

# Ethical Conduct and Student Safety in Immersive Virtual Reality: Protocols and Resources from the VR School Research Project

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## ABSTRACT

Very little is known about the effects of immersive virtual reality on children and young people, yet it is incumbent upon researchers and educators to identify risk, mitigate harm and provide an ethical and safe environment for students under their care. The purpose of this paper is to describe the VR School Project, a study using immersive virtual reality in Australian high school classrooms, and to present and elaborate on the ethical and safety protocols and resources produced as a key component of the research. Specifically, the paper provides an exploration of the four key dimensions of ethical conduct and safety that emerged during the initial phase of the research. These were: screening students for cybersickness and other potential harms; student education for health and safety; the role of observation in maintaining a safe environment; and child protection protocols. The paper provides practical resources for researchers, teachers and students.

**Index Terms:** Human-centered computing—Human computer interaction (HCI)—Interaction paradigms—Virtual reality; Social and professional topics—User characteristics—Age—Children; Human-centered computing—Human computer interaction (HCI)—HCI design and evaluation methods—Field studies

## 1 INTRODUCTION

As virtual reality gaming and head-mounted displays (HMD) become more popular, increasing numbers of children and young people are being exposed to intensely immersive virtual experiences during their leisure time and their schooling [2]. However, very little is known about the impact that intensely immersive experiences have on children and young people (0-18 years). Beyond the standard health and safety advice offered by manufacturers of immersive virtual reality (IVR) hardware [3, 10, 13], there is limited evidence

regarding the safety issues for children and young people. Moreover, there are few ethical and safety protocols or resources available to guide students, teachers and researchers in classroom use of IVR technologies.

The purpose of this paper is to describe the VR School Project, a study using immersive virtual reality in Australian high school classrooms, and to present and elaborate on the ethical and safety protocols and resources produced as a key component of the research. The paper begins by briefly reviewing the literature on children and young people and highly immersive virtual reality with a focus on health and safety. We then provide a description of the VR School Project in order to contextualise the development of the ethical and safety protocols and resources. This is followed by an exploration of, and practical resources related to, four key dimensions of health and safety related to IVR and education that emerged in the initial phase of the research: screening students for cybersickness and other potential harms; student education for health and safety; the role of observation in maintaining a safe environment; and child protection protocols.

## 2 RELATED LITERATURE

Legally and ethically, teachers (and researchers) have a duty of care towards students in all educational settings [14]. This includes ensuring that they are kept safe when using new and emerging technologies and that the use of such technologies does not interfere with their learning. Highly IVR presents challenges for teachers and researchers using this technology in schools. While there is no accepted definition of ‘highly immersive’, it is reasonable to say that there are virtual reality experiences mediated through HMDs that can create very intense psychological and embodied feeling of presence or ‘being there’ [12]. While different VR technologies and applications produce different degrees of feeling immersed, and there is still much work to be done on understanding how levels of immersion effect different groups of people, the characteristics of IVR we are referring to in this paper involve high degrees of user autonomy through manipulation, interaction, navigation, and free play. Manufacturers of IVR have issued health and safety warnings that their HMDs are not suitable for children under 12-13 years based on physical development norms (of course there is wide physical variation of these norms especially during adolescence). Generally manufacturers recommend that young people should limit their time in HMDs and take frequent breaks under adult supervision. However, evidence-based advice on what constitutes a safe duration in IVR does not exist. Although Madary and Metzinger’s [7] recent code of ethical conduct for good scientific practice for using VR-technology provides very limited discussion of vulnerable groups such as children, it does provide a warning about the possible psychological

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risks of long term immersion.

The relatively recent consumer access to IVR means that there are no large scale and/or longitudinal studies of its effects on adults or children. Young people themselves are certainly concerned about potential the health impacts of IVR [15] and a recent marketing survey [2] highlighted that a relatively small minority of students had experienced IVR that was 'too intense' and had felt physical discomfort. One early experiment [1] comparing prefrontal brain arousal in adults and children (mean age 8.7 years) on a IVR roller coaster ride, found that children were much more susceptible to the arousing impact of audio/visual stimuli and that they appeared unable to critically evaluate and monitor the experience or inhibit a sense of presence. Baumgartner et al. [1] concluded that there should be more reluctance to 'expose children to emotional virtual reality stimuli as currently practiced'. In a more recent study reported by the press [8], 20 children aged 8-12 years who played a 20 minute game in IVR, there were two cases of disrupted stereo-acuity, the ability to detect differences in distances, and one case that showed a worsening of balance after finishing the VR game. However, no child experienced serious deterioration in eyesight.

