Virtually Learning...Or Not?

Conference or Workshop Item

VIRTUALLY LEARNING… OR NOT?

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Abstract

Virtual Reality (VR) is a growth area; with a worldwide market revenue of 3.89 billion US dollars in 2020 projected to rise to 12.19 billion US dollars by 2024. In 2020, Education was projected to be the second most disrupted sector due to extended reality (XR). As long ago as 1990, Bricken described education in the virtual sphere and postulated that VR would be commonplace in 20 years.

Unfortunately, it took another 12 years on top of Bricken's prediction of 2010 before we arrive at a stage where an estimated 6 million VR headsets are being sold in a year; whether this counts as commonplace is debateable, but certainly far more common than in 2010. But in education there are still huge gaps. In some areas of higher education, such as in the Askwith Kenner Global Languages and Cultures Room at Carnegie Mellon University, students complete learning modules entirely around and supported by VR and have the opportunity to borrow one of the hundreds of headsets owned by the University. Scholarly papers abound sharing the benefits of medical education in VR increasing confidence and maximising efficacy.

As education approaches the masses, however, things are not so bright. This paper explores the uses, or rather lack of uses, of VR in compulsory-aged education within the United Kingdom. Reporting on early data from a SERAS (Skills and education for Robotics and Autonomous Systems)-funded pilot study, opportunities are described, but critically the blocking factors are identified, discussed, and challenged. In the interests of always looking for light at the end of the tunnel, this paper also opens up some opportunities that educators can further explore for themselves.

Keywords: Virtual Reality,K12,Immersive learning

1 INTRODUCTION

It cannot be debated that VR (Virtual Reality) and in particular iVR (immersive Virtual Reality) is a growth area. The 2021 Christmas week downloads for the Oculus application (needed when setting up an popular Oculus Quest 2 VR headset) jumped up by 517% and reached 1.5 million installations [1]. Worldwide market revenue is due to increase by a multiple of over 3 between 2020 and 2024 [2]. In 1990, Bricken suggested we would have to wait "ten years for the first prototype systems to reach the schools" and "another ten years for common usage" [3]. Unfortunately, Bricken's dates were somewhat skewed, and it is only quite recent that there is any chance of seeing Virtual Reality in education.

Anecdotally, this is still incredibly limited. As an ex-school 11-18 school-teacher specialising in Computer Science, I have a huge network of colleagues, ex-colleagues and acquaintances. Some have dallied with Virtual Reality, but primarily as exactly that: a dalliance rather than a teaching tool. What little research exists [4] is primarily exclusive of the curriculum needs of the schools.

2 METHODOLOGY

This paper consists of two parts; part one is a short study investigating how easy (relatively) novice STEM educators find the Oculus Quest 2 to use. This was initially exploring ease of use in terms of navigating the software and using the controllers. The study then went on to explore the participants' experiences using an immersive 3D interactive video of tunnel-building equipment and encouraged them to consider whether similar technologies could be used within their teaching. Finally, they were introduced to a 3D programmable robot simulator, BooBot, and again encouraged to consider whether similar creations could be utilized within their teaching. The primary emphasis of this study was to identify how easy it could be for educators to get students used to using modern mid-range iVR such as the Oculus Quest 2, and to identify which areas of the STEM (or other) curriculum could potentially be supported in the short to mid-term by developing new software. Participants were surveyed after each experience, as well as being invited to a short iVR-based focus group meeting.

Participants for the pilot project were sought via Facebook groups. These were primarily Computer Science education groups, although the advert encouraged those interested to pass on the details to other STEM colleagues outside of Computer Science. There were nearly thirty initial responders, with over twenty confirming interest. Of these, budgetary restraints limited the project to 18 participants, although technical problems meant that the project had to be paused after five colleagues had engaged in the project. The results of these surveys are compared below in terms of how suitable the provided software was for introducing the Quest headset and how suitable they feel the interactive learning material would be compared to more traditional methods.

The participants were initially asked to reflect on their confidence in using the controllers and navigating the interface before and after using introductory applications, and whether they felt these would be useful in introducing the device to students. These confidences were measured on a five-point Likert scale. A five-point scale was chosen for simplicity as there is no need for repeated administration[5].

Participants were then asked to explore a free educational application. The free application, TunnelSkills – Shaft and Tunnel Construction[6] was chosen for this. This application was chosen as being STEM related, a generic enough design and concept as to be suitable for other learning tasks. Visually the application was of reasonable quality but did not have the 'wow' factor of the introductory tasks. It is hoped that this would allow the participants to focus on the pedagogical implications rather than being distracted by the visual effects. The application takes the participants through up to four different tunnelling methods in either of two modes; participants can watch a guided tour, with voiceover (analogous to watching a video on a screen), or can explore by clicking on hotspots (analogous to using an interactive computer application or reading a book). Participants commented upon the perceived efficacy for teaching in comparison to more traditional pedagogic methods. Without trialling on actual students, we are reliant upon the experience these professionals bring[7].

