Virtual Field Trips and Impact on Learning

Anila Das
Learning Technologies
University of North Texas
United States
aniladas@my.unt.edu

Abstract: The rise of online technologies has led to students' learning activities and experiences no longer being limited by conditions such as administrative approval, rising cost, circumstances, or location. Students can use virtual field trips to interact with and learn authentically about people, places, artifacts, discover places of interest relevant to their topic of study, and customize education to their specific learning needs. Furthermore, learners frequently discover tools and resources valuable in the classroom and relate to the real world. Virtual field trips provide a national and global perspective to the content being studied as well as a real-world perspective to issues presented in course textbooks. This paper reviews the literature around the integration of virtual field trips in the K-12 classroom to improve student engagement and retention of material.

Introduction

Captivating the 21st-century learner is a challenge, one that can be approached with the integration of various technologies to grasp the learner's interest. Virtual field trips (VFT) are one such technology that has been integrated into the classroom. It is now more possible than ever before in today's technologically advanced world to transport kids to places they could never have imagined. "Virtual Field Guides have many benefits to students, such as being more inclusive, building student skills and confidence in a controlled environment pre-field trip and can increase engagement in the topic studied" (Cliffe, 2017, p. 1). The inclusion of virtual field trips into the K-12 classroom would improve student engagement and information retention.

Schools grappled with the transition to online learning during the COVID-19 pandemic, forcing educational institutions to be more creative than ever to keep their students engaged and retain the material. As educational institutions were forced to close due to the COVID-19 outbreak, field trips also became non-existent. With all main avenues closed, teachers turned to virtual learning and virtual field trips to provide learners with the same, if not better, experience of visiting various locations while also offering a multitude of possibilities for teachers without limiting them to local locations. Virtual field trips allow teachers to take students throughout the world in both space and time.

A field trip is an educational journey that students go to a location in order to learn and experiment with real-world principles, or simply to see what they have learned about in class come to life. Within a virtual field trip, students can use prior knowledge to build connections and compare concepts and theories to real-world situations. Students are urged to think critically and apply what they've learned in class to real-life scenarios. Virtual field trips bring to the classroom what once was thought to be impossible. Virtual field trips offer teachers and students an enriched educational experience like no other. First, virtual field trips afford students real-world experience. Allowing students to be fully immersed in the given virtual field trip they may not be able to experience otherwise. Therefore, by stimulating the brain to better transfer knowledge to the real world, the "virtual experiences can be psychologically impactful" (Markowitz et al., 2018, p. 1). Second, teachers have the freedom to choose any location that meets the needs of the lesson. No location is too far away or out of reach, adding a whole new dimension to the classroom.

Teachers historically planned and prepared for weeks in advance in order to get all of the required clearances from parents and administration. Even after all of the administrative work was completed, the actual day's planning, which included lunches, bus reservations, travel time, planning for an unforeseen emergency, preparing students and parents, asking for volunteers, working with the schedule of the field trip venue, and last but not least the cost, was a significant undertaking. Virtual field trips eliminate the need for all of that, and many are free. Meaning teachers are

no longer constrained by the time or financial constraints that often obstruct the experiences we wish to provide our students. Third, teachers can encourage exploration through this new modality and disseminate knowledge in ways never imagined before. Furthermore, the knowledge gap between learning and experiencing is decreased with the virtual field trip experience. "VFGs (Virtual Field Guides) not only include all students but they also allow them to develop their skills and enhance their confidence in implementing such skills, in a real-world environment" (Cliffe, 2017, p. 5).

Support Claims and Evidence

Students have experienced learning in many various facets, including portfolio systems, video creating platforms, learning management systems, gaming apps, blogs, to name a few. Of all of the technologies incorporated into the classroom, nothing equates to implementing virtual reality. "Interactive multimedia in particular provides a powerful tool for both teachers and learners in the design of environments which enables student learning" (Semple, 2000, p. 21). Educational theories maintain that knowledge is something that is building actively through real-world interactive experiences, not something that is passively absorbed. "Virtual field trip shows the value for carefully targeted learning objectives of in-curriculum material, especially when the real environment is not available" (Harrington, 2011, p. 185).

