Actual Data from VR Usage: What Happens When VR is in Schools

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Abstract

Virtual reality is rapidly becoming more accessible to the general public as well as educators for use in school settings. On the surface, it appears to be an interesting tool for learning but very little work has been done to gather data and feedback from teachers and students about its actual efficacy and implementation in the classroom. Our applied VR study involved 13 schools and 1351 students, in the 2016-2017 school year, with the goal of exploring student interest in the technology, content consumption and creation, immersion in a classroom setting and concerns raised by the use of VR in the classroom. Participants in the study utilized a wide-range of content and hardware to achieve their own learning objectives which we think strengthens the applicability of our work.

Introduction

The advent of commercially available VR headsets, across a range of price points, with varying complexity, alongside promises of VR for empathy, engagement and the chance to see the world is an appealing prospect to educators. Though there are a number of well-designed laboratory studies exploring various aspects of virtual reality usage (Cummings & Bailenson, 2016; Fox et al., 2012; Langerak et al., 2016) there is a dearth of research in applied educational settings. Though some researchers have been focusing on VR for educational uses (Friena & Ott, 2015; Winn, 1993; Bricken & Byrne, 1994), we still feel that concrete data from actual classrooms in a variety of geographical areas would really add value to the discussions amongst educators and researchers. As educators know, what works well in a laboratory setting with volunteer college undergraduates is likely not going to work the same way in an actual middle school classroom. In addition, often new technologies are thrown into classrooms with little opportunity for students and teachers to truly voice their opinions on the value of the technologies for educational purposes. We wanted to explore what really happens when VR is integrated into actual classrooms.

Experimental research with older models of virtual reality hardware has suggested that there may be interesting implications for training (Psotka, 2012), learning (Ritter, et al., 2012; Pantelidis, 2009), transfer of knowledge (Witmer et al.,1996) and empathy/perspective taking

(Yee & Balienson, 2006; Fonseca & Kraus, 2016). Though it is interesting to explore these ideas in a laboratory setting, it is useful to consider what types of learning and interactions might occur when this technology is placed in an applied learning setting, such as a classroom. The entire purpose of our study was to gather findings from actual teachers and students in the areas of content, immersion and general impressions of virtual reality after engaging with it multiple times across a school year. We wanted to move beyond the hype of it being a "wow" experience and begin to dig more deeply into how we can study the impact this technology may, or may not have, in a learning environment.

It has been important to us that we exert as little influence over the teacher and student experience as possible. Thus, as part of our study, teachers were able to select either Google Cardboard, Samsung Gear, Oculus Rift or the HTC Vive for use in their classrooms based on which seemed to provide the best fit for their course objectives. The teachers themselves determined how they wanted to integrate the materials and then provided us with their feedback. Their students provided their own feedback and insights, anonymously through an online survey.

The emergence of commercially accessible virtual reality equipment has made the technology more available to everyday users. Even with increased accessibility, the costs can still be prohibitive for educational purposes. In 2015-2016, we ran a successful pilot study wherein we provided the headsets and, in some cases, computers, that were powerful enough for teachers to use VR in the classroom. Based on general themes in the findings of the 2015-2016 study, we added new areas to the 2016-2017 study as we focused our work more specifically on content, its uses in the classroom, connections between content and curriculum, perspective and what breaks immersion. We will discuss data from four areas: General VR usage, content consumption and creation, immersion in a classroom setting and concerns or issues with VR.

Study Objectives

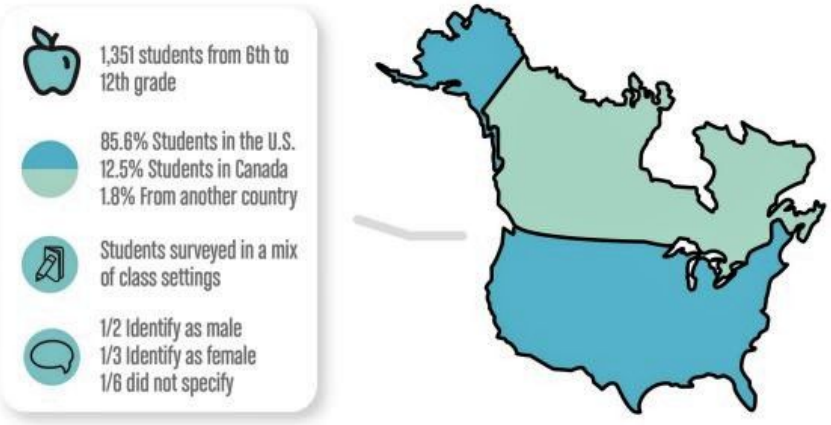
We had several objectives in mind for designing this study all grounded in what actually happens when VR enters the classroom environment. Specifically, we wanted to examine the role that the content itself plays in the VR student learning experience, particularly with regard to student understanding of people and/or places. We also wanted to hear from students and teachers how they consider the use of VR for both content consumption and content creation purposes. Given VR's immersive nature we hoped to develop a more clear understanding of how immersion in a classroom setting may differ from a sense of immersion in non-educational environments. Finally, we also wanted to more clearly identify concerns/issues that might arise from VR usage within educational settings across the course of the school year.

