8th International Conference of the Immersive Learning Research Network
Practitioner Proceedings iLRN2022

DOI: https://doi.org/10.56198/A6PFY4TUG

Marine XR: The Impact of an Immersive Learning AR App on Student Motivation and Engagement with the Biology, Ecology and Conservation of Basking Sharks

Paul Mensink, Rajan Brar, Aleena Sajid, and Isha Decoito

Western University, London, Canada
paul.mensink@uwo.ca

Abstract. There is growing evidence that technology-enhanced teaching can foster engagement in scientific literacy for all students. For example, immersive educational technologies, such as augmented reality (AR), focus on engaging students by providing interactive experiences that intrinsically motivate them to explore both virtual and real environments for science learning. We developed a "tap-to-place" highly immersive augmented reality application, Marine XR, that uses the principles of gamification, simulation, role-playing and immersion to engage students in scientific concepts. Marine XR focuses on one of the world's ocean giants, the basking shark, to teach students fundamental scientific skills, while simultaneously emphasizing the importance of ocean conservation. We conducted a controlled experimental study comparing the impact of Marine XR to a more traditional web-based learning module in a large, first-year environmental sciences class under remote learning conditions (~200 students). Specifically, we measured how motivation, engagement, engrossment, and cognitive load differed between the two groups within the context of their attitudes towards science (as assessed by the Modified Attitudes Towards Science instrument). In addition, we investigated whether Marine XR could increase motivation to participate in a subsequent learning experience. The results of the study and its consequences will be discussed.

Keywords: Augmented Reality, Serious Games, Marine Biology, Gamification, Simulation.

1 Introduction

Preparing our students to help solve the world's most complex challenges necessitates an interdisciplinary approach to teaching and learning that fosters the development of STEM competencies (science, technology, engineering, and mathematics). Hands-on and experiential learning has always been a cornerstone of science education and as post-secondary institutions transition to hybrid campuses, it is critical that we create engaging

digital experiences that maintain and expand on our capability to develop scientific literacy and knowledge in our students. An important consideration in creating these experiences is minimizing the 'engagement gap' between science and non-science students, which threatens to reinforce disciplinary siloes and jeopardizes equitable learning and enhanced scientific literacy within the general public. There is growing evidence that immersive educational technologies, such as augmented reality (AR), are excellent at engaging students from diverse disciplinary backgrounds by providing interactive experiences that intrinsically motivate them to explore both virtual and real environments for science learning.

The use of augmented reality (AR) in education, defined as "technology which overlays virtual objects (augmented components) in the real world", has rapidly increased over the last decade [1]. One area where AR tools have been used frequently is in science education [2]. At present, there is a literature gap surrounding the relationship between immersion in augmented reality and learning. Further exploring this field can make a great contribution to science education as immersion is theorized to support insights of complex scientific phenomena, situated learning, and transferring skills learned to the real world [3]. Georgiou and Kyza further explored these relationships by focusing on motivation as an individual difference contributing to the discrepancies in results among studies [4]. Both domain-specific motivation and cognitive motivation were predictors of immersion on different levels [4]. Domain-specific being able to effectively predict student engagement, an entry-level of immersion. On the other hand, the students' cognitive motivation effectively predicted higher levels of immersion including engrossment and total immersion. Overall, results from the study supported the positive relationship between immersion and conceptual learning [4].

1.1 Motivation and Engagement

Student academic achievement is often highly influenced by their motivation levels as well as engagement, making these factors a great foundation for educational studies. According to content and bibliometric mapping analysis, both high engagement and increased motivation in science concepts were observed when using augmented reality applications [2]. Many science and biology discipline-focused studies that examined these factors found that incorporation of AR technology had a positive motivational impact on the students [2]. A study by Ferrer-Torregrosa et al. (2014) explored AR in anatomical education and it was found to be beneficial for student motivation, as it allows for independent work and spatial interpretation [5]. Immersion, on the other hand, involves both cognitive and emotional involvement [4]. The higher levels of immersion, engrossment and total immersion were predicted by the students' cognitive motivation. The greater the degree of cognitive motivation the student has, the better they will focus on the activity and by extension be immersed into it. In general, AR has been suggested to increase science interest [6] and

therefore, for the delivery of science concepts, using AR could help increase both the students' motivation and engagement and by extension, their overall academic achievement.

1.2 Research Study

In this research project, we developed an AR experience on ocean ecology and one of Canada's ocean giants, the basking shark, to teach students fundamental scientific skills, while simultaneously emphasizing the importance of ocean conservation and environmental sustainability (Fig. 1). We conducted a controlled experimental study comparing the impact of Marine XR to a more traditional web-based learning module in a large, first-year environmental sciences class under remote learning conditions (~200 students). Specifically, we measured how motivation, engagement, engrossment, and cognitive load differed between the two groups within the context of their attitudes towards science (as assessed by the Modified Attitudes Towards Science instrument). In addition, we investigated whether Marine XR could increase motivation to participate in a subsequent learning experience.

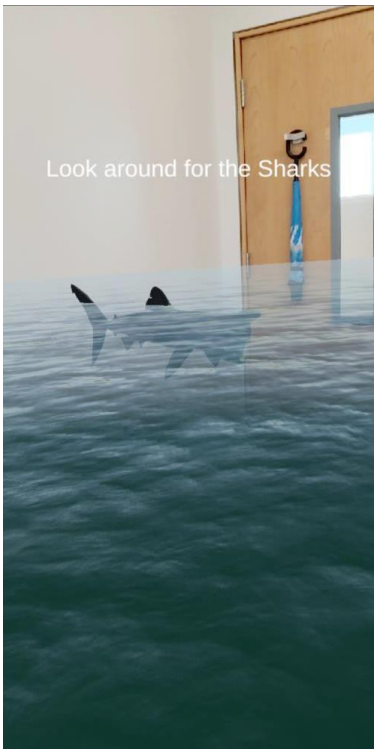

Fig. 1. A screenshot from the Marine XR application showing students looking for sharks in the ocean environment.

Acknowledgements

We gratefully acknowledge support from the Unity Charitable Fund, a fund of the Tides Foundation.

References

1. Akçayır, M. & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*. *20*, pp. 1–11.
2. Arici, F., Yildirim, P., Caliklar, Ş. & Yilmaz, R. M. (2019). Research trends in the use of augmented reality in science education: Content and bibliometric mapping analysis. *Computers & Education*. *142*, 103647.
3. Dede, C. (2009). "Immersive Interfaces for Engagement and Learning." *Science*. *323*, pp. 66–69
4. Georgiou, Y. & Kyza, E. A. (2018). Relations between student motivation, immersion and learning outcomes in location-based augmented reality settings. *Computers in Human Behavior*. *89*, pp. 173–181
5. Ferrer-Torregrosa, J., Torralba, J., Jimenez, M. A., García, S. & Barcia, J. M. (2015). "ARBOOK: Development and Assessment of a Tool Based on Augmented Reality for Anatomy." *J Sci Educ Technol*. *24*, pp. 119–124.
6. Bressler, D. M. & Bodzin, A. M. (2013). A mixed methods assessment of students' flow experiences during a mobile augmented reality science game: Flow experience with mobile AR. *Journal of Computer Assisted Learning*. *29*, pp. 505–517.