International Journal of the Whole Child
2019, VOL. 4, NO. 1

From Theory to Practice: Building Leadership Opportunities through Virtual Reality Science Expeditions

Kaitlin Peterson[a], Brian Andrew Stone[b]

[a-b]Northern Arizona University

Kaitlin Peterson is a practicing teacher at Mountain Charter School in Flagstaff, AZ. She was a dual certification student with a degree in elementary and special education. Kaitlin took a significant interest in the use of virtual reality in her methods courses at the university, used them in her student teaching, and has provided professional development training in the use of VR. Her interests include child-centered practice, technology integration, and child development.

Dr. Brian A. Stone is a Senior Lecturer at Northern Arizona University. He teaches elementary science and social studies methods courses for undergraduates. He is the Director for the Professional Development School program at NAU, and also runs faculty-led study abroad programs to Australia, New Zealand, Ireland, and the U.K. with a specific focus on integrated curriculum and multiage education. Dr. Stone's research interests include child-centered educational practices, inquiry-based learning, constructivism, and play.

Abstract

The authors of this paper discuss the use of Virtual Reality (VR) as a tool for building meaningful connections in science education across different grade levels. The authors elaborate on their experiences with using VR in teacher training programs, in practicum and student teaching experiences, and in providing a professional development workshop on how to use VR in science classrooms. With adequate preparation and training, teacher candidates can become leaders in their schools with regard for building more interactive STEAM-based programs that utilize cutting-edge technologies like VR and AR (Augmented Reality). Furthermore, the benefits of using VR in the classroom are discussed. These include whole-child benefits such as opportunities for meaningful social interaction, student-led inquiry, intrinsically motivated exploration and investigation, meaningful integration with other subjects, and substantial student engagement. VR expeditions provide a high level of cognitive, social, and physical activity that

can supplement any form of instruction, and help students make lasting connections to the material.

The use of Virtual Reality (VR) as an instructional tool is increasing across the globe. Teachers are just beginning to tap the potential of this constantly evolving resource, as cameras, hardware, software, and programs are continually improving. VR is defined as a "near reality," computer-generated, three-dimensional environment (Virtual Reality Society, 2017). Often, it takes the form of a 360 degree picture that students can view through a headset with the practical effect of making people think they are really experiencing that view. Multiple companies have developed VR and AR (Augmented Reality) programs for educational use. Within this emerging market, the research, and subsequent training of teacher candidates has been scarce. Therefore, it is the purpose of this article to investigate and describe the use of VR in a teacher-training program, and the subsequent use of the technology in practicum classrooms, student teaching experiences, and even in a professional development workshop for a local school. Ultimately, the initial use of the technology has provided significant insight into its potential and multiple observed benefits are described. It is important to note that this paper describes the use and benefits of VR as it relates to science education, and STEAM integration. However, VR expeditions are not limited to science, as there are multiple connections with social studies and the arts.

Current Literature

The literature on the use of VR in the elementary classroom is still emerging, and the literature on its use in teacher training programs is scarce (Nussli & Oh, 2016; Guzzetti & Stockrocki, 2013). However, the potential for VR as an instructional tool is undeniable. Lisichenko (2016) states that the "adoption of VR has brought the promise of unique and effective methods of instruction" (p. 159). Furthermore, Hinrichs and Wankel (2011) suggest that virtual learning is transformational. Some studies have emphasized VR as an effective tool to build students' content understandings (Fernandez, 2017; Zantua, 2017). VR is immersive, and helps students build abstract understandings (Curcio, Dipace, & Norlund, 2016; Hwang & Hu, 2013). Much of the research that has been done is through small-scale case studies. However, the research so far is promising. For example, in a case study conducted at an elementary school in Florida in connection with the ANGARI Foundation (a non-profit marine and environmental organization), students were able to learn about corals and reef ecosystems through VR. Based on the study, students were observed to be highly engaged, posed meaningful questions, made relevant connections, and acquired a strong command of content knowledge through their VR investigations (ClassVR, 2018). Students then went on a field trip to the Florida Keys and were readily able to make coral identifications from their prior VR work.