The intention was to ask participants to engage with BooBot[8], an iVR application I developed to enable participants to explore programming a robot to complete a task, using an assembly-style programming language. Unforeseen circumstances related to the software being pre-release meant that the participants were unable to use the software which will be explored further in a future project.

Part two of this paper is a reflection upon lessons learned during this and other recent pilot projects, as well as innumerable conversations with colleagues, to identify the current position of VR, and primarily iVR, within the educational space, and open up potential areas for further investigation and development not only to find out more about how iVR can enhance education in principle, but to find out more about what iVR can be developed to actually enhance the education of young people. The first project was a project in conjunction with Youth Shedz[9] in which the author supported young people in deciding upon and building a virtual environment to meet and share their experiences. The second project is on-going at time of writing, in conjunction with Merthyr Tydfil college, Wales. This project involved two sets of students, a group of esports students exploring the use of iVR in their esports course, and a group of students exploring how iVR can link with the world of art.

3 RESULTS

The results will be divided again into parts, with part 1 reporting on the pilot project with STEM educators, and part 2 consisting of my own reflections.

3.1 STEM Educators using iVR

3.1.1 The Participants

Five participants took part in the pilot project. All taught Computer Science at 11-16 or 11-18, in an undefined mix of state and independent schools. Only one had used an Oculus Quest 2 before, playing some games with a friend. Two had used other VR systems before, one an undisclosed system to play a music game and one had used Google Cardboard (a lower end iVR system) in school some years before. If we consider a novice as someone still establishing basic routine and focussing on survival rather than development [10] then it is fair to describe all participants as novices in terms of their experience of using iVR and certainly in terms of applying iVR to education.

3.1.2 Using Introductory Software

The Oculus Quest 2 has two introductory 'experiences' within it; First Steps[11] is designed to introduce the controllers and control mechanism and First Contact[12] encourages users to further engage with controlling and interacting with the system.

Four questions were asked, each asking the participants to respond on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The results of these questions are shown in Figure 1.

Question 1 asked whether they felt confident in using the controllers before using the introductory software. One responder slightly agreed, one was undecided, the other three disagreed; they did not feel confident with the controllers initially.

Question 2 asked whether they felt confident in navigating the Oculus interface before using the introductory software. Again, one slightly agreed, although this time two were undecided and two did not feel confident.

Question 3 asked whether the introductory software provided sufficient guidance in controlling the Quest, while question 4 asked whether they would use the introductory software when introducing students to the Quest for educational purposes. Four strongly felt the introductory software was sufficient, with one slightly agreeing. All five responders strongly agreed that they would use the software when introducing their students to the Quest.

The participants were asked to anonymously comment upon any other thoughts they had about the introductory software. All comments were positive, with the quality of the environment and the feeling of a "safe space" coming through. It seems a little more exploration of the buttons, and additional practice in grabbing with the controllers could have been beneficial.

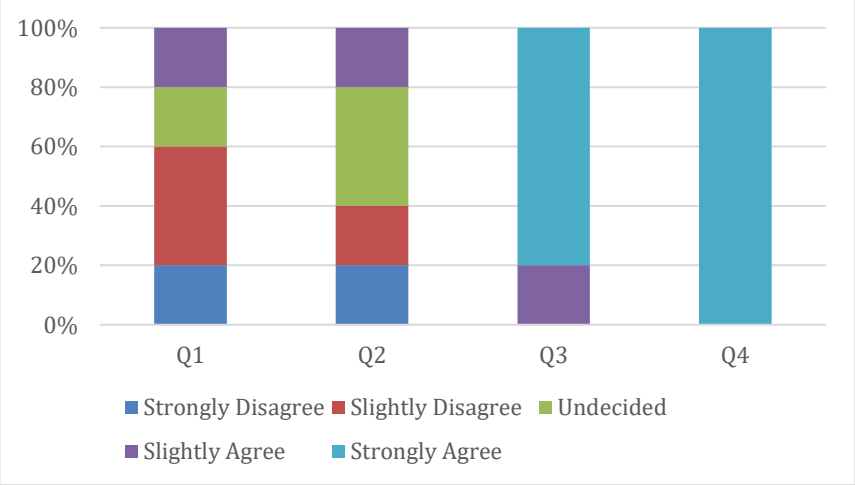

Figure 1. Introductory Applications

3.1.3 TunnelSkills – 360° Video Walkthroughs

Once confident with navigating the Oculus system, the participants were asked to move on to the TunnelSkills application. The minimum activities engaged with was a single exploration and a single guided tour, while the maximum was four of each. The mean engagements from each participant were 2.2 guided tours and 2.0 explorations.