> The 3rd-grade students bounced up and down with excitement as they looked over the shoulders of ocean explorers using sonar technology to map the deep sea nearly 20,000 feet below the water's surface near Indonesia. The students were on a virtual field trip called "Voyages of Discovery: NOAA's Okeanos Explorer" on the website of the Exploratorium museum. (Cox, 2014, para. 1)

Virtual field trips bring authenticity back to the learner allowing the learner to engage in the environment thoroughly. Newmann and Wehlage (1993) argued "that innovations should aim toward a vision of authentic student achievement, and we are examining the extent to which instruction in restructured schools is directed toward authentic forms of student achievement" (p. 8). Further explaining "(1) students construct meaning and produce knowledge, (2) students use disciplined inquiry to construct meaning, and (3) students aim their work toward production of discourse, products, and performances that have value or meaning beyond success in school" (Newmann & Wehlage, 1993, p. 8).

Research of various augmented technologies helps us understand "the potential advantage of immersive interfaces for situated learning is that their simulation of real world problems and contexts means that students must attain only near-transfer to achieve preparation for future learning" (Dede, 2009, p.67). That "immersion may enhance transfer through simulation of the real world" (Dedse, 2009, p. 67).

Raines (2014) described virtual field trips as a source that would "allow learners to engage with and to learn about authentic artifacts and to explore places important to their discipline of study and consistent with their individual learning needs" (para. 1). "Student response to the virtual field trip activity has been overwhelmingly positive." Raines (2014) further talks about students' responses after being on a virtual field trip and states that "student response to the virtual field trip activity has been overwhelmingly positive" (para. 4). In the study, she states:

> In the posting sharing experiences and learning during the virtual field trip, it is evident that many students explored their destination and accessed documents or viewed items relevant to their nursing practice settings. In each group, a couple of students have reached out to ask questions or seek additional information from staff at the site being visited. (Raines, n.d., para. 4)

This example was only going to show that the "additional activity that was initiated by the student is evidence of their engagement in the activity and the effectiveness of the virtual field trip in encouraging them to seek knowledge to fulfill their learning needs" (Raines, n.d., para. 4).

In a study conducted by Han (2020), students reported: "feelings of engagement, being in the virtual space, and realness as advantages of using immersive virtual field trips (VFTs)" (Han, 2021, p. 188). Han (2021) further went on to show student responses in their reflection papers, and these responses consisted of students stating, "It is so real," and "I can watch all the details" (p. 188). Furthermore, "students also perceived the scenes within immersive VFTs as engaging, saying, "It is so fun, exciting, and marvelous," and "I can see 360-degree scenes surrounding me." (Han, 2021, p. 189).

Mead et al. (2019) conducted a study on virtual field trips in science learning with teachers reporting that "by the end of the experience, many of the students personally identified with the scientists in the iVFTs (interactive virtual field trips)" (p. 135). Teachers further went on to state that "their K–12 students would not have been able to

effectively learn from the VFT without a lab guiding their thinking and giving them background information" (Mead et al., 2019, p. 135). Mead et al.'s (2019) result indicated that scores of 359 students who completed a pre- and post-lesson survey "increased from 1% on the pre-lesson survey to 9% on the post-lesson" (Mead et al., 2019, p. 135).   The results from a second test administered by Mead et al. (2019) indicated scores from 245 students who completed a pre- and post-lesson survey "increased significantly from pre- to post-lesson (Mpre = 3.94, SDpre = 1.29; Mpost = 4.65, SDpost 1.39; t(244) = 6.97, p < .001)" (Mead et al., 2019, p. 136). Overall, the study by Mead et al. (2019) exhibited "students who engaged with the VFTs revealed an increase in their understanding" (p. 136), indicating the significance of virtual field trips and what they offer to the learner through the experience and knowledge acquired.

Virtual field trips create a unique interactive experience. Students are able to collaborate and navigate in places otherwise impossible. Virtual field trips also entice students to visit the place of the field trip one day possibly. "Students who were able to navigate the virtual field trip in teams were more likely than their peers who had the system demonstrated by a teacher to want to visit the national park" (Tutwiler et al., 2013, p. 351). Dede (2009) noted that virtual environments have the aptitude to be both engaging and immersive, all rolled into the same experience. According to Elmqaddem (2019):

> The value of adopting virtual reality in education and learning is related in part to the fact that this technology can improve and facilitate learning, increase memory capacity and make better decisions while working in entertaining and stimulating conditions. In fact, when we read textual content (on a printed document, for example), our brain uses a process of interpretation of everything we read, which increases our cognitive efforts. (p. 237)

Places that were once difficult to spark interest and motivate, now with the use of "these applications show that VLE (virtual learning environment) can be means of enhancing, motivating and stimulating learners' understanding of certain events, especially those for which the traditional notion of instructional learning have proven inappropriate or difficult" (Pan et al., 2006, p. 20). Furthermore, Elmqaddem (2019) state:

> The learner can, for example, explore the moon or the ocean floor or the state of a place as it has been in the past. This allows a better understanding of things and phenomena with less cognitive effort on the part of the learner, and less cost for the institute that deals with learning. The learner feels more engaged, more motivated and more receptive, and ready to learn and communicate with others. (p. 237)

We can also see this in a study conducted on the effectiveness of immersive virtual reality "indicated that HMDs (head-mounted displays) are more effective than non-immersive learning approaches" (Wu et al., 2020, p. 2001). This study "contributes to VR research by revealing that HMD-based immersive learning has an overall better effect on learning performance than non-immersive learning approaches" (Wu et al., 2020, p. 2003).   Their findings showed that "HMDs have encouraging distinct effects on K-12 learners, improving both their knowledge and skill development" (Wu et al., 2020, p. 2003).

Borst et al. (2018) conducted a study that used two approaches to test student learning testing to see if there was a significant difference between the experiences:

> In one approach, networked student groups are guided by a live teacher captured as live-streamed depth camera imagery. The second approach is a standalone (non-networked) version allowing students to individually experience the field trip based on depth camera recordings of the same teacher. (p. 467)

Borst et al. (2018) reported: "11% and 13% average normalized test score gains in two high school studies (7% and 6% raw gain)" (p. 468). Student engagement in this study also showed an increase, reporting "high motivation and focus" (Borst et al., 2018, p. 472).   Students were asked to conduct a self-report, and the results indicated "students are highly engaged" (Borst et al., 2018, p. 472). Engaging students so they are able to better retain information and grasping their attention is key to their learning.

A study conducted by Kamarainen et al. (2013) on integrating augmented reality and probe ware with environmental education field trips showed "gains in student affective measures and content understanding following the intervention" (Kamarainen et al., 2013, p. 545).   The study also stated that teachers stated "that the combined technologies promoted student interaction with the pond and with classmates in a format that was student-centered rather than teacher-directed; teachers also reported that students demonstrated a deeper understanding of the principles of water quality measurement than was typical on prior field trips without these technologies and that students had expanded opportunities to engage in activities that resemble scientific practice" (Kamarainen et al., 2013, p. 545).   The results of this student suggested "that there are multiple benefits to using this suite of technologies for teaching and learning" (Kamarainen et al., 2013, p. 555).

Results from studies showing "virtual reality-based learning has been proven to increase learners' level of attention by 100% and improve test results by 30%" (Elmqaddem, 2019, p. 237).   Rahman (2009) surveyed students on their opinions if their knowledge base has increased with the incorporation of field trips. As seen in
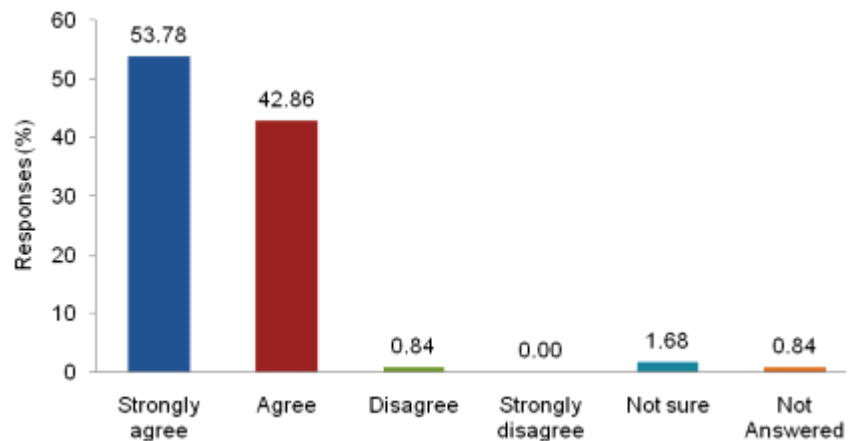
Figure 1, 53.78% strongly agreed.

Figure 1: Student responses to the question: Field trips have helped to increase my knowledge base.

Conclusions

Field trips are an integral part of the learning experience. They bring what is being taught in the classroom to life and give it a whole new meaning. Learners are able to see various aspects, understand the concepts in a whole new way, never thought of before. Due to the current climate and advancement in virtual learning, virtual field trips offer teachers and students the experience of a field trip from the comfort of the classroom and home.