Methods

The research study was approved by an Independent Review Board and adhered to all guidelines set forth by the various schools, districts and their relevant IRBs. Since nearly all participants were under the age of 18, parental consent was required. We followed manufacturer guidelines for age-groups and usage. Participants were recruited from thirteen schools across the United States and in Canada. Some were returning schools from previous studies, others were recruited online from an open call for interested educators. Each research school had a signed a Memorandum of Understanding about what the study entailed and consent for student participation in the surveys/interviews. VR headsets were given to the teachers to use within the classroom/school environment. All teachers were allowed to select the VR hardware that they felt best met their educational objectives. In the instances where teachers did not have computers powerful enough to run the more advanced headsets, we provided computers. All hardware was donated to the schools for their use after the study.

Student participants completed two questionnaires, pre/post, with Likert Scale (1-9) ratings for content as well as open-ended response questions regarding their overall VR experiences. Teacher participants completed three open-ended response verbal interviews. Responses were analyzed to assess whether virtual reality content impacts the student learning experience specifically with regard to the immersive nature, educational value, relevance, and student perspective. Students were asked to reflect on their overall VR experience, comfort level with VR as well as particular content experiences. We drew from literature in several fields, including psychology, games, virtual reality, business and media to ensure as thorough a connection as possible to the previous literature as well as expand upon research questions used in our 2015-2016 study.

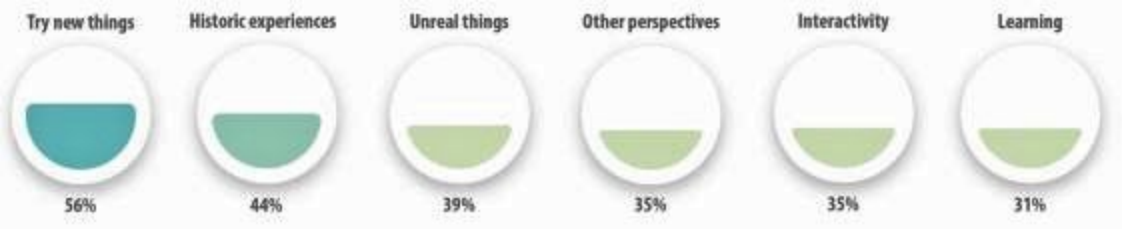
Demographic variables (e.g., gender, grade-level) were used to describe the sample of participants and were included in the subsequent analysis. Participants, both teacher and student, were asked to provide basic demographic information (e.g., school affiliation, gender and grade level) and level of experience with VR.



Likert data was analyzed quantitatively for reporting. Open-response data was thematically coded by multiple teams of coders and Cohen's Kappa was used to assess inter-rater reliability.