Participants were asked to compare, using a five-point Likert scale, the perceived efficacy of the guided tour to a video shown on a 2D screen to students, and the exploration against a 2D interactive application on a computer and a 2D non-interactive in a book. All participants believed the iVR would be more effective than the more traditional method in every case. These results were split between iVR being (potentially) slightly more effective, and iVR being (potentially) far more effective are shown in Figure 2. iVR vs 2D Pedagogical Approaches, below.

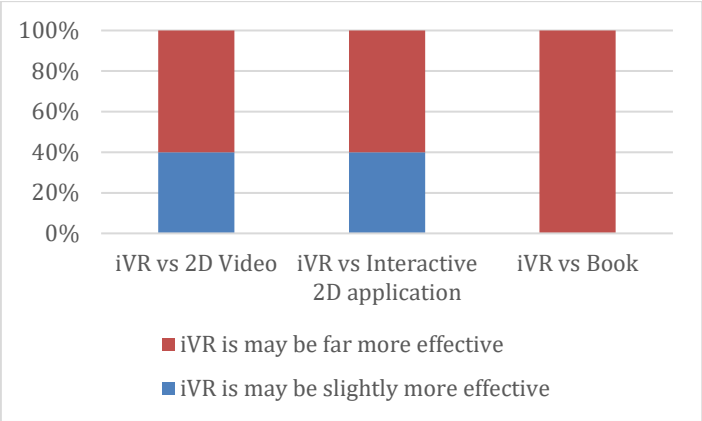

Figure 2. iVR vs 2D Pedagogical Approaches

Participants were asked to comment upon the experiences, as well as suggesting areas of the curriculum that could benefit from such an approach.

The immersive feel, ability to focus your attention on specific parts as wished, and the depth of field available in the iVR applications were all suggested to be positive improvements over more traditional approaches. There were suggestions for improvements, including increased information-focussing and interactivity (particularly referring back to the introductory applications as examples), improved scale and referring to a relatively low video quality. One participant stated that it was “like a BBC video from the old days”. The Quest 2 can play high resolution videos, both 2D and 3D, from the likes of Netflix, Amazon Prime and YouTube, so it is presumed that the video quality was down to the videography and editing rather than capabilities.

One participant raised a desire to be able to “take along” a class through a tour, giving them free reign within a scene but allowing the teacher to then force-move them to another scene, much like in a real-life museum.

When asked to consider which curriculum areas might benefit from similar experiences, the participants’ Computer Science focus showed through with repeated suggestions of health and safety, mechanical engineering, experiences within a computer and within a central processing unit, as well as data centres, Internet hubs, and visiting areas where the impact of e-waste can be seen. Further suggestions included robotics, the Globe theatre and even inside a detective novel. Slightly vaguer notions included building objects, use in careers education, coding examples, and the subjects of History and Geography in general. One participant queried whether they could be useful in sports training and dealing with the pressure and atmosphere in a sports stadium. The word cloud below was created from the participants’ input.

Figure 3. Word Cloud of Potential Curriculum Uses of iVR

3.2 Reflection on Recent Projects

3.2.1 Introducing iVR to Young People and the Educational Space

The use of iVR by novices – and particularly younger people in an educational setting – is still very new. While more users than ever have access to some form of VR at home, it is still not ubiquitous enough that we can assume learners – or educators – can use it without training. The ability of learners to pick up and use a Quest 2, for example, seems to vary depending upon their experiences and their general computer literacy. In a current project with Merthyr Tydfil college, we found that a group of six esports students, all young males, were able after a one-hour session to engage in a variety of activities, exploring the headsets themselves and even installing new software. The group of art students had a wider range of ages and genders and while the two youngest students were the most comfortable, none described themselves as computer literate and all needed far more help than the esports students. Even the esports students needed help in getting the headsets fitted properly – we found adjusting the side straps and then the top strap helped. They then needed help in picking up and orienting the hand controllers, and guidance on getting out of the applications should they become lost or confused. At least an hour per group is needed to run through these things – and we only had groups of at maximum six; a whole class could be far more difficult. There are also space related issues. Six people in a relatively normal sized room was find when seated, but when using room-space iVR four of them in the same room is difficult: a hall or gym would be needed for more.

