

Premier’s Teachers Mutual Bank New and Emerging Technologies Scholarship

An exploration of Augmented and Virtual Reality in education

Brenden Davidson

St Mary’s Cathedral College

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# Introduction

The 2017 Gartner Hype Cycle[[1]](#footnote-1) listed the immersive technologies, Augmented Reality (AR) and Virtual Reality (VR), as new and emerging technologies. An Immersive technology is “a deeply engaging, multisensory, digital experience, which can be delivered using VR, AR, 360° video, mixed reality, and other technologies.” (Cook, Jones, Raghavan and Saif, (2018)

Specifically:

* VR refers to computer-generated environments that simulate the physical presence of people and/or objects and realistic sensory experiences
* AR, put simply, are “technologies that project digital materials onto real world objects.” (Cuendet, Bonnard, Do-Lenh, and Dillenbourg, 2013)

According to the 2016 Goldman Sachs Profiles In Innovation Report[[2]](#footnote-2), VR and AR technology have “the potential to be a standard tool in education and could revolutionize the way in which students are taught.” Significant advancements have been made with respect to immersive technologies in recent years. Once only accessible via advanced and very costly equipment, they are now available on almost any smartphone, making them viable tools in education. The 2017 edition of the Horizon Report[[3]](#footnote-3) estimates the time of adoption of these immersive technologies as two to five years.

# Focus of Study

The focus of the study was to seek out the tools and/or strategies being used to implement immersive technologies into teaching practice and,  additionally, to see how others are going beyond teaching how to use the technology, to that of learning and creating with the technology.

The areas of investigation were to:

* further investigate the affordances of immersive technologies
* investigate how the technology is being used to create knowledge
* investigate best practice of immersive technologies implementation in education.

# Significant Learning

### Learning with the technology

When planning the itinerary of the study tour, the AVR 360 conference, which is an annual Augmented Reality Show in London was the first to be booked. It is considered Europe’s leading event for immersive technology bringing together leading exponents from across the globe. Spending two days at this show ensured exposure to a large amount of content in a short amount of time.

The most relatable and thought-provoking sessions and exhibits centred around purposefully using immersive technology in education and training, followed by physical demonstrations. Paul Speight of Leicestershire Fire and Rescue Services detailed his journey of using immersive technologies to develop a road safety education package to educate young drivers in road safety, aiming to reduce deaths and serious injuries. This program utilised a 360 degree immersive film, which exposed young drivers to car accidents in a simulated environment. This created an awareness of the dangers prior to getting behind the wheel of an actual car. It was asserted that, through the use of immersive technologies, the service was able to engage with young drivers “in a more realistic and effective way.” (Leicestershire Fire and Rescue Service, 2018). Speight was inspired by the success of this program to further investigate the affordances immersive technology could offer his industry.  He partnered with RiVR (Reality in Virtual Reality), a specialist team who create interactive, photorealistic, room-scale VR experiences. RiVR enabled Speight to move beyond a passive immersive experience, such as the road safety initiative, to that of a photorealistic and interactive experience. Together, they developed VR training scenarios. Trainees are immersed in virtual photorealistic fire investigation scenes, allowing them to walk around the site, move objects and dig into debris. At the same time, assessment can be carried out by a qualified trainer, monitoring their every move on a monitor or tablet. Further research into this initiative after the conference reported, “this means that the trainer is able to give real-time feedback that can be key to ensuring effective training. When a scenario looks and feels real, you get much better results because people behave more like they would in a real-life situation – it’s all about immersion.” (Koolonavich, 2018)

A visit to Bloc Digital’s exhibit provided for further examples of where immersive technologies were being used as learning and training aides. Bloc Digital showcased their AR, VR, and MR (Mixed Reality) developments, with their VR trainerbeing of particular interest due to its procedural emulation and product familiarisation capabilities.