Virtual Reality is a rapidly emerging technology, and is on the cusp of widespread use in the American education system. Wankel and Blessinger (2012) suggest that advancements in this technology as well as other interactive interfaces are "transforming the way we teach and learn and those advancements are refining our views of what it means to learn" (p. 3). The use of VR has the potential to be such a transformative experience for children that a number of companies and developers are working on integrating this technology into the classroom as a mainstay of

educational practice (Immersive VR Education, Unimersiv, Google Expeditions, Alchemy VR, Discovery VR, zSpace, Curiscope, WoofbertVr, ClassVR, etc.). Hinrichs and Wankel (2011) suggest that this development is helping students navigate the learning experience by "building the physical world inside the virtual world, and bringing the virtual world outside to the physical world" (p. xiii). In other words, this technology can seamlessly integrate with teaching practices and content in the elementary classroom.

Hansman (2016) reports that VR "boosts student engagement" (para. 3), and that students can build content understandings through "visiting" the Great Barrier Reef, as an example (para. 1). Teachers can connect the experience to learning objectives and standards. The recommendation is to build immersive environments in which students can build their understanding, develop inquiry and collaboration, and learn across the affective, behavioral, and cognitive domains (Wankel & Blessinger, 2012). The VR platform can also be an important resource to teach children about environmental issues and social justice as it can "expose people, from school-aged kids on up, to large-scale, global issues that are hard to grasp if they can't see them for themselves" (Hansman, 2016, para. 11).

From Theory: Teacher Training on VR in Science Methods Courses

Teacher candidates were introduced to VR in their science methods courses at the university, and had the opportunity to use the technology as an instructional tool in their practicum experiences. The training consisted of VR tours of several different places, including: the Taj Mahal, the International Space Station, and the Jordan River. During each tour, the levels of engagement, interest, and discovery became evident as the teachers in training were walking around the classroom with the VR goggles glued to their eyes, waiting for the next scene to be shown and asking to visit more places. Teacher candidates were first given the opportunity to experience VR through the eyes of students, and were then taught how to utilize the technology to take students on their own VR tours. This training consisted of the following: setting up a router and an internal network, connecting the student devices (phones) and the teacher device (tablet) to the router, downloading a VR expedition, and guiding the tour through the tablet. For the teacher candidates, this technology was inspiring and eye-opening. Many had never heard of VR or its use in the classroom. However, teacher candidates were intrigued and eager for opportunities to utilize this technology in a practicum setting. The first-hand experience that they received indicated how powerful these learning experiences could be.

To Practice: VR in Practicum and Student Teaching Experiences

Teacher candidates in science methods courses at the university were given the option of using VR as a tool to teach science content through their varied practicum experiences in K-8 classrooms. Students used the platform to teach content ranging from space to landfills (environmental education). All VR practicum activities were supervised, and the benefits of the instructional tool were immediately evident. It is important to note that the evidence gathered was only observational/anecdotal. However, the students were highly engaged with the content. Engagement was observed across cognitive, social, and physical realms. Students in K-8 classrooms became involved in interest-driven, student-directed inquiry, posing questions to

peers and to the teacher candidates leading the expeditions. Furthermore, students were highly social during VR activities, comparing observations with each other, and sharing VR headsets. Imaginary play was common, and students engaged socially in their play. They would make comments like, “Ahh, the shark is going to eat us, swim away!” This was in response to an ocean creatures VR expedition, as an example. Finally, students were moving around the classroom, “walking” through their digital, virtual environments. They would reach out and try to touch virtual objects in front of them. The cognitive, social, and physical engagement was evident across grade levels.

Teacher candidates became proficient with the technology, and mentioned they would feel comfortable using the technology in any setting going forward. Furthermore, most teacher candidates mentioned that they viewed VR as a necessary or helpful instructional tool. Mentor teachers across the local district where VR was used in practicum experiences mentioned how they would also like to have access to the technology, and how they would use it regularly as an instructional tool.

The following reflects the experiences of a female teacher candidate. Throughout the course of her student teaching, she led two VR tours with her first grade students. The first graders had expressed an interest in learning about the ocean and prior to the VR tour they had watched “Finding Nemo” in class. This interest sparked the first tour, which was “A Journey Along the Great Barrier Reef.” Among some of the pre-expedition questions and comments from the students were the following:

> “I have virtual reality at home, will it be like the cardboard ones?”
>
> “I’ve heard of virtual reality before!”
>
> “Will we be able to see sharks in the ocean?”
>
> “Will we see dolphins and turtles?”

The candidate prepared the students for VR use by telling them they need to use the goggles responsibly. She explained to the students that it is a privilege to use VR and that they should be treated with respect and care. The candidate practiced using goggles with the students by asking them to form circles with their hands and pretend that their hands were goggles. They practiced picking the goggles up with two hands and setting them down gently. They practiced taking turns, sharing with their table partners, and handing the goggles off to another student. The particular VR set that was utilized contained ten goggles, and the classroom had twenty-two students, so they were required to share. This meant that there were eight pairs of students sharing and two groups of three students sharing.