Little is known about the prevalence or intensity of IVR-related cybersickness in children or young people. The vast majority of research on IVR and children and young people has been conducted with relatively small samples in controlled clinical and experimental settings, for example [5, 11]. Few report incidence of cybersickness which may be minimised by the controlled nature of the experiments. Introducing IVR into natural settings such as homes or schools, that are much busier and less predictable than experimental ones, raises questions about educating and mitigating cybersickness in children and young people. It is ethical to suggest that no child's learning in school should be disrupted by cybersickness and so due caution is warranted.

### 3 THE VR SCHOOL RESEARCH PROJECT

The VR School Research Project ([www.vrschoolresearch.com](http://www.vrschoolresearch.com)) is an exploratory study into using IVR, in this case the Oculus Rift, in high school classrooms. It is a co-research project with teachers at the two junior campuses of Callaghan College, Newcastle, Australia (the Callaghan junior campuses are for students in Years 7-10 or aged 12-16). Callaghan College is a low income school community that has a pedagogy focus with a desire to understand and utilise technology to maximise student outcomes. The VR School Project is guided by the following research question:

1. What happens when students and teachers use IVR for learning?
2. How can the curriculum be tailored to use the affordances of IVR for deep learning and how can we assess if it enhances learning, including cooperative learning?
3. What are the opportunities and challenges of using the latest IVR technology in low-income school communities?
4. How do students and teachers experience IVR in their classrooms?
5. Given the developmental stages of learners, how can we use this type of technology safely and ethically in schools?

The study is being conducted in two phases. The first phase (Nov/Dec 2017) involves: establishing and piloting health and safety tools, protocols and resources (the focus this paper); the development and trialling of curriculum material that leverages the affordances of IVR; and evaluating the practical implications of using IVR in actual school classrooms from the perspective of students and teachers. The IVR used was the Windows 10 version of Minecraft

(<https://minecraft.net/>) using Oculus Rift (CV1) with Oculus Touch controllers. The second phase (April/May/June 2018) of the project extends exploration into these three areas but will also focus on measuring learning impact.

The VR School Project uses mixed method research with data collected through: observation; audio and video recording of students in IVR and screen capture; pre and post self-report student engagement surveys; student work samples and grades; semi-structured interviews with students; and teacher and researcher reflection. During phase 1 of the study, 54 students, aged between 13-15 years, participated with a gender profile of 22 female and 32 male. Students were from two science classes and one ICT elective class (which skewed the gender profile as there was only one girl in this class).

### 4 APPROACHES TO CHILD HEALTH AND SAFETY IN THE VR SCHOOL RESEARCH PROJECT

Southgate, Smith and Scevak [14] argue for the importance of asking ethical questions in immersive technology research with children, and of freely sharing tested ethical and safety resources in this area with researchers and teachers. Developing ethical and safety resources is part of seeking and maintaining procedural (institutional) ethics approval and is a key component of ethics-in-practice (i.e. as response to issues that emerge during the research process). Most of the resources that are presented in this section of the paper were developed as part of procedural ethics; that is they were created to mitigate potential risk and harm identified during the institutional ethics application stage (these resources being the cybersickness screening tool, the teacher safety talk script and the 'Be VR Aware' classroom poster). The child protection protocol (known as the DATA procedure, see Fig. 4) and the need for ongoing researcher observation to ensure child safety evolved as a part of an ethics-in-practice activity (see Section 4.4).

#### 4.1 Screening for cybersickness and other potential harm

The project team were committed to minimizing incidents of cybersickness as we believe that it is not the purpose of research to cause discomfort or distress, nor to disrupt student learning. Students were given an information pack to take home to their parents/carers. The pack comprised a participant information statement, a parent consent/child assent form and a health and safety survey. The survey is essentially a one page, plain English screening tool that consisted of questions on: demographics; previous experience of VR using HMD and if this had caused sickness; previous experience of motion sickness adapted from the Motion Sickness Susceptibility Questionnaire Short-form (MSSQ-Short) [6]; experience or diagnosis of serious conditions (e.g. heart condition, epileptic seizure) specified as potentially harmful in the Oculus Rift Health and Safety guidelines [10]; an open ended question for parent/carers and their child to provide other information. The survey and the accompanying information statement were also educative tools for parents, carers and students so that they could be properly informed about the potential health and safety risks.

