands and not enough time to meet them (Hill 2019). This being the case, is the addition of another set of tools beneficial or the next shiny tool forced on educators by administrators who want their schools to be cutting edge? Too often, educators are given the latest and greatest technology. They are shown how to use it, but there is usually no explanation/examination of how to effectively implement the tool for the purpose of learning (Gilakjani 2013). For example, a teacher is shown how to use the online guided programing site Scratch. They may have a working knowledge of how the program functions, but how does that help them understand the possibilities of implementation in their curriculum? Will they need to then spend more time learning how to include the tool? The answer is, "yes." Once educators are given more learner focused training on the implementation of the tools, they can begin to find ways to effectively include virtual and augmented reality in their classrooms.

The COVID-19 Pandemic of 2020 and 2021 has shown the world that innovation is not an act of futility. Schools across the globe closed their doors and those in education had to instantly convert their in person learning to fit a distance education model. Many felt overwhelmed and that they could not manage this new way of educating their students (Long 2020). In addition to a number of social learning aspects that had to be altered due to the unforeseen switch to virtual learning, one element of elementary education had to be completely revamped: field trips. There was no option to take groups of students together on school buses to visit sites. Here comes virtual field trips. Those school divisions that already had looked into and/or used Google Maps for virtual tours were able to readily make adaptations to something so pivotal as elementary school field trips. Students may benefit on a number of levels from the use of virtual reality field trips. According to Blascovich and Bailenson (2011), the virtual field trips may remain with students for an extended period of time. If this is indeed the case, educators can use that connection to their advantage. They can create activities for after the virtual

experience that would continue to draw upon and make connections to their experience. They could, in turn, retain more information which could result in a better understanding of the content that educators are learning.

There are limitations to the effectiveness of implementing virtual and augmented reality tools. The learning is only as effective as the tool (Markowitz et al., 2018). If the simulation is not one that is transferable due to the technology itself or maybe even the learner's experience within the simulated environment, learning may be disrupted. Arcades are a great example of virtual or augmented reality experiences that aren't always for the purpose of learning. Some of the motorcycle simulation rides are entertaining, but don't allow the user the chance to test and practice skills that would be necessary in order to obtain a motorcycle license. Instead, the objective may be to complete a course before the other competitors. This goal would not necessarily assist the participant in learning how to shift gears, braking and maintaining appropriate speed for example, but would supply a somewhat similar experience to riding a motorcycle. In many arcades, there are examples of extended reality but the purpose is enjoyment, not actually learning how to ride a motorcycle. This is the issue that educators must address during implementation. The purpose of the simulation has to remain in the forefront. Another important aspect to consider is the introductory period. If students are new to the concept of using such tools in their learning, they must first get past the initial newness in order to get to the learning goal (Jensen, Koradsen, 2018).

Medical Education

Is it necessary to simulate a surgical procedure before medical personnel perform said task on patients? From an instructional message design perspective, and given the the many simulation options available, it should be. There was a time when, if a patient arrived with a toothache, the tooth was externally examined and, if deemed necessary, removed without the use of anesthesia. As we have learned more about the function of the components that make up the human body, we have a need for more invasive procedures. In an article by Botden & Jakimowicz (2008), virtual and augmented reality have been tools used to offset the possibility of critical issues being caused by surgeons. They discuss how augmented reality simulations

are preferred over virtual reality simulations because of the opportunity to include physically handling tools of the trade versus just in an abstract sphere. These experiences also give students an opportunity to receive correction in the moment as they are not removed from the physical environment. Diana & Marescaux (2015) discuss how the use of virtual simulation can reduce the recovery time of patients as medical practitioners are becoming more precise with their ability to perform procedures. Universities are using their augmented reality opportunities as a means of recruitment. Mary Baldwin University has an image and an explanation of how they incorporate experiential learning into their curriculum. This is to show prospective students that they will have the opportunity to have hands-on experience versus just discussions in lecture halls. Figure 2 represents a student working with another student in a lab simulation that includes the use of attachments to monitor the student who is in place of a patient (Mary Baldwin Website, n.d.).

Figure 2

Students using an augmented reality environment to practice skills.

