Implications of Virtual Reality in Applied Educational Settings

L. Castaneda, A. Cechony, T. Swanson

Abstract

Introducing advanced technology into a classroom requires thoughtful planning and implementation, especially with something as personally impactful as virtual reality. Throughout our work with schools across North America, we have been examining some case studies of VR kits in real classrooms. Our VR program has examined various combinations of hardware, software, subject matter, age groups, and locales to see what happens when VR gets into the hands of students and teachers. Through our interviews with teachers and surveys with students, we have uncovered many promising opportunities, but also some concerns that lead us to carefully consider the role of VR in education. We present considerations, challenges, and our experience in three key areas: ethical VR use, pedagogy/content, and immersive communities in classrooms. We offer discussion points about both positive and negative impacts of VR, and what we can do to maximize its usefulness in creating valuable learning for students.

Introduction

As virtual reality becomes more accessible to consumers, potential connections to education are developing. However, to our knowledge there are few resources available addressing the benefits and challenges of using advanced VR in applied educational settings. While lab studies add to our knowledge, sometimes they do not address simple, yet very real concerns that occur in classroom settings such as: only having one computer that can realistically run VR, a lack of usable space, having a room full of energetic middle schoolers present and pedagogically trying to connect curriculum to available content. These are tangible issues for practitioners, and the gap between published educational research and direct communication of findings to educators is adding to the concern [1]. The average classroom teacher is likely not reading articles about learning with VR from university laboratories and those laboratories are also not often reaching out to classroom teachers about best practices. It is important for this dialogue to occur and for researchers to engage directly with the teachers themselves.

In addition to engaging with teachers, hearing from students about their experiences can shed light on concerns and situations that teachers may not have even considered [2]. Often students and teachers don't get to voice their experiences with technology in the classroom, nor are they asked to reflect on the usefulness and value it creates. For example, when talking with students and teachers in our study, we observed that there are genuine ethical considerations that need to be discussed when using VR in educational environments. Currently researchers are highlighting a need to focus on ethical conduct in the use of VR [3], yet we don't hear much about this topic in the educational technology community.

Our work explored the challenges of VR use in seven classrooms across North America. Through structured interviews with teachers and survey questions with students, we gained valuable insights directly from classrooms using VR that we think would be useful for educators interested in implementing it themselves. We think these exploratory findings may also provide information useful for researchers and software developers. We will focus on three key areas: ethical considerations, pedagogy/content, and building an immersive community.

Methods

The study consisted of seven teacher participants from six schools across North America. Four of these teachers worked with middle school students (grades seven and eight), and three worked with high school students (grades nine-twelve). Both teachers and students demonstrated a range of familiarity with virtual reality. Over the course of the 2015-2016 school year, three interviews were conducted with teachers: before using VR, during the VR-related curriculum and at the end of the program. Teacher interviews emphasized implementation, technological challenges, content, concerns and student observations. Students completed three online surveys, according to their schools' schedules, also before, during, and after the VR curriculum. Student surveys were a mixture of Likert scales and open-ended response questions targeting their expectations and comfort level with VR, technical knowledge and the perceived role for VR in the classroom. In order to ensure that teachers had VR technology, our organization supplied the hardware of their choice to suit the objectives of their course. Participants were primarily technology or media teachers and students, although we did have a middle school that used the technology in social studies and a high school that used it in language arts.

Results and Interpretations

Ethics

Many of the concerns expressed about VR use with children and adolescents center on eye strain [4] and other physiological impacts. While these concerns need to be addressed, it is equally important to consider the ethics of the psychological impacts of VR on youth. While virtual experiences may appear objective in nature, there is a very real and subjective component to virtual worlds, particularly when considering use with adolescents. Users of VR bring their life experiences, emotions and fears into the immersion with them. Previous research [5] along with our experiences with elementary aged students have shown that they may have difficulty separating virtual reality from actual reality. Even middle school students in our study made observations that led us to question how they were conceptualizing the virtual experience. For instance, several students referenced VR as a way to see history from history's perspective, perhaps not fully understanding that the experience was created by a developer. Others had real fears triggered by CGI virtual animals. Finally, even high school aged students, experiencing *Henry* from Oculus Story Studio, a heartfelt narrative with an emotional story, cried and referenced feeling sad during the experience despite Henry being a CGI hedgehog. It is important to consider how students are situating virtual content within their real lives. Do they understand that someone created this simulation and that they cannot go back in time to relive an event? Do they understand what they are seeing is not real in the same way an adult could? These are questions we feel educators need to be considering as they implement VR.

Another consideration we found important was scaffolding users into a virtual experience in the classroom. This was important both on physical and emotional levels to help students more positively engage with content. Using content such as *Tilt Brush* or *The Lab* to help users acquaint themselves with space, control and motion was imperative. Even these simple experiences could elicit strong responses, although mostly positive. Gradually increasing student exposure to more active, emotional and/or narrative-based experiences can help them better acclimate to virtual environments. This is essential in order for students to be emotionally prepared for intense settings like *Clouds over Sidra*, a short 360 film from the perspective of a 12 year old Syrian refugee, or *08:46*, a simulation of the 9/11 terrorist attacks. In addition, those intense experiences require careful scaffolding and thoughtful implementation, which often

involves pre-experience discussion and post-experience debriefing. Teachers across all subject areas who use VR need to keep these and other potential psychological issues in mind.