Subsequent research, following the conference, reported that Bloc Digital’s VR scenarios developed for Rolls-Royce have “become a game-changer” for training their engineers. Allowing engineers to “practise highly complex tasks” without requiring direct access to the extremely large and expensive physical equipment, saving the company time and money. (Pickup, 2017) These real-world examples suggest that immersive technology is moving beyond being a passive experience to that of being an active, interactive experience.

Attending a presentation by Preloaded[[4]](#footnote-4) and Hilary Knight at AVR 360 was a precursor to visiting and experiencing the Modigliani exhibition at the Tate Modern in London. Knight is the Head of Digital Content for Tate and oversaw the gallery’s first VR installation, which was a partnership between Tate and HTC VIVE.  HTC VIVE saw their involvement in this project as a way to prove that the technology has a wider value than that of purely entertainment. (Rigg, 2018)

Whilst VR experiences already exist in many museums and galleries, Modigliani VR “was to be a first – a VR experience that is fully integrated into a wider exhibition, and not simply a standalone add-on.” (Preloaded, 2018) The VR experience recreates the renowned painter Modigliani’s last studio in which he lived and worked.  Reviews of the exhibition stated that the immersive experience allowed visitors to see the exhibition from different angles and provided them with more insight into the artist himself. (Rigg, 2018). As a visitor who was immersed in the VR experience, it was a great way to be provided with context that would otherwise not have been possible. For this participant, it certainly enhanced the exhibition, just as Preloaded intended.

Museums are also using AR to bring their exhibits to life. At the Smithsonian National Museum of Natural History in Washington D.C., the Bone Hall Exhibit has many of the original skeletons from when it first opened in 1881. As a visitor in 2018, through downloading the Museum’s AR app, it was possible to scan over the bones and see them overlayed in muscle and skin, along with how the bones within various creatures once moved. This has moved an existing long-term exhibit from a static one to that of an interactive one, enabling it to be viewed in new and engaging ways.

### Creating with the technology

This year, the Develop3D Live[[5]](#footnote-5) conference in Coventry dedicated a new section of the event to VR and AR, making it an essential stop on the study tour itinerary. The fact that this section alone needed an entire building demonstrated, as asserted by Develop3D, “the speed at which these technologies are maturing from future-facing luxury pipedream to must-have kit.” (Holmes, 2018)

Richard Seale’s (lead automotive designer at Seymourpowell) live demonstration of sketching an original car design in 3D in real-size, was a powerful illustration of how immersive technology can be used to design and, according to Seale, has dramatically changed and streamlined his workflow. Seymourpowell claim that their VR sketch tool, Reality Works, “allows designers to easily duplicate designs, draw complex spline curves, and work within industry safety regulations and parameters” at full-scale in 3D. (RealityWorks, 2018) Additionally, it allows for collaboration, as teams can work from the same data whilst also dialling in from different locations via tablets and VR headsets. Seale believes that by enabling “designers (to) create designs in 3D and at any scale from the very start of the design process... is the future of design.” (Dexigner.com, 2018)

This is an exciting development as this functionality removes the scale and sharing constraints of more traditional design practices. Whilst still an emerging aspect of the technology’s capabilities, there are already applications available that allow users to draw in 3D (e.g. Tilt Brush by Google) and “sculpt, model, paint and create tangible objects in a VR environment” (e.g. Oculus Medium). (Oculus.com, 2018). Delegates of Develop3D Live were provided with hands-on access to Reality Works during the conference.

Visitors to VR World in New York, the largest VR experience centre in the Northern Hemisphere, provided access to Tilt Brush by Google, a dedicated VR experience. The hands-on experience, gained through using both Reality Works and Tilt Brush by Google, not only reinforced the potential of the technology but also its potential application in different Key Learning Areas (KLAs). The keynote speaker at Develop3D Live was Mike McCoy who is the CEO of Hackrod[[6]](#footnote-6). McCoy’s speech centred around his company’s approach to design and manufacture through the use of digital technologies. Hackrod were already taking advantage of the affordances of VR in their design process. Hackrod designed the body of a classic speedster in VR, engineering it with artificial intelligence, and using 3D printing technology, in aluminium, to realise the final design in full-size. McCoy asserted that, as VR enabled the design to be viewed in full-size, there was no need to prototype full-size models, saving the company time and money.