Note. Students benefit from using augmented reality environments to practice skills in low-risk simulations. (https://marybaldwin.edu/health-sciences/about/campus-facilities/).

Military

As mentioned before, military personnel are responsible for performing many high stakes tasks and it would be extremely beneficial if they could perform such tasks in a virtual environment before ever implementing them in practice. For example, Livingston et al. (2002) explains that warfare is shifting. No longer are troops being tasked with open space combat situations. They are finding themselves in urban combat situations. Troops will need to be able to access pertinent information pertaining to the urban structures and layouts without taking their attention away from their surroundings. Also, Lele (2011) describes the employment of virtual reality in order to reduce the possibility of error when constructing military equipment, such as complex aircraft. Military personnel can simulate the building of a piece of equipment and have the opportunity to compensate for any issues without the potential of operator harm. Symposiums have been held in order to discuss and display options for using augmented reality in the rehabilitation process for patients. Figure 3 is an advertisement for an event that was held in order to discuss augmented reality and its use with medically disabled military veterans.

Figure 3
Augmented in Health Care

Note. Example of augmented reality research being included in mainstream health care. (https://acrm.org/meetings/2019-annual-conference/).

Tools of the Trade

Education

As mentioned previously, one resource that may be more approachable is the creation of virtual tools through the use of Google Maps. Either through sharing their screen on the devices of their students or sharing the information on a projected screen, teachers can walk students through environments and locations that they actually would not even be able to explore on a standard field trip. Through the use of Street View and Pegman, an educator can pick a location on a map and walk the students through any city that has been mapped by Google. For example, while learning about Virginia history, a teacher could walk students through Jamestown. The students could be tasked to look for certain markers or find where they are on the virtual field trip in comparison to an older map of the same area. Educators could

also use the street view to have students travel along a watershed for a science unit in order to have a visual representation of where their water may originate. Google also has created another avenue for students to have a virtual reality experience called Google Cardboard as shown in Figure 4. According to the Google Cardboard site (n.d.), students explore space, go on tours with actual tour guides, fly and more. The device is simple to put together and they range from $8.95 to $39.95. Another virtual reality experience is available through a free resource called NearPod. Teachers can sign up with their Google accounts and create interactive lessons that would include a virtual reality component. Students will have the choice to see 360 views of Mars, The Great Wall of China, The Great Barrier Reef, and more with or without the use of VR goggles (Nearpod, 2022).

Figure 4
Google Cardboard Goggles

Note. Cost effective mixed reality via Google Cardboard goggles and a smartphone (Flickr).

Medical Education

Diana & Marescaux (2015) go into detail about the many tools that are implemented in the medical field in order to simulate medical procedures and provide more training in general. For example, a 3D simulator that allows medical professionals to examine parts of the human body in more depth in order to gain a better understanding of the specific parts. This allows trainees to have more accurate representations and therefore, reduce the chance of error when operating on when discussing options with patients. One such simulation is in reference to applying a catheter to a patient. This procedure can require many practice attempts before a practitioner is able to perform it on a live patient. Virtual reality simulations allow for such practice in a reduced risk situation (Bodhi Health Education, 2020). These simulators also allow trainees to have a 3D representation of specific organs of patients in order to work through possibilities before actually performing any procedure. There are other augmented reality devices that have been employed in the medical field that assist in active procedure.

One such item is the da Vinci® Surgical Robotic System. This system allows for practitioners to have a 3D representation of the area of operation during the actual procedure. From their location, they are able to manipulate a camera in order to have differing views of the area. There are also benefits in wound securing when employing augmented reality devices. Wounds can be secured more thoroughly, which will result in less healing time and reduced risk of infection. Also, devices that employ augmented reality can reduce the amount of blood loss (Diana & Marescaux, 2015). Touch Surgery Dynamic has developed an iPhone and iPad enabled app called Touch Surgery: Surgical Videos. This app allows medical professionals to watch informative videos, as well as practice surgical procedures using 3D images. The procedures aren't reserved for one field of study, they pertain to many areas of the medical field.

