Designing and conducting research using immersive technologies in schools: Seven observations

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ABSTRACT

This paper documents seven key areas for consideration when designing and conducting research using immersive virtual, augmented and mixed reality technologies in school settings. We provide seven observations drawn from the literature, theory and research experience to offer initial methodological, ethical and practical advice on such research. These observations are designed to prompt a broader interdisciplinary conversation and knowledge-base on school-based research using immersive technologies, so that the educational benefits of the technologies can be fuller realised.

Keywords: Virtual reality, augmented reality, mixed reality, methodology, children, adolescents, K-12 education, learning, ethics, teachers, school.

Index Terms: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, augmented and virtual realities; K.4.1 [Computers and Society]: Public Policy Issues—Ethics; K.7.4 [The Computing Profession]: Professional Ethics—Codes of good practice

1 INTRODUCTION

There is significant global ‘buzz’ surrounding the release of head mounted displays (HMDs) devices such as the Oculus Rift™, HTC Vive™ and HoloLens™ and renewed interest in using these highly immersive virtual, augmented and mixed reality technologies for edutainment and learning. It has been estimated that that by 2025 the virtual and augmented reality market (including HMDs and software) will reach USD$80bn shipment units annually and it is conservatively estimated that in K-12 and higher education there will be 15 million users with USD$700m spend in annual shipment units [8]. While there is a relatively small but interesting literature on desktop virtual reality and K-12 learning [14, 15] studies on using HMDs in schools are currently very rare with most literature exploring the use of HMDs with children in clinical or experimental settings [1, 2, 16, 18].

Given the educational promise of immersive technologies, it is timely to reflect on some of the methodological, ethical and practical issues that can arise when conducting research using these technologies in schools. Selwyn [20] suggests that the field of educational technology has a misguided focus on the ‘state-of-the-art’ rather than the ‘state-of-the-actual’. He proposes that a more critical study of educational technology is required, one that addresses questions about what is actually taking place when technology meets the complexities of educational settings. Such questions include: ‘What is the use of technology in educational settings actually like?’ and ‘What are the consequences of what happens with technologies in educational settings?’ We have drawn on our experience in designing and conducting research using immersive virtual reality in an Australian school community to provide some initial observations that other researchers may find useful. These observations derived from the literature, theory and reflection are, like all critical thinking, designed to facilitate skilful and appropriate judgements and a questioning stance [6].

2 SEVEN OBSERVATIONS ON RESEARCH USING IMMERSIVE TECHNOLOGIES IN SCHOOLS

Observation 1 – Schools are natural settings not laboratory or clinical ones: While this observation appears to be self-evident, it is a crucial for researchers using immersive technologies to acknowledge that the relatively high degree of control they have over technological and human dynamics in their laboratories, offices or in clinical contexts, will probably not be replicated in a natural (institutional) setting such as a school. Schools comprise complex social and power arrangements, have distinct cultures, rituals and routines, and are populated by students representing a broad and complicated array of human development; schools can be surprisingly (and delightfully) unpredictable at times. Implementing a strict research protocol for clinical or experimental purposes may not always be possible or even desirable. Spending time in schools and especially classrooms to get acquainted with the distinct culture of the school and the views of teachers and students is crucial if rigorous and appropriate research is to be designed and conducted. Moreover, documenting the messy ‘state-of-the-actual’ when conducting research using immersive technologies is vital if the field is to produce doable and relevant research.

Observation 2 – Even if students are the same age and in the same class, they may be at different stages or windows of human development: Child development is vastly complex and involves physical, cognitive, affective, social and moral domains which interact. A considerable amount of literature from the field of human development indicates that children and young people will have very different reactions to highly immersive virtual, augmented and mixed reality experiences depending on the stage and domain of development and that individual difference should be accounted for. For example, between the ages of 3 to 12 years, most children gradually begin to discern the difference between reality and fantasy. A recent experiment found that when elementary school children were given an immersive VR experience through a HMD, after a week 50% believed the experience to be real [24], while another study found that many young elementary school children were prone to developing false memories of swimming with whales after having this type of immersive virtual reality experience [19]. It is vital for researchers using immersive technologies with children and young people to become knowledgeable about child development, its domains and stages, in order to design developmentally appropriate and ethical research – this is particularly crucial so that harms are prevented and teachers, students and parents/carers are fully informed as part of ethical consent and assent process [23].

