

Premier’s Teachers Mutual Bank New and Emerging Technologies Scholarship

The present and future reality of immersive technologies in education.

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# Introduction

In 1946, an educator named Edgar Dale devised a concept called the “cone of experience” in response to the emerging technology of the day – audio visual media. He proposed a hierarchy of learning associated with the interrelationship of the various types of audio visual media.

Dale envisaged that this cone would help educators in selecting the best instructional resources and activities from the myriad of new resources that were emerging. The cone was a way of comparing instructional material to real life. The closer to real life the better, as it incorporated more of the student’s senses during the activity. There is a [correlation](https://www.evidenceforlearning.org.au/toolkit/digital-technology/) today with real word experiences and improved learning and engagement among students. It is proposed that immersive technologies can provide tangible, meaningful connections with the outside world without having to leave the comfort and safety of the classroom.

Immersive technologies refer to computer-generated simulations and environments that have the capacity to mimic real-world scenarios and experiences, but in a safe and controlled manner. Virtual reality (VR) creates simulations and environments that are fully immersive and encompassing for the user. The most immersive experiences require a powerful computer running an expensive head mounted display (HMD).hand controls and sensors to extend the user’s experience and allow for interaction within the environment. Augmented reality (AR), on the other hand, involves the process of layering digital content on top of the user’s current natural world. AR can be experienced effectively and cheaply without an HMD using current mobile technologies like smart phones and tablets. Mixed reality is harder to define but is often described as a hybrid of VR and AR where digital objects are incorporated and interact with the natural world. All three of these technologies are known colloquially as extended reality (XR).

As with all new and emerging technologies that have come before it, immersive technologies have the capacity to increase student engagement due to their novelty and fun value. As with all technology, however, excitement often quickly wanes so if this technology does not also come with sound pedagogical reasoning for its use, the large financial and time investment for schools in incorporating XR technologies into the curriculum, particularly in regard to VR, cannot be justified.

# Focus of Study

Augmented and Virtual Reality (A/VR) offer new ways to enhance face-to-face and online teaching through making abstract concepts more tangible to students by providing them with sensory experiences that they may otherwise not be able to encounter. Are the considerable barriers in implementing emerging technologies such as A/VR, such as cost and teacher training, worth the perceived gain in educational outcomes?

Through my study tour, I endeavoured to observe the current state of immersive technologies as a whole. I planned to investigate the future-reality of XR in education and observe its present use in the classroom. My tour included a series of conferences, expos and, technology corporations as well as visits to schools in the USA and Sydney. These visits would incorporate interviews with teachers who use immersive technologies meaningfully in their classrooms.

# Significant Learning

## The similarities of XR beginnings

A significant portion of my study tour involved interviewing teachers about their use of XR in the classroom. The teachers I spoke with had differing amounts of experience and taught a range of ages and subjects. The way they use XR in their classrooms may differ, however, a common theme amongst all the teachers I interviewed during my study tour was how they began their own journey with XR technologies. Without exception, teachers were first introduced to VR through simple experiences on their mobile device. For some, the introduction happened through a colleague whereas for others it was personal experimentation that ignited their XR passion.

Marie Graham from Mount Vernon Presbyterian School in Atlanta, tried out VR in the hope of better engaging her students with the plight of Syrian refugees - the topic she was exploring with her middle school humanities class. Discussions and YouTube videos had not sparked the student engagement she was hoping for, and while researching online she came across a [United Nations VR experience](http://unvr.sdgactioncampaign.org/cloudsoversidra/#.XE0yRNCWaM8), which was filmed on-location in the Za’atri Camp in Jordan. She viewed this experience on her phone using a basic Google Cardboard, causing a tremendous emotional response within her. The next day she showed this same VR video to her students and to her satisfaction, they had a similar emotional reaction. Once student, with tears in her eyes, responded, “they’re just like us”. It was then that Graham saw the power of VR and it ignited a passion for incorporating this technology into her teaching.