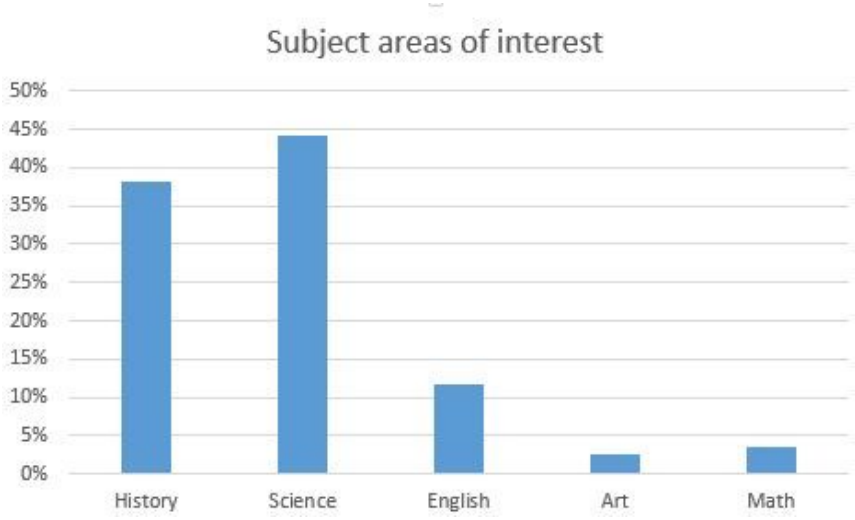
Results

Our first area of investigation explored findings on student VR usage. The vast majority of students expressed interest in using VR and generally felt more positive about its use in educational settings as the study progressed. The graph below shows a shift in the pre/post surveys of students with their general impressions of using VR. The graph shows that in the categories try new things, experience historic content, experience unreal things, develop other perspectives, have an interactive experience and using VR for learning, there was a positive increase in each category. For instance, 56% of students felt, after using VR, that it could be used to "try new things." We have seen, and continue to see, that the average student is not entirely clear about what a VR experience might entail and having some exposure to it can really help with their understanding and comfort.

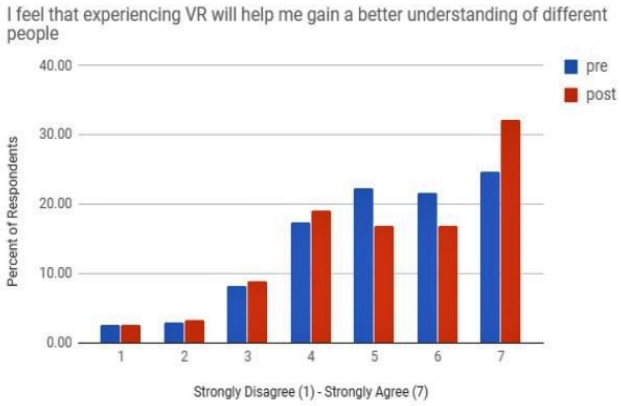


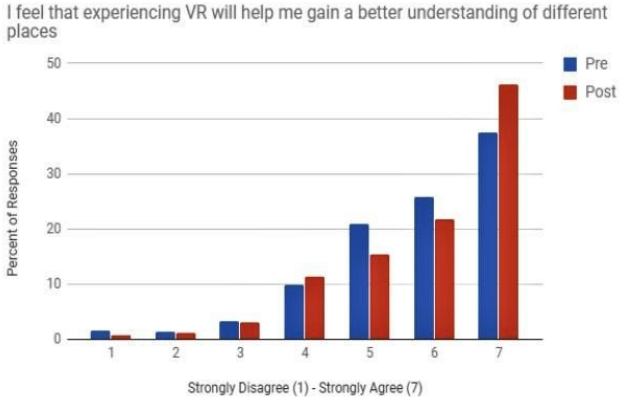
In terms of specific content, students were most excited about the idea of experiencing things that are "real" but they might not actually encounter in their real lives (places, dangerous things, famous landmarks). Another appealing area was historic events from the past as well as

science. Interestingly, in our new data-set, we see increases over these, already, with regard to art, math and English. It appears that as students have more exposure to VR, their understanding of the myriad of uses for the technology in a school setting increases.



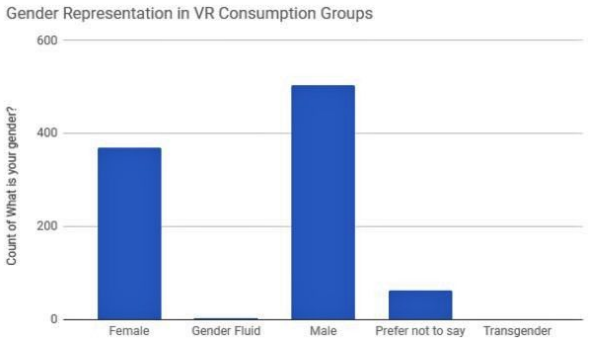
To our surprise, the majority of students in the study felt that VR was most useful as a tool to learn about places, not people.This finding is intriguing because of the massive push for VR to be utilized as a tool for developing empathy. In fact, as students gained more experience with VR content they were less sure it was a good way to learn about people but more sure it was a good way to learn about places.