Beyond these individual experiences with VR, ethics extend to the wider population with questions regarding equity and access. One school in the study utilized Google Cardboard with all of its students because they wanted the hardware to be more accessible and keep costs down. Though 80% of the students had smart phones that would work, we wonder about the social implications surrounding the 20% that had to admit they didn't. This issue becomes more complex when we consider the range of advanced systems and price points. Even wealthier schools struggled to provide high-end computers that were able to run VR. Some schools found creative ways around the issue by having students build school computers in tech classes, rotating equipment between classrooms or even creating magnet classrooms open to many students. These options were situationally viable, and helped to create better access for all, however they may not be feasible in every setting.

One of the clear findings from our study, both from teacher and student perspectives, was that exposure to cutting-edge technology like VR was seen as an opportunity that would benefit students in their future academic pursuits. We found that VR taps into a wide array of important concepts including creativity, self-expression, confidence and ownership. It engaged students in new ways and provided a different outlook on technology and computer science for many students. Our data suggest that the opportunity to use VR sparked further interest in pursuing tech courses for some of the young women who were already enrolled. Students and teachers in VR classes were eager to share the technology with the wider school community, and many students even became local experts in running and supporting VR. Students became very intrigued by the opportunity to learn with VR and teachers referenced new students enrolling in their courses as a direct result of wanting to explore it. This increased overall interest among a wider demographic group in creating VR content that was relevant and accessible to them. Because of these findings, we believe that students who are not exposed to VR by the time they get to college or technical school may find themselves at a disadvantage relative to their peers.

Pedagogy/Content

While VR is a natural fit for tech classes, it can be used in many different settings. When considering this, it is important to look at the logistical side of VR setups. Class structure, in our study, had to reflect the hardware available, which in some cases was one advanced headset with one advanced computer. In humanities based classrooms, where content design was not emphasized, the ability to get students exposed to VR experiences as quickly and efficiently as possible was paramount. In an effort to overcome the lag of trying to get 30 students through a social studies experience, one of the teachers used 1-to-1 Google Cardboards. However, having so many moving pieces at the same time in a classroom was challenging. The same teacher utilized the HTC Vive, and though the students found it to be a more impressive piece of hardware, their limited time with it within the course structure did not allow them to fully engage. Another humanities teacher teamed up with a tech-teacher in our study. They rotated kids out of the humanities class in small groups to come have a VR experience related to their coursework and then return to their regular class. This rotation system allowed for a few students to deeply engage with VR at a time while others were focused on traditional course material.

In technology classes, this presented less of a problem because students were creating content which did not require use of a headset until they were testing their simulations. One teacher who had five Oculus headsets realized that even having three headsets in his room of 30

computer science students would have been sufficient for content creation. Another school that focused on 360 video creation said that it was not an issue they only had two camera rigs as the students found ways to work on other projects when they weren't filming. The great challenge for them was that they only had one computer capable of running the Kolor editing software, which created a bottleneck and students were unable to quickly turn out a testable product. The quick turn-around time for testing and iteration was a key point noted by all of the teachers to hold student interest, and was a potential slowdown for content creation classes.

Even though the humanities teachers may not have the same technical skill as the tech teachers, they were more equipped to discuss perspective and effectively debrief experiences with their students because they do this frequently in their regular classrooms. They also spoke eloquently about the need to discuss primary vs. secondary sources with students, how VR could better help students "walk in the shoes of others" and the importance of having students write and dialogue about their experiences. This was a strength of the inherent curricular structure of humanities courses which often easily extend into discussions of empathy and humanity.

One of the pieces of advice teachers in our study shared was that content needed to be tested by teachers before students interacted with it. The teachers who were unfamiliar with VR tech before this study were surprised by how much an underwater scene with a whale or a moment in a friendly cartoon hedgehog's life could profoundly affect people of all ages, including teachers, even when it seemed innocuous. Humanities teachers were more likely to discuss putting students in emotionally heavier VR scenarios that connected to their curriculum right away. Though the teachers did note that it might be intense, it was not until they had experienced the content themselves that they gained a solid understanding of how visceral a VR experience can be, on both a physiological and emotional level. Also, anecdotally, we heard from several teachers that students with less gaming/technical experience were more apt to feel overwhelmed by content. We feel this is another important aspect for educators to consider as they think about how to scaffold students into VR experiences in a constructive way.