After initial preparations to use VR, the students' excitement level was encouraging to see. Their eyes lit up as they formed into groups and were given the goggles. The first grade students began their journey along the Great Barrier Reef, as the first scene appeared in their goggles with coral reefs and schools of fish, their excitement was evident through their apparent laughter and

jumping up and down. Exclamations such as: “woah,” “awesome,” and “this is so cool,” were heard throughout the classroom. The students began to walk around and attempt to touch objects as they were “swimming through the sea.” The next scene depicted Manta Rays, before telling the students the name of the animal shown, the teacher candidate allowed for the students to explore the scene and make predictions to one another about the animal. The teacher candidate did not have to prompt the students as it was a natural process for the students to make predictions, connections, and ask questions. After they had been given time to look around, make predictions of their own, and talk with their classmates, the teacher candidate answered their questions and told them that the animal they were viewing was a Manta Ray. The students repeatedly asked, “Are we going to see a shark?” Though they were very hopeful that they would see a shark, there were only dolphins, turtles, Potato Cod fish, and more Manta Rays. However, their interest in sharks represented an opportunity for future exploration and inquiry. After the expedition was over, one student asked the teacher candidate if she could, “Please do the next one on volcanoes?” Other students asked, “When will we get to use these again?” Their eager attitudes reflected the value of the learning experience that they were given.

Throughout the expedition, the students were fully engaged. There were no behavior issues and no students “off task.” The VR tour was truly centered on the whole-child. The first grade students were making predictions and speaking to one another about their explorations as well as the plants and animals that they were seeing. The discovery process was natural, exciting, and inspiring for them. They could not wait for the next scene to pop up and they excelled at sharing with their partners. Sharing is a fundamental skill that can be difficult for many children and even some adults, however, the first graders mastered this skill during the VR tour. They looked around and explored the current scene, and then allowed for their partner to do the same without being asked. Students even went home to tell their parents and siblings about their experiences, as the following day, the teacher candidate had siblings of students in her class coming up to her and asking, “When are we going to use the VR goggles in my class?” This experience allowed for students to be social with one another as they explored and learned about the Great Barrier Reef.

The VR experience also allowed for the students to inquire and discover. The students were excited to tell their friends in the class what they were seeing and to ask questions. Not only were students asking questions, but they were making connections, observing, and building meaningful understandings throughout their journey along the Great Barrier Reef.

This process and the observed benefits also occurred in the students' next tour. At the time, they were learning about penguins and Antarctica which catalyzed the expedition. Students were making predictions about what types of penguins and seals they were seeing. They were also trying to figure out whether people live in Antarctica or not. The tour included Port Lockroy, an outpost on Goudier Island in the Antarctic Peninsula, which is open to visitors during the summer. Due to the fact that the students saw boats, cruise ships, and a house, it was natural for them to inquire about people living in Antarctica. The tour also showed volcanic peaks, which catered to students' previous interest. One scene in the tour depicted Leopard Seals, and they were enthralled with the size of the animal. At the end of the day, students were still discussing

new things they learned from the VR expedition. A few students stated, "I never knew that they were called Leopard Seals, I thought they were called Lion Seals." Students also stated that they had never heard of Gentoo Penguins (the penguins featured in one VR scene) before, because they had only learned about Rockhopper Penguins. These tours activated their prior knowledge, and allowed them to make predictions, connections, and discoveries, while encouraging intrinsically motivated inquiry.

Along with fostering social and cognitive activity, VR expeditions also emphasize physical movement. The students were actively engaged, moving around the classroom, and walking through their virtual worlds. VR tours allow for the students to be fully engaged in a topic. During VR, students learn, discover, and inquire about what they are seeing. They discuss what they are seeing with their peers and ask questions. They also walk around and even attempt to touch the objects that they are seeing. Students were excited to be using the technology and they felt like "big kids" because they were trusted with it. At least temporarily, they mastered the art of sharing and were very responsible. VR allowed the students to truly feel like they were on the Great Barrier Reef and in Antarctica.