### Teaching (and learning) with the technology

As immersive technology is an emerging technology, there is much research into its potential being conducted by organisations.  For this reason, the SITE[[7]](#footnote-7) conference’s line-up in Washington DC for this year included many presentations on immersive technology in education. Over the course of four days, the most thought-provoking session was that of the University of Illinois College of Medicine’s presentation on using VR as a teaching and learning platform for medical school education. The University’s extensive VR research was indicating that the technology had the potential to facilitate teaching and learning, which could lead to improved learning outcomes and ultimately improved patient care.

Dr Matthew Bramlet, who is the University’s lead investigator, detailed how the Children’s Hospital of Illinois is currently printing 3D heart models from the MRI data of patients with complex heart disease.  Bramlet believes, however, that the use of VR may make this process redundant, as it allows medical staff to view the heart in more ways that the 3D model cannot. According to Bramlet, having access to 3D printed hearts led surgeons to change their surgical plan prior to surgery about 15 percent of the time, as it improved their understanding of the issue. Recently, the patient’s scans were also being dropped into VR, giving the surgeons the opportunity to explore the issues even further. Bramlet observed that when the surgeons used VR, they became quite animated as they explained their surgical plan.  He felt that if this was recorded, it could be used as a way to teach medical students. This led to the creation of Enduvo.

Enduvo is an asynchronous VR learning platform that incorporates 3D images, radiographic images, and videos.  Bramlet asserts that “Enduvo fosters exploration and discovery, which is key to learning,” and that “a huge strength of the software is its ability to bring three dimensions into the mostly 2D world of learning.”  Rather than “trying to absorb complex information from a book, students step into a three-dimensional environment free from distractions.” (Renken, 2018)

At this same SITE conference, there were several presentations which detailed the affordances of VR in educational settings along with the increasing accessibility of VR in education. One researcher presented the theory of “seeing is believing”, and that VR is a way for students to “see” by transporting them beyond their classroom or location, of which they may not otherwise have been able to experience.  (Wereley, Broda and Schmidt, 2018) Others asserted that VR may promote student engagement and provide for flexible learning. (Bethea-Hampton and Johnson-Holder, 2018). All of these researchers focused on how the technology is far more accessible in the educational setting now, due to the availability of low cost VR viewers, such as Google Cardboard, paired with smartphones.

At the end of 2017, the University of Newcastle (UON) in Australia ran an EdTech TalkFest, which invited conversation about how educational technology can be adopted with criticality and enthusiasm. On this day, IT Innovation Manager for UON Craig Williams demonstrated the University’s ground-breaking development in VR technology ‘Road to Birth’.

The UON website depicts the development as “a world-first opportunity to follow a detailed, realistic and 3D figure through a pregnancy without any visual barriers.” the University of Newcastle, Australia, 2018). Educators use the mixed reality headset, HoloLens, to project simulations in front of the class. Students are also able access the application on their own device, enabling them to learn in their own time and at their own pace, providing a safe place to practise and learn from their mistakes before entering the delivery room.

The University recognises that “individualised learning is incredibly effective” and believe that as the application provides students with a new way to visualise realistic situations, this goes further to “bridge(s) the gap between classroom and delivery suite.” (the University of Newcastle, Australia, 2018)

Another session at this EdTech TalkFest provided an overview of VR School, a case study on the implementation of VR in select STEM classrooms, being undertaken in collaboration with the University and the junior campuses of a local secondary school, Callaghan College. As part of the study, Year 9 science students worked collaboratively in Minecraft VR[[8]](#footnote-8) to produce VR models that demonstrated an understanding of scientific concepts.

This case study is one of the very few documented, where immersive technology is being used actively, not passively, by more than one user at a time. The study’s leaders detailed the various practical implementation challenges that needed to be overcome to make this type of project successful.