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Observation 3 – Provide an empowering role for teachers and students in the research process: The interdisciplinary field of child studies suggests that researchers explicitly clarify their methodological and ethical position by answering the question - Is the research on, with or by children? [12]. Researchers need to ask themselves will children be treated as objects or subjects of research, or will they be considered as co-researchers or research agents in their own right? The same question needs to be applied to the role of teachers. Figure 1 adapted from Punch and Oancea [17] provides a tool for researchers to use when considering these questions. Rigorous research can also be respectful and empowering if designed correctly. This involves collaborating with students and teachers to develop innovative methodological alternatives to the experimental approach that is dominant in current immersive technologies research where people are considered the subjects (and sometimes objects) of research.

Observation 4 – Don’t underestimate the time or level of engagement needed, even for pilot studies: Designing methodologically innovative studies takes time. This is particularly true if a participatory or agile design framework is used. Students and teachers need lead time for skilling up in participatory processes. Resources developed for participatory design, modes of communication and the structure of workshops need to be developmentally, academically, linguistically and culturally appropriate [10, 13]. Participatory and agile approaches take time and timetabling the process and its relationship to an often ‘crowded’ curriculum needs upfront commitment from the school, students and parents/carers. Furthermore, even in ‘tech-savvy’ schools the coding and graphic design skills of teachers and students will vary considerably. Taking time to assess this will ensure the success of projects.

Observation 5 – Consider the foundational ‘message systems’ of education so that benefit to students, the school and teaching profession are maximised: There is a tendency in educational technology research to differentially engage with how the technology relates to the foundational ‘message systems’ [3] of education; these being, pedagogy, curriculum, assessment and learning. While there is a growing literature on virtual and augmented reality and learning [5, 14, 15], there is far less explicit scholarship on how technologies relate to pedagogical frameworks, curricula and syllabi, and formative and summative assessment practices in schools [4, 11, 21, 25]. Teachers, administrators and educational policy-makers want to know how immersive technologies integrate with curricula, assessment and pedagogy, as well as their utility in enhancing learning outcomes for a diverse range of students. It is incumbent upon researchers using new immersive technologies to increase their relevance to these foundational components of education.

Observation 6 – Not all schools are equal in terms of access to resources and opportunities: Inequalities in school education are well documented internationally [26]. Immersive technologies range in quality, price and degrees of interactivity and the potential for content creation. What schools can afford will fundamentally affect study design and implementation. Furthermore, school systems which have ‘Bring Your Own Device’ policies will have wide variation in the quality of hardware and software students have access to resulting in educational inequity [9]. There are often issues with system-wide firewalls which may prevent students and teachers accessing online resources particularly where this is at scale such as in state education systems. In this case, negotiating access to blocked content that can facilitate a project can be a long bureaucratic process. Low income school communities have as much right to innovate and experiment with immersive technologies as wealthier school communities; indeed, the educational and social pay-offs may be more substantial in poorer schools [22]. Understanding educational inequality and the potential benefits of the research is vital when choosing which schools to work with.

Observation 7 – Educate yourself on child protection and duty of care: Teachers undertake regular training on duty of care responsibilities and have child protection regulatory and legal frameworks. This ensures they enact professional conduct with the children and young people in their care. Using immersive technologies such as HMDs, controllers and haptic devices in research can involve assisting participants with fitting the devices. Researchers should take the lead from teachers regarding interactions with students to ensure professional conduct in schools. Moreover, researchers should undertake child protection training and other requirements such as working with children checks, if mandated by school systems or law. Finally, there are health and safety issues with any new technologies and for HMDs this includes adverse effect such as cybersickness [7] and overuse. Researchers have a duty of care to screen and monitor for potential harms. Engagement with immersive technologies should not result in the disruption of learning during or after the experience.

3 Conclusion

As research involving immersive technologies in school becomes more widespread, researchers will need to consider the methodological, ethical and practical concerns associated with inquiry conducted in complex and dynamic natural settings. This paper has canvassed seven key observations drawn from the literature, theory and research experience, in the hope of prompting a broader conversation about designing and conducting immersive technology research in educational sites. Our hope is that a sophisticated interdisciplinary knowledge base may grow from such a conversation so that the educational benefits of immersive technologies can be fuller realised.
REFERENCES