All students in the project had the option of using desktop VR if they were considered at risk of cybersickness. The research team agreed on a cautious approach to screening as there is scant evidence on IVR and young people's safety. Therefore, if the parent/carer answered that their child 'sometimes or frequently felt sick' during a previous IVR experience and/or had this high frequency of motion sickness based on the adapted MSSQ-Short, or if they ticked any of the serious health condition listed, they would be exempted from using the Oculus Rift (parents/carers and their child would be informed of this by the school). The screening tool is available online<sup>1</sup>.

<sup>1</sup><https://vrschoolresearch.files.wordpress.com/2017/07/vr-school-project-health-and-safety-screening-survey-docx.pdf>

## VR School Teacher Safety Talk Script

We are going to talk about using the virtual reality headset with the Oculus Rift safely in the classroom. Here are some things you need to know:

- You would have filled out a health and safety survey with your guardian. This survey helped us to make an assessment about whether you might have a bad reaction when using the VR headset version of Minecraft. If you and your parents have been told that you might have a bad reaction then its best to just use the desktop computer version of Minecraft instead of the headset version.
- For hygiene reasons please put a hair cover on before putting the VR headset on. Keep the hair cover and reuse it next time you go in headset.
- There are parts on the Oculus headset that allow you to adjust for your eye width (teacher demonstrates this). You need to adjust these when you put the headset on so that what you are seeing is clear.
- Some people get cyber-sickness when using VR headsets. This is a type of motion sickness, just like when people get sick on buses or planes. If you begin to feel sick or queasy or your eyes hurt, then take the headset off and sit down. Ask another student to come and get me, so that we make sure you are alright.
- It is important that you only spend up to 15 minutes in the headset.
- The Oculus is set up so that you can stand up, move around and use the Oculus controllers. You must always have someone observing when you are in this mode. They will make sure that you do not bump into anything or damage equipment.
- The headset blocks out all of your surroundings. When you are in the headset you can only see the world of Minecraft and hear its sound effects. There is a virtual blue cage called the guardian system that will come up if you go out of the safe area. Look out for this and step back in the safe area.
- If, when using the controllers (teacher demonstrates this), your hand or arm starts to tingle or hurt, take a break.
- If you ever feel the VR experience is too intense or unpleasant then take the headset off and give yourself a break for the lesson. If you don't want to use the headset for any reason then use the desktop computer version of Minecraft instead.
- If you ever need a reminder about these safety tips, check out the Be VR Aware poster which has been put up near the Oculus Rifts.
- Are there any comments or questions?

Figure 1: VR School Safety Talk Script.

Of the 54 students who participated in phase 1 of the study, only one was self-screened out of the study.

### 4.2 Educating students on health and safety in IVR

Although educating students on IVR is an ongoing endeavour, two specific resources were developed during phase 1 of the research. The first is the Teacher Safety Talk Script, used by the teacher before students use the Oculus Rift for the first time (see Fig. 1).

The second resource is a classroom poster, in a standard format (see Fig. 3) and in an accessible format (all resources can be found on the project website). The 'Be VR Aware' poster provides both visual (emoji representations) and brief, plain English text on the six key safety messages that students needed to keep in mind when going into IVR. The use of visual and textual representation for each safety message draws on dual coding theory [4] which suggests that images aid in remembering and learning.

### 4.3 Observation for safety

IVR systems (Oculus Rift or HTC Vive) are designed so that the user is 'protected' or 'contained' by a virtual Guardian or Chaperone system. These systems consist of a cage which pops up when the user strays beyond the safe, object free area that the user sets up when configuring the equipment: it is an engineered solution to break the sense of immersive presence by providing a visual safety cue for the user. In phase 1 of the VR School Project the equipment (3 x Oculus Rifts for each campus) were set up by teachers in a VR room connected to but separate from the classroom (on one campus the VR room comprised a storeroom approximately 4.5m x 3m (Fig. 2), and, on the other campus, the VR room was a former preparation area off a science lab at approximately 6m x 5m).