One such challenge was safety in VR.  VR systems are designed with visual safety cues to contain the user in an object-free area; however, some students tended to ignore these cues. This led to the need for another person, teacher or student, to act as a ‘spotter’, ensuring that the user remained within the allocated area. There was also the challenge of finding the appropriate space to conduct the study in a school environment.  Traditionally, classrooms are not set up to provide this space, and additional spaces may not be located in proximity to the rest of the class, making supervision an issue.

Introducing a new technology into the classroom also brings with it the need for knowledge to resolve technical issues, something the students may not yet have. This study involved both the classroom teacher and the university researcher spending considerable time resolving such issues.

# Conclusion

The 2018 Gartner Hype Cycle continues to list Augmented Reality and now Mixed Reality as emerging technologies Virtual Reality, however, has graduated off the cycle altogether. According to Gartner, VR “is rapidly approaching a much more mature stage, which moves it off the emerging technology class of innovation profiles.” (Bastian, 2018)

During the course of the study tour, it was quite evident that VR has matured. VR is already being used by many varied industries to provide training and learning experiences. Whilst the initiatives witnessed are currently on a small scale, they are being used for training in highly skilled areas, i.e. aircraft engineers and heart surgeons, reinforcing that the technology has been recognised as an effective training tool.

Subsequent research, following the study tour, found that VR technology is now also being used on a much larger scale. American retailer Walmart recently announced that it intends to expand its immersive training program. The program was initially introduced into their 200 training centres in 2017 but will now be to accessible in their 4,700 locations, through the distribution of 17,000 Oculus Go headsets. (Archambault, 2018)

During the course of the study tour, there were no shortages of evidence of affordances of immersive technology. The key benefits to the educational setting were the potential cost savings, using the technology for assessment, hands-on practice in a consequence-free environment, and asynchronous learning. It no longer seems a matter of whether we should use VR in education, but rather, how we should be using it in education.

An overarching theme garnered throughout the study tour and since returning, is that it is not about replacing real-world experiences with immersive experiences, but rather using the technology as a complementary tool for training, teaching and learning. This would appear to be the best approach to implementing immersive technology into the educational setting today. An example being using immersive technologies to provide students with the opportunity to undertake virtual practical tasks in their own time and on multiple occasions before undertaking the actual task.

For educators looking to introduce immersive technology into their educational setting, low cost viewers paired with BYO smartphones have been shown to be effective tools whilst requiring little investment by the school.

However, when moving beyond passive uses of the technology, from that of watching a 360° video to that of creating with the technology, educators are presented with far more logistical issues to overcome.

Seeing immersive technology being used to design was incredibly inspiring but equally daunting. Learning through creating with the technology appeared to be very powerful, but also logistically challenging in the educational setting. It is for this reason that the VR School case study shall be followed with interest, as well as a continuation of professional development in this area in the coming years.

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1. Information Technology firm Gartner’s graphical representation of the maturity of emerging technology. [↑](#footnote-ref-1)
2. Global investment bank Goldman Sachs’ look at emerging technologies that are creating new profit pools and disrupting old ones. [↑](#footnote-ref-2)
3. Ongoing research project that seeks to identify emerging technologies likely to have an impact on the educational setting. [↑](#footnote-ref-3)
4. A games studio that develops games and immersive experiences that have purpose. [↑](#footnote-ref-4)
5. Develop3D Live is one of the UK's leading conferences focussing on design, engineering and manufacturing technology. [↑](#footnote-ref-5)
6. Hackrod is a start-up company looking to revolutionise the automotive industry through the use of 3D printing, virtual reality, and artificial intelligence. [↑](#footnote-ref-6)
7. The Society for Information Technology and Teacher Education (SITE) [↑](#footnote-ref-7)
8. Virtual Reality version of the extremely popular video game Minecraft, which is about placing blocks and going on adventures. [↑](#footnote-ref-8)