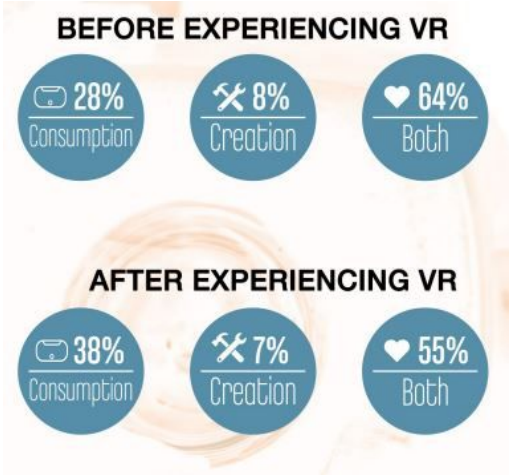


Our second area of investigation looked at VR in the classroom in terms of content creation and content consumption. We were surprised by the number of students that expressed interest in creating VR content this was regardless of whether they were in a computer science or programming class or a course like humanities. Students envisioned themselves using VR creation tools or 360 video to create content and about 90% of all students wanted to be involved in content creation in some capacity. We did notice a gender difference amongst the students in

terms of their interest in content creation, however. As can be seen below, the vast majority of students enrolled in courses where content creation was programming based (versus in-VR creation or artistic tools), were male.



In courses that were more apt to focus on VR content consumption, the ratio of male to female students was more balanced. We found, however, that there were interesting implications by allowing students in non-programming courses to create content as well as those in more advanced computer science classes. Even though a humanities class might not be using Unity to create content, but perhaps 360 video to do so, the number of students really engaging with the technology and thinking creatively about its use, across gender and ethnic groups, was more balanced. This has important implications for introducing advanced technologies in non-tech specific courses. Perhaps if we can get more students access to the technologies, as creators, in general education courses, they may feel more comfortable or inclined to enroll in more advanced technology courses in the future. This is something we'd like to investigate further.



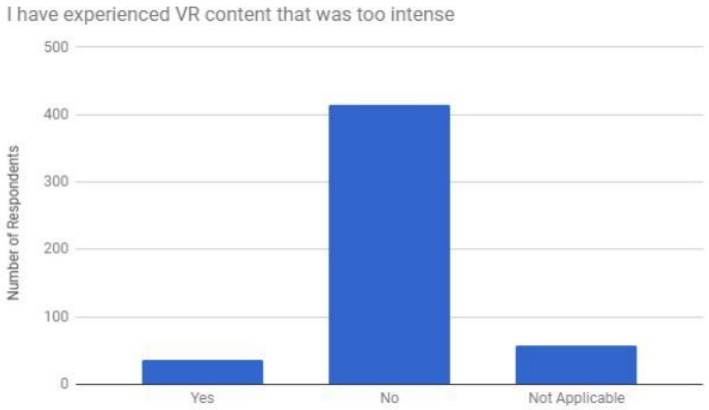
We did see shifts over time within the content creation/consumption data. After some exposure to VR, the majority of students still had interest in content creation, but the numbers dropped off (closer to 62%). We think this is worthy of further investigation. Did students feel creation was too hard? How does this compare to other types of content creation (e.g., games?). We did observe in some student groups a level of frustration in utilizing VR creation tools that may explain some of the shift in the desire to actually create their own content. 62% is still a solid number of students with an interest in designing and creating.

A third area of focus was centered on immersion in the classroom setting. Schools are inherently noisy and can be distracting places. Students identified background noise as being a major issue relating to their sense of immersion. Other sources of disruption to the sense of immersion were related to peers (though not as much as we expected) and the content itself (e.g., some sort of flaw in the content design like a glitch, a poor mechanic, or motion). Interestingly, a large factor that impacted learning while immersed in VR during school was the pacing and timing of the experience provided by the teacher. If the teacher tried to rotate kids through too quickly or set strict time limits, students remained constantly aware of that restriction and it impacted their level of immersion.

