Virtual Reality: Making Learning Accessible in New Ways

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Exploring technology is a vital part of modern day students' educational experiences. Often, however, schools come in on the tail-end of an emerging technology, thereby limiting students' opportunities for exposure and skill development. Advanced technology can be considered a type of cultural capital which students can utilize in order to progress and navigate future career pathways. Virtual reality is one such advanced technology, now readily commercially available, which is making its way into classrooms. Our recent research focusing on the implementation of VR in classrooms provides information about how educators can make VR accessible to students. Access in virtually reality can be considered through multiple lenses and we discuss a few of them here. The first considers learning styles and non-traditional engagement, the second discusses access to a global education, and the third revolves around issues of social justice. We feel these areas are highly relevant considerations for educators as they consider the use of virtual reality.

Learning styles and the potential of interactive 3D learning
Students clearly expressed to us that they know themselves as learners. As they interacted with the more advanced VR headsets, they envisioned themselves learning in ways that were a better fit for them than traditional methods. Some students referenced that they didn't learn well from textbooks or that they saw themselves as hands-on learners who would learn more effectively if they could physically interact with the materials, which they could do within the virtual environment. This allows students to access concepts and representations that may have felt inaccessible before. Some topics are inherently easier to understand in an interactive 3D environment. A student articulated, *"When learning about things that are difficult to visualize, VR would be a useful tool."* Another stated he found VR useful when designing because, *"Being able to see game design and texturing through a VR headset and using it for content creation, you have a better/different perspective on 3d models etc."* Visualizations in virtual reality are very powerful and students are able to manipulate objects and move through space in ways that allow for exploration and interaction other technical mediums do not.

Observations by students included things like, *"I personally think it would help learning cause it's more interesting than sitting and listening."* Students discussed how even beyond interest-type engagement, cognitively, they perceived they might actually learn better, *"I think students would remember things better if they actually got to experience them for themselves."* As educators know, at times it can be very challenging to implement certain types of hands-on experiences. Students suggested using the controller and their hands to manipulate objects in 3D space in ways the real world just does not allow, for example, 3D manipulation of geometric forms in math class in order to better understand them. Another student said *"I think it would be especially useful in classes such as biology and anatomy. These classes are much easier to understand when you can participate in the things that you are learning about. For example, while learning about surgeries, you could actually perform the surgery in a simulation."* Other

students talked about trying out chemistry or physics labs in a virtual space which might be dangerous or impossible try them in real life. Virtual reality can provide access to simulations and experiences that may not feasible within the regular curricular structure.

Some students felt that this medium may help educators better personalize learning, either through content that is developed in schools or through the growing selection of pre-made content available to consumers. One student remarked, *"I hope that virtual reality and related technology will be able to better engage and track students so that teachers can better tailor their learning experience for the students."* Another noted, *"I hope VR can be used to simulate important situations and new, more personalized ways to teach individual students.*" Students creating with 360 video and VR found ways to tell stories about their personal communities and share them out to other students in a new, more immersive way. Virtual reality allows for an interesting educational blend of personalization and socialization within a traditional classroom structure.

Global Education

Another very popular theme touched on by many students was the amazing potential of VR to allow access to events, places, and times that they otherwise never would experience. Students talked about how field trips are difficult or non-existent in some of their locations, and how they might see places in the world (or even local communities) that they might never see otherwise. For example, a school in rural Ohio used VR as a way for their students to experience a subway so they could better relate to content in a fictional book they were reading in English class. It helped provide a frame of reference students might not have. Accessing historical content or different cultures was one of the most popular responses when students were asked how they saw virtual reality being used. Students felt that virtual reality provided a unique opportunity to connect and empathize with others in a way that many forms of media do not. Increasing access to others' cultures, experiences and geography helps imagined visualizations become more real and through emerging VR content and technology, this is becoming more and more possible.

Students' comments on virtual reality's potential for increasing access and exposure also included interesting references to students who might be ill or otherwise absent from the educational environment. *"It can be used to go to school even when I am sick."* Whether out for an extended sick-leave or during hospitalization, students saw virtual reality as a way for kids who were off-site to remain connected with their peers. In addition, recent research has looked at the potential of VR for development of skills for people with disabilities (e.g., Jeffs, 2010) which could further expand this idea of access.