Military

One important augmented reality tool employed by the US Military is BARS or the Battlefield Augmented Reality System. Livingston et al (2002) explains that this system was developed in response to the shift in wartime situations. Figure 5 shows what these devices look like at their current status of development. As the face of the battlefield has changed, soldiers are more often finding themselves faced with handling combat in areas that are not open spaces. They have to navigate terrain that includes buildings and structures in tight spaces. In such situations, it can prove fatal to remove their eyes from their surroundings. BARS was invented to alleviate the need to look at physical objects in order to become oriented to the physical space. Now, there are heads up displays that can provide building layouts and even track the emotional status of users. For example, if a soldier is being provided with a great deal of information in a situation that requires a great deal of concentration, that extraneous load can prove to be counter productive. It may indeed prove to be a distraction rather than an aid to the user.

Figure 5

Augmented Reality Headsets

Note. This figure displays US Army soldiers wearing augmented reality Microsoft Hololens headsets. Modified from https://www.popularmechanics.com/military/a30898514/mixed-reality-goggles-army/

Funding

Now, after hearing about all of these great options, what happens in situations where there are limited resources? Funding is often limited when working in public k-12 education settings. Educators have to become creative with the materials that they are able to access. One option as a potential work around is creating discourse around the subject of virtual and augmented reality in relation to education. Teachers, specifically, can reach out to their IT departments in order to get a general idea of what resources are being used in their school districts. If they learn of a resource that has already been purchased and in use, that would be a great place to start as far as getting in contact with whomever has the resources at that time. Also, teachers may find that there are resources that have been purchased, but aren't being used. In a blog post written by Auletto (2016), school districts have spent large sums of money on entertainment and food orders, which has prompted investigations into getting more transparency about how tax dollars are spent in public education settings. For those looking to capitalize on already purchased resources, this issue can work in their favor. Leaders in school districts don't want to seem wasteful knowing that spending may be under a metaphorical microscope.

Reaching out to the technology department may also help because Instructional Resource Teachers may be able more directly point teachers in the direction of colleagues who are already using some of the technologies. Educators can also look to their local, state or nationwide education associations in order to apply for grants. For example, in the state of Virginia, there is the Virginia Education Association and this organization provides the opportunity to apply for grants of up to $500 which are awarded annually. The website for the National Education Association also provides a search tool in order to query federal funding options for education (National Education Association, 2022). Grant writing can be intimidating, but one of the great aspects of applying for these grants is that it can be a collaborative effort. Using the connections with colleagues that can be provided through a technology department, teachers can call on each other in order to obtain funds to purchase equipment. As of May 28, 2021, according to Macias (2021) in an article on CNBC, the request for the 2022 Defense Budget was $753 billion. Within that budget,

$715 billion is being requested specifically by the Pentagon. As such, funding for Augmented and Virtual Reality tools is much easier to access. Unlike their counterparts in the public education sector, US Military personnel can look to their departments and their allocation of funding for the equipment that they will use. More extended reality systems for military use are becoming not only more sophisticated but more affordable. Within the medical community, funding takes a consumer based route. Ultimately, consumers are taxed and those taxes go to the medical centers, consumers also pay insurance premiums and pay other expenses that are not covered by insurance providers. Those profits are what should used to pay for the various elements of health care facilities, including the use of new technology in training and in surgical procedures (National Library of Medicine, 2017).

Conclusion

In terms of instructional message design, virtual and augmented reality can be tools that lend themselves to integration in many facets of education and training in our world. The medical field has benefited tremendously from the integration in that the possibility of egregious medical errors has been greatly reduced due to the use of medical simulation using both types of realities as the means of providing practice. Patients can be more confident in their practitioners and practitioners can be more confident in their ability to deliver safe medical care. Within the military, US troops can have up to date training that applies to the ever changing landscape of war situations. They can feel confident knowing that their equipment will provide appropriate aid for urban combat zones. Within education, K-12 educators can now more easily find affordable resources that would allow students to have experiences that would be difficult to duplicate without the use of virtual or augmented reality. There are still some barriers for the inclusion of these two realities, or extended realities. Instructional designers must keep the learning task as the focus and be diligent as to not allow the features that make extended reality beneficial to become a hindrance. As new technologies are developed, the possibility to better prepare learners through the use of these solutions may become even more prevalent.

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