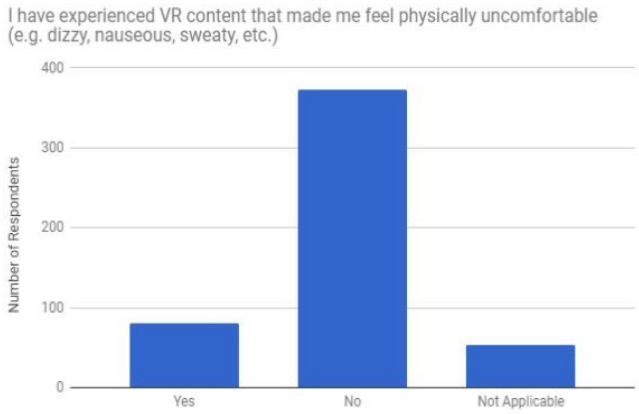
Data we gathered from teachers and students suggested that setting clear ground rules was an imperative step in maintaining a sense of immersion. Especially important among these was not allowing anyone to touch a person immersed in VR as it not only made students feel unsafe, it broke that sense of immersion to have an external person interact with them. Audio was also very, very important. In one classroom, students were not allowed to wear headphones because the teacher wanted to be heard. Thus, students in that course were experiencing two realities simultaneously, the visual reality in the VR content and the aural reality of the classroom. This can be disconcerting and definitely pulled students out of the immersion. Our data show that high quality headsets were really important to help block out the external noises but also to allow students to find themselves within the VR experience.

Finally, we felt it was important to examine concerns students and teachers might have, or may have experienced directly, in their VR experiences. Intensity of content/experience was one area where students had thoughts. Though most students did not find the VR content used in their classrooms to be too intense, there were some notable exceptions content-wise (e.g., an underwater experience where students, at times, felt claustrophobic or fearful about something scary they thought “might” happen) and about 7% of students did find VR to be too intense, overall. Though not a majority, it was a decent number of students. 24 of the 40 students said it was when the experience felt “too real” for them, 19 referenced phobias, and 6 talked about things being too close, proximity-wise. We know from our conversations with students that audio adds to that intensity. While having headphones on definitely helps with the level of

immersion, that same factor can cause the VR experience to seem more intense because two external senses, sight and sound, are blocked.



With regard to physical discomfort, a fair number of students, about 81 or 16% of the sample that answered those questions, did experience content that made them feel physically uncomfortable. Key responses students referenced included sensations such as feeling sweaty or anxious, dizziness, headaches or nausea. Nausea is often a big concern for students, pre-VR usage, even though the vast majority of students do not experience motion sickness in VR. Just the fear of motion sickness can deter students from even trying VR. It is also important to note that several classes tried games involving motion (such as roller coaster VR experiences) and even with a fast frame rate (which often can help protect users from feelings of nausea), motion-intense experiences are more apt to induce strong physical sensations. Interestingly, even when students knew that in real-life roller coasters weren't something they enjoyed, that did not necessarily deter them from trying roller coasters in VR.



Delving into conversations with educators and students we did see some topics come up that made us think more deeply about the ethics of VR usage. As more and more immersive

experiences are brought into the classroom, we had some anecdotal observations/stories from students about triggers and anxiety from VR. Though we also heard stories about VR experiences feeling therapeutic (such as the more art-based pieces) we did hear stories about content that students needed some help processing. Most importantly, a big thing we learned was that even content teachers (or even we) considered relatively innocuous may not feel that way to students, and, as educators, we need to be very conscious of that fact as we expose our students to this medium for learning.

Conclusion

We feel that this study touched on a variety of areas that should resonate with both researchers and educators. Throughout our work with students on this data-set, we heard a great deal of positive commentary about the potential of VR for learning. Students saw it is a great tool to experience content in new ways, to explore things they might not see in real-life, to better understand other places, and to create their own experiences. In our school visits we observed students fully engaging with the technology and articulating, in interesting ways, what they were able to take away from the virtual experience.

At the same time, there were areas that were slightly less positive. Issues about equity and access came up. Upon observation and in conversation with students, we found that female students were less likely to use the technology, period, and less likely to create with it. Some students found the technology anxiety producing. We also found that there are specific steps educators need to take when implementing the technology in a classroom setting to help ensure that immersion can take place effectively for students.

This study helped us formulate follow-up work for the 2017-2018 school year which we are currently analyzing. We look forward to further exploring the idea of relative value of VR as a learning tool, VR for empathy and a better understanding of what makes content useful or interesting for students.

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