Equity and access

Of course, from an equity standpoint, access is only possible if schools can actually acquire the equipment. It behooves hardware developers to think about ways to engage with school programs because the students of today are the developers, artists, and creators of tomorrow, and, as we have repeatedly seen, students are thinking broadly about VR and its uses. Many of

the hardware developers are working to find ways to get their hardware to schools. However, a limitation here is often not the advanced headsets but the computers needed to run them. Some of the schools with whom we worked had courses in which students built computers. These teachers were able to leverage the skills of students to build computers (at a fraction of the cost) for the classes to use for VR. This sort of dual-educational experience was an interesting way to link learning and hardware. Other teachers in our study used Go-Fund Me, DonorsChoose or similar programs to help raise money in their communities for more advanced computers. Additional schools shared hardware or set up a VR room where students from different courses could use the advanced equipment without the need for buying multiple computers and headsets for each class. Other schools were able to obtain grants through their school district foundations or from outside organizations such as ours, to get VR hardware for their class. Teachers often referenced how they were surprised that, when they reached out to hardware and software developers, they often found more avenues for obtaining equipment for learning than they had expected. Though there is no perfect system at present, we were impressed by the savvy approach the teachers and their tech administrators used to acquire additional technology for the benefit of students.

Even the few teachers in the study who didn't attempt to acquire the more advanced hardware still ran into equity and social justice issues. Google Cardboard is obviously a much more pocket-book friendly way to explore VR with students. At a cost of $15 a unit, a classroom set is relatively affordable to obtain. However, the challenge here is that students must have devices that can run the content. In one school we worked with, about 84% of the middle schoolers had smart phones that could run the content. However, that left an awkward 16% that did not have phones available and stood out to their peers as being the ones who needed to share or check-out an iPod, becoming an issue of the haves and have nots. Another school we are working with is using Cardboard with an elementary classroom and was able to purchase a small amount of devices to use in a small group setting (e.g., six devices shared among 20 students). This may cost less than running a more advanced headset and provides an access point for a wide-array of VR content for students.

Low-cost options such as Cardboard may work well for younger students but we saw that high school students were eager to get their hands on the more advanced headsets. We believe that exposure to emerging technologies, such as the advanced headsets, is really important for students who are going to be societally and technologically fluent in the future. Certainly schools with more resources may have an easier time obtaining advanced equipment. However, it was heartening to see multiple instances of schools who did not have a great amount of resources, but had strong student interest, that were able to make VR happen. In fact, we heard from several teachers that going through the process of strategically thinking about how to get VR equipment, ordering it, setting it up, and experiencing it together was a valuable learning and team-building experience.

Final Thoughts on Access

In American education there is often a message that students must reach a certain level of experience prior to using more advanced technology. For example, in some school environments, students cannot access "computer programming" classes until they have completed Algebra 2, which effectively excludes students who have difficulty with or are less engaged with math. Historically, this has tended to limit opportunities for some students usually including low income students, students of color and women, and has discouraged interest among students who feel the technology and skills are out of reach.The diverse input from these very students would be highly beneficial to the field. We have found that students can access and are successful with advanced technological techniques such as programming, game design and VR at very early ages. When kids can interact directly with advanced and immersive technology without jumping through a bunch of intermediary and less engaging hoops, a larger and more diverse group of students can become engaged with interesting questions about technology. Students began to see potential in themselves and ways that they could contribute through their experiences with virtual reality as well as expanded views in terms of their conceptualization of what it means to "do" computer science. As educators, it is important to acknowledge potential barriers for students and question whether or not they truly need to be there.

Improving students' abilities to think in interesting and creative ways about how to utilize technology has been widely identified as a pressing need in order to solve complex societal challenges of the future. Virtual reality presents a unique technological tool to explore learning in ways we have been unable to do before. Whether for students with different learning styles, those with lack of engagement with traditional educational techniques, those who may not initially identify as having STEM interest, or for schools with limited resources, VR is one format that may help address access issues. We believe it would be a positive development to bring VR into more schools in order to provide this unique learning experience to as broad and diverse a student base as possible.