Even with the Guardian system in place, constant observation of students in VR was required by either the researcher or a student designated as a 'spotter' - a term used for someone with the role of spotting potential risk and keeping students safe. The teacher was unable to provide constant supervision as their role is necessarily



Figure 2: The VR space at one campus.

to educate the rest of the class. Even in the larger VR room some students were prone to moving around more than others and ignoring the Guardian system. Reasons for ignoring the Guardian system require investigation: it may have been because the students did not do the entire set up procedure and training and were less aware of the Guardian system or; as observed by the researcher, some students become so immersed in the very interactive VR Minecraft experience that they do not 'see' the Guardian system or at least not in time to prevent potential harm. The need for constant supervision, even if the equipment was set up within the main space of a classroom (which is not practical in most schools because they are configured by an architecture of industrial age design), raises serious questions about the current practicality of integrating and scaling up IVR into

classrooms. While students undertaking a 'spotter' role are learning about safety and technology, respect and care for other students, they are also removed from the formal lesson context and this has to be taken into account in regard to impact on student learning. From an ethical, methodological and practical perspective, researchers within this context are necessarily participants as well as scientists.

#### 4.4 Child protection

Child protection is a serious issue in today's society. There are laws, policies and procedures to ensure the welfare of children and young people. Schools are required to provide a protective and caring environment. In Australia, Working with Children Checks are required by law every five years for employees and prior to appointment for potential employees and volunteers in child-related work. This Check involves a national criminal history check and a review of findings of workplace misconduct [9]. All researchers were required to undergo a working with children check prior to commencing the project. School systems have clear guidelines for teachers on what constitutes acceptable practice and respectful behaviour towards students.

During phase 1 of the project it became apparent that the majority of students were novices to IVR: Approximately 35% had not tried HMD mediated VR; 46% had tried it once; 11% had tried it 2-3 times and 8% had tried it 4 times or more. Although no students had tried the Oculus Rift, a handful of students did comment to the researcher that they had tried the HTC Vive at a local leisure centre and one student owned a HTC Vive. Almost all students, including those that had tried the HTC Vive, needed assistance with putting on and taking off equipment and in being redirected back to safe positions in the VR room as Guardian systems were often ignored. After a few sessions using the Oculus Rift around half of the students became adept at fitting and taking off their own equipment, however there remained students who still requested assistance with this. When using a HMD a person is either in darkness while they are waiting for an application to load or in the virtual world; basically, they cannot see what is going on outside of the HMD nor who is near them. It can be a shock to be in a virtual world and have someone in the real world start talking to you or to put a hand on your shoulder.

It is also important to be mindful that in any class there will be students who have special needs, life circumstances or cultural norms which have made them adverse to touch. During the first phase of VR School Project conversations between the researcher (ES) and a teacher (CC) about appropriate assistance and child protection guidelines led to the development of the DATA training protocol to guide those assisting others in VR in a safe and respectful manner. The protocol can be used by anyone assisting others in VR, in our case students who acted as VR assistants and 'spotters', teachers or researchers. The DATA procedure involves three actions which are outlined in a training poster (see Fig. 4).

#### 5 CONCLUSION

To our knowledge there are no in-depth case studies of integrating IVR into real classroom contexts, including comprehensive approaches to ensuring ethical and safe research using this technology with children and young people in natural setting such as schools. This paper addresses this gap by providing an overview of a range of ethical and safety issues related to IVR in classrooms and a set of evidence-based, trialled resources that have been developed to prevent and mitigate harm and promote ethical conduct. As the field of IVR in education matures we hope that the insights of researchers, teachers and students and the protocols and resources they produce in response to similar issues are openly and freely shared so that student learning can truly benefit from immersive technologies.

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# BE VR AWARE



**First cover your hair, then put on the headset.**



**Feeling sick or your eyes hurt?  
Take off the headset, stay seated and tell  
the teacher.**



**Stick to the time limit and have breaks.**



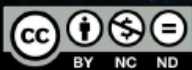
**Don't move around with the headset  
on, unless the room is set up for it  
and someone is watching.**



**When using controllers take a break if your  
hand hurts or tingles.**



**Having too much fun? Enjoy!**



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Figure 3: 'Be VR Aware' classroom poster.



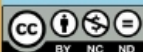
# DATA

A procedure for respectful and safe VR interaction

1. **Demonstrate** to students what the headset looks like, how it adjusts, and how to hold and use controllers. They may be able to fit the equipment themselves after one or two demonstrations.

2. **Ask** if the student would like help putting on, taking off or adjusting equipment *before* assisting them e.g. 'Do you need help in adjusting the headset?' or 'You are getting too close to the wall. Is it okay if I put my hand on your shoulder and guide you to a safe area?'

3. **Talk Aloud** to explain what you are doing while assisting students e.g. 'I am now going to adjust your headset. Is that okay?' or 'My hand is on your right shoulder, can you take a step in that direction so that you are safe to continue in VR?'



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Figure 4: Classroom poster for DATA: A procedure for respectful and safe VR interaction.