Tech teachers, on the other hand, were often ahead of the curve on how to implement VR content creation utilizing programs such as Unity. As one would expect, the tech-based critical dialogue had much less to do with historical accuracy or perspective in an empathetic sense, like in the humanities courses, but had much more to do with quality, design principles, 3D modeling and the overall immersive experience of the existing content. Tech teachers were not as cautious about trying virtual experiences before students, and one learned a valuable lesson about powerful content from the 9/11 simulation *08:46* and talked about the need to debrief, even in a tech class, intense emotional experiences in VR. Some things that teachers of all subjects found helpful was allowing students to process together verbally or through online forum posts after a particularly challenging virtual experience. Not only did this help the students work through emotion, but also gave all members of the class a chance to talk about whose perspective was represented and what being a part of that virtual experience meant to them.

Creating an Immersive Community

The guidelines that apply to a normal classroom environment are often created collaboratively between students and teachers. In this study, we found that developing shared guidelines for VR was important to both maintaining student safety and wellbeing as well as respecting the immersive experience of others. All of the classrooms we worked with used head mounted display (HMD) technology which includes a headset and headphones that block most external stimuli and render users unaware of their actual surroundings. In order to create space

for exploration, emotional expression and engagement, one of the most important ground rules that was set was not to touch people in VR. Teachers using the HTC Vive created a physical boundary with tape and several wrote "Do not enter when someone is using VR" on the tape. Others implemented rules that students could only be touched if they were going to collide with an object in the real world. In one classroom, a student using the HTC Vive accidentally punched another student in the face with a controller, again highlighting the need for physical space that is safe and people-free. Additionally, having other students in the area watching quietly and respectfully in order to not disrupt the aural experience for the student was key. It was noted by participants that sound is a vital part of the immersive experience and there are obvious challenges with sound in a classroom environment.

Being able to be fully immersed and interact with the virtual environments takes courage for youth because, as one teacher puts it, "They are willing to do things that would look goofy even without the goggles on because they are so excited and immersed in the experience." This kind of comfort and safety to explore that environment comes from a strong set of teacher and student expectations for shared behaviors and norms. Though we were initially concerned that students might be inclined to capture footage on their phones or tease other students when they were immersed and moving around, this did not turn out to be an issue in any of the schools. Teachers in the study commented that, for the most part, once students had experienced the advanced headsets themselves, they were primarily interested in trying whatever content the person immersed was in rather than making fun of them for wearing the headset.

Additionally, some students were participating in content that was deeply emotional and, depending on lived experiences, could have varied impacts. Some content could be triggering for students. In this case, it is crucial that educators implement a community of "challenge by choice" philosophy by allowing students to either be fully immersed, watch someone else who is immersed or remove themselves from the activity altogether. Teachers referenced times where students preferred to actually watch on the computer screen versus be in it themselves; students wanted to see the experience but not necessarily be the one to engage first-person. We are not advocating for students to be able to remove themselves from difficult topics altogether. Instead, we want teachers to understand that even simple experiences can be more impactful than expected, and that choice is a vital component of a student's experience with immersion.

In the technology classes, community was also informed by the troubleshooting students utilized. Students self-identified as experts in different areas of creation, provided critical feedback for one another and actively engaged with content as a way to make improvements or to inspire entirely new designs. Tech based classrooms that utilized a game design studio approach had small communities of learners who distributed their expertise across the team to build something of value. Troubleshooting and tackling issues that perhaps had not even been addressed by adults in professional fields was a rewarding experience for teams of students. This was also true of the sense of ownership over content created and shared, particularly when tech students were able to develop simulations that were utilized in different courses.

Conclusion

The vast majority of students in our study hope that virtual reality is a way to fundamentally alter teaching and learning. The students and teachers saw enormous potential in terms of virtual field trips, historical simulations, scientific experimentation, and creative expression. In order for these high hopes to be realized, we need to have a broad, open-minded view of how virtual reality intersects with curricular areas (e.g., using *Keep Talking So No One*

Explodes as a collaborative exercise, having students do creative writing after *Alien Surgeon Simulator*, or using Unity to design a scene from a novel for other students to explore). Furthermore, as we explore the exciting options VR presents for learning, it is equally important that we take time to pause and consider the implications of this new form of media. In order to best capitalize on positive elements and avoid pitfalls, we need to better understand how to think about the student users, the context of the content and the classroom environment. Contrary to some concerns that VR would be isolating, the students and teachers in our study found it to be an excellent mechanism for shared experience, dialogue and bonding. Building and strengthening classroom communities through the use of immersive technology requires pre-planning. Additionally, as more content becomes available, we hope research continues to look at positive ways to use VR to extend and enhance learning in educational settings.

We would like to conclude with one point from the student surveys. Students hope that educators and schools will not diminish or wreck VR when it crosses into the classroom like they have seen happen with other technologies. A high school male remarked, "I would like teachers to understand that VR doesn't have to be the same as current schooling...students should explore instead of mindlessly following paths where they don't even need to think to understand." We are at the point in VR usage where we can begin to lay the groundwork for how it might be considered in classrooms. This is, no doubt, one of many coming technologies that will expand how we look at learning and present both new possibilities and hurdles in education. It is imperative that we rise to the challenge of integrating these new tools now, and through discussion, documentation, open-minds and shared experience, we can.

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