Virtual field trips create a multimedia learning experience for 21st-century students. Virtual field trips encourage active, self-paced, and personalized learning. As a result, students are able to make real-world connections. Teachers are also able to modify content to students' individual needs. Current research supports incorporating virtual field trips into the classroom, optimizing the learner experiences to understand better what is being taught and transfer it to the real world.

References

Borst, C. W., Lipari, N. G., & Woodworth, J. W. (2018). Teacher-Guided Educational VR: Assessment of Live and Prerecorded Teachers Guiding Virtual Field Trips. *25th IEEE Conference on Virtual Reality and 3D User Interfaces, VR 2018 - Proceedings*, 467–474. https://doi.org/10.1109/VR.2018.8448286

Cliffe, A. D. (2017). A review of the benefits and drawbacks to virtual field guides in today's Geoscience higher education environment. In *International Journal of Educational Technology in Higher Education* (Vol. 14, Issue 1, pp. 1–14). Springer Netherlands. https://doi.org/10.1186/s41239-017-0066-x

Cox, C. (2014). *Virtual Field Trips | Reading Rockets*. https://www.readingrockets.org/article/virtual-field-trips
Dede, C. (2009). Immersive interfaces for engagement and learning. *Science*, *323*(5910), 66–69. https://doi.org/10.1126/science.1167311

Elmqaddem, N. (2019). Augmented Reality and Virtual Reality in Education. Myth or Reality? *International Journal of Emerging Technologies in Learning (IJET)*, *14*(03), 234–242. https://doi.org/10.3991/ijet.v14i03.9289
Han, I. (2021). Immersive virtual field trips and elementary students' perceptions. *British Journal of Educational Technology*, *52*(1), 179–195. https://doi.org/10.1111/bjet.12946

Harrington, M. C. R. (2011). Empirical evidence of priming, transfer, reinforcement, and learning in the real and

virtual trillium trails. *IEEE Transactions on Learning Technologies*, *4*(2), 175–186. https://doi.org/10.1109/TLT.2010.20

Kamarainen, A. M., Metcalf, S., Grotzer, T., Browne, A., Mazzuca, D., Tutwiler, M. S., & Dede, C. (2013). EcoMOBILE: Integrating augmented reality and probeware with environmental education field trips. *Computers and Education*, *68*, 545–556. https://doi.org/10.1016/j.compedu.2013.02.018

Markowitz, D. M., Laha, R., Perone, B. P., Pea, R. D., & Bailenson, J. N. (2018). Immersive Virtual Reality field trips facilitate learning about climate change. *Frontiers in Psychology*, *9*(NOV), 2364. https://doi.org/10.3389/fpsyg.2018.02364

Mead, C., Buxner, S., Bruce, G., Taylor, W., Semken, S., & Anbar, A. D. (2019). Immersive, interactive virtual field trips promote science learning. *Journal of Geoscience Education*, *67*(2), 131–142. https://doi.org/10.1080/10899995.2019.1565285

Newmann, F. M., & Wehlage, G. G. (1993). Five Standards of Authentic Instruction - Educational Leadership. *Educational Leadershi*, *50*(7), 8–12. http://www.ascd.org/publications/educational-leadership/apr93/vol50/num07/Five-Standards-of-Authentic-Instruction.aspx

Pan, Z., Cheok, A. D., Yang, H., Zhu, J., & Shi, J. (2006). Virtual reality and mixed reality for virtual learning environments. *Computers and Graphics (Pergamon)*, *30*(1), 20–28. https://doi.org/10.1016/j.cag.2005.10.004
Raines, D. A. (n.d.). *Virtual Field Trips: An Online Learning Experience | Online Learning Consortium, Inc*. Retrieved April 16, 2021, from https://secure.onlinelearningconsortium.org/effective_practices/virtual-field-trips-online-learning-experience

Semple, A. (2000). Learning theories and their influence on the development and use of educational technologies. *Australian Science Teachers Journal*, *46*(3), 21–28.

Tutwiler, M. S., Lin, M. C., & Chang, C. Y. (2013). Determining Virtual Environment "Fit": The Relationship Between Navigation Style in a Virtual Field Trip, Student Self-Reported Desire to Visit the Field Trip Site in the Real World, and the Purposes of Science Education. *Journal of Science Education and Technology*, *22*(3), 351–361. https://doi.org/10.1007/s10956-012-9398-4

Wu, B., Yu, X., & Gu, X. (2020). Effectiveness of immersive virtual reality using head-mounted displays on learning performance: A meta-analysis. *British Journal of Educational Technology*, *51*(6), 1991–2005. https://doi.org/10.1111/bjet.13023