3.2.2 Managing Multiple Headsets

While they may (re)introduce a system in the future, Meta, who own Oculus do not currently offer a simple way to manage multiple headsets. The Quest software just lists “Quest 2” on the application, so differentiating them is difficult. There are a number of pieces of software available for managing multiple headsets, though I have not had chance to try them out yet. Still, we found that multiple devices on a single account, on a college WiFi network was manageable but did not allow casting of the current image to the controlling iPad. The advantage of a single account is software can be purchased once and used by all, and installation is relatively easy. In the Youth Shedz project each participant used their own Facebook account which left the management up to them but is less useful when sharing across multiple users (particularly if the users are younger and may not have a Facebook account). Another downside of having multiple devices on one account is what happens on one may happen on all; when sending headsets to the STEM educators, one inadvertently added a lock code. The only way to remove this was to have all headsets returned to me so I could reset using the central iPad.

3.2.3 Consider Purpose for Use

It is easy to envision a situation wherein students “have a VR lesson”; as a Computer Science teacher, I often heard of students “having an computer room lesson” where the key point they took away was they were using the technology – not that they were learning a specific concept and the technology helped them. The Youth Shedz project was an excellent example of a need (to be able to get together during a COVID-19 lockdown) in which iVR was a suitable solution. The Merthyr Tydfil college project is exploring what iVR can add to learning opportunities.

3.2.4 Consider How To “Get In”

There are a lot of “bits” of educational content that may be enhanced by accessing it via VR. Oculus TV[13], for example, has a huge number of immersive led experiences about space and the International Space Station. However, there is no simple way to jump straight to that experience. While it is simple for a casual user to find a section of the application, having a whole group of young people getting to the same place at the same time would be challenging.

3.2.5 There Is Not Enough Focussed Content

Through discussion with the focus groups of the SERAS project and ad-hoc discussion with other educators, there are a large number of potential uses of iVR in education, just a few are introduced in Fig 3. However, not enough exist currently. This was evident in the SERAS project; I though a robot of some kind would be an easy application to find but ended up having to write my own. Anecdotally, there are other content on additional platforms. However, some of these are either not available on the Quest, or require a link to a powerful gaming computer which adds a significant multiplier to the cost. There is also a lot of potentially misleading or inadequate content; in nations where education sectors “from high chair to higher education and beyond are siloed and disconnected”[14] and highly restricted to specified

content the chances of existing applications meeting the teaching needs of a particular topic is quite slim.

4 CONCLUSIONS

4.1 Applications and Experiences

4.1.1 Introductory Applications

The introductory applications were an unparalleled success; all participants enjoyed them, found them useful for being introduced to the hardware, and acknowledged that they would be useful for introducing novice learners to iVR.

4.1.2 TunnelSkills

The TunnelSkills application raised some interesting points. Participants acknowledged the style could be useful and offered a number of curriculum areas that it could be used. The quality and level of interactivity were seen as areas for improvement.

4.1.3 iVR Conferencing

iVR conferencing has been used in a number of projects; the SERAS participants were invited to a focus group meeting in RecRoom[15], and the Youth Shedz project explore a range of software, finally settling on FrameVR[16]. This is an effective and fun way to communicate, although as with iVR in general, familiarity is needed to make the most of it. More work is needed to form a full and conclusive comparison and identify which tool is right for which task.

4.2 Use within the Educational Setting

4.2.1 Introducing new users to the Oculus Quest 2

It is not prudent to assume young people will be able to pick up and use the Quest 2 (or other iVR headsets). Time needs to be given over to getting used to the system and navigating around the interface. In getting used to the system, the First Steps and First Contact applications are an effective starting point. Time – at least an hour – must be devoted to this.

4.2.2 Managing multiple headsets

When setting up the headsets, time is need. A full day would probably be needed to update and setup a class set! I found writing the last few digits of the serial number on the headset in sharpie, as well as giving each one an ID number and writing the same ID on the controllers is useful. Keeping them charged is also a problem – and in a school setting as “VR monitor” pupil would probably be needed. Keeping each in its box and having battery packs ready to go if needed is a good idea!

4.2.3 Go with Reason

It is suggested that VR opportunities are sought to support learning explicitly and used where there is an enhancement in learning. Of course, use for pleasure is an excellent use of the technology, but is insufficient to justify the cost and effort.

4.2.4 Content Creation

There is a need for more content to be created, and ideally this would be specified by and created for the educators that will use it. This should include simple ways for them to drive or pull student headsets to a particular resource, either by individual small applications or larger applications which can be (semi) controlled externally.

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