Professional Development

Following the second VR tour, the teacher candidate was approached by the principal of the school and asked if she would be willing to give a demonstration on VR. The teacher candidate gave this demonstration to every teacher at the school during a staff meeting. She took them on the same tour to the Great Barrier Reef as the first grade students. The professional development workshop consisted of a brief demonstration on how to set up the VR expeditions. Then, the candidate took the teachers on the expedition, showing them first-hand how powerful the learning experience could be for all ages. They were almost as excited as the first graders, exclaiming how "their students would love to use this." The teacher candidate went around to each of the teachers, and showed them what it looked like from the perspective of the expedition leader, using the guide tablet. They were able to see how to lead an expedition as well as experience the expedition through the VR goggles. During the demonstration, teachers asked questions about what types of tours they could take with their students. The candidate explained that VR expeditions consist of multiple genres. Even the Spanish teacher asked if there was anything she would be able to utilize, and the candidate showed her direct possibilities using the VR platform. The teachers were eager to utilize VR in their classrooms and asked the teacher candidate if she would be willing to help them find expeditions and teach them, individually, how to set up and guide a tour. The teachers recognized the benefits of the VR during the demonstration and were willing and eager to use them in their classrooms.

Whole-Child Benefits of VR

As mentioned in the literature and in the anecdotal/observational use of VR in practicum experiences, student teaching, and in professional development, the use of VR has several child-centered benefits in the classroom that foster engagement, concept development, and understanding of material. These benefits are evident across whole-child realms such as cognitive/academic, social, and physical. Students engaged in VR activities were observed to

inquire, play, interact with the content and with others in meaningful ways, and make personal connections. Classes were highly social, with students interacting with multiple peers as they experienced new places or content through their expeditions. VR also promoted physical movement and students were observed to be moving constantly, walking around the room, or trying to touch objects in virtual space.

Conclusions

As VR and AR continue to develop, entire virtual worlds will open for students to explore. The technology will soon be in mainstream use, and will develop to the point that students can fully interact with their virtual world through the use of haptic gloves, motion sensors, and eye-tracking cameras. The Virtual Reality Society (2017) explains that "we can expect to see many more innovative uses for the technology in the future and perhaps a fundamental way in which we communicate and work" (para. 15). Imagine if children could manipulate a cell in virtual space, or pull apart geologic layers. The potential for use in schools is endless. As the educational landscape shifts towards a more technologically-integrated classroom, teachers need to be prepared to use technologies like VR. So far, the benefits have been evident in pioneering classrooms, including whole-child benefits across cognitive, social, and physical realms. If teacher-training programs can utilize this technology in methods courses and prepare students for using the technology in their future classrooms, then teacher candidates can be at the forefront of a technological revolution in schools.

References

ClassVR. (2018). Geography & science VR case study: Ocean: Coral reefs. Retrieved from http://www.classvr.com/geography-science-generation-ocean-coral-reefs-student-age-11/

Curcio, I. D. D., Dipace, A., & Norlund, A. (2016). Virtual realities and education. *Research on Education and Media*, *8*(2), 60-68.

Fernandez, M. (2017). Augmented-virtual reality: How to improve education systems. *Higher Learning Research Communications*, *7*(1).

Guzzetti, B. J., & Stockrocki, M. (2013). Teaching and learning in a virtual world. *E-Learning and Digital Media, 10*(3), 242-259.

Hansman, H. (2016). How can schools use virtual reality? *Smithsonian.com*. Retrieved from: https://www.smithsonianmag.com/innovation/how-can-schools-use-virtual-reality-180957974/

Hinrichs, R., & Wankel, C. (Eds.). (2011). *Transforming virtual world learning: Cutting-Edge Technologies in Education* (Vol. 4). Bingley, UK: Emerald.

Hwang, W. Y., & Hu, S. S. (2013). Analysis of peer learning behaviors using multiple representations in virtual reality and their impacts on geometry problem solving. *Computers & Education*, *62*, 308– 319.

Lisichenko, R. (2016). Issues surrounding the use of virtual reality in geographic education. *The Geography Teacher*, *12*(4), 159-166.

Nussli, N.C., & Oh, K. (2016). A systematic, inquiry-based 7-step virtual worlds teacher training. *E-Learning and Digital Media*, *12*, 502-529.

Virtual Reality Society. (2017). What is virtual reality? Retrieved from https://www.vrs.org.uk/virtual-reality/what-is-virtual-reality.html

Wankel, C., & Blessinger, P. (2012). *Increasing student engagement and retention using immersive interfaces: Virtual worlds, gaming, and simulation: Cutting-Edge Technologies in Higher Education* (Vol. 6c), Bingley, UK: Emerald.

Zantua, L.S. (2017). Utilization of virtual reality content in grade 6 social studies using affordable virtual reality technology. *Asia Pacific Journal of Multidisciplinary Research*, *5*(2), 1-10.