Some of the teachers I interviewed have moved on from their simple beginnings and are now experimenting with immersive experiences using powerful HMDs. However, for others; the low-cost and readily accessible Google Cardboard/smart phone combination has been where they have stayed. Moreover, with Google investing heavily into their Google Expeditions platform, the number and quality of experiences available has grown considerably. Cost, therefore, should not prevent teachers from trying out XR in their classrooms. Most students, especially in secondary school, have a smart phone already so teachers can easily – and cheaply begin their own journey through the purchase of a class set of Google Cardboard viewers for about four dollars each and having students download the Google Expeditions app on their phones.

## Student engagement and immersion

Technology as a tool helps teachers create and present content and instruction that is interesting and relevant to students and when learning is relevant to students, they become engaged, active learners. Teaching using XR technologies has been theorised as a way of increasing both engagement in learning and immersion in topics studied – particularly with topics that are potentially difficult to experience, due to geographic limitations or safety concerns. As theorised in Dale’s cone of experience, the closer or more real an experience is, the deeper its impact. For example, watching a documentary on a tropical rainforest may impart visual and auditory information, however, if you were able to visit an actual rainforest you would get the visual and auditory information plus kinaesthetic facts such as the heat and humidity that would often come with a tropical environment.

Through my experiences, interviews and observations I was able to better grasp and understand how XR can improve both engagement and immersion in education. XR is fun and exciting and during VR you are experiencing stimuli across a range of senses which adds greatly to the feeling that you are in a real situation. While in Orange County, I participated in three Extreme Immersive Experiences. They all revolved around games and had a common theme of you “defeating the bad guys and saving the world”. What made these experiences extreme was that the actual physical world that you played in mimicked what you were seeing in the virtual world. If you saw a wall in the virtual world, you could reach out and touch a physical wall. If you needed to pick up an object and place it in a slot during the game, then there was an actual object in the physical world that you picked up and placed into its necessary location. These games were very engaging and the link between the virtual and physical greatly increased the enjoyment over a regular game. Moreover, as the gap between the real and virtual decreased with the addition of shaking, noise and air movement to mimic the idea of flying, so did my level of engagement in the activity.

Another immersive experience I had was at VR World - a commercial establishment in Manhattan, New York. Here I was able to try out [Richie’s Plank Experience](https://www.youtube.com/watch?v=4M92kfnpg-k), which is a VR activity that involves walking along a timber plank on the ground, however, in the VR world the plank is 80 storeys above the ground. This, for me, was the clearest example of the power of VR, because even though I kept telling myself that I was on the ground and could not get hurt, I was shaking the whole time as I walked along the plank and had to hold onto the shoulder of the supervisor next to me for balance. It was a clear example of how VR can be used to directly experience a dangerous situation, but in a safe and controlled manner.

This does, however, raise another important consideration when using XR, namely the ethical issues associated with the high-level of immersion of different experiences. Marie Graham from Mount Vernon Presbyterian School increased the student’s emotional engagement with the topic on refugees through the use of VR, however, would it be possible to de-sensitise students too? These are important considerations to consider as the use of XR in education increases.

In regard to classroom engagement, I observed elementary students excitedly using Google Expeditions to view coral on their classroom floor and also secondary students learning from a virtual tutor in VR, how to mix songs using a professional DJ mixing deck. The students could adjust sliders, set loops and mix tracks together under the direct guidance of the professional DJ, represented via an avatar. In both these experiences engagement was high, however, on talking with teachers, as with all technology, the high-level of engagement that comes with a new, fun activity, will quickly wane if overused or is poorly executed. An important understanding that I developed on my study tour is that XR technologies are just tools for teachers to use. They are not going to replace all the myriad of teaching strategies and pedagogies that educators use each day, but will be a valuable and powerful addition that, if used correctly and appropriately, has the power to deepen a student’s understanding of the curriculum – particularly in relation to concepts that are difficult to understand.

## Opportunities for student creativity

As a teacher I am always keen to find new opportunities and strategies to use in the classroom, both for students to learn from but, more importantly, for students to use as composers themselves. Currently, the majority of XR use in education revolves around consumption. However, as I investigated the current state and future opportunities of XR in education, one area of the technology I was keen to investigate was its application as a tool for composing. The current NSW K-10 English syllabus requires students to respond to texts showing their own personal and intellectual connection. XR has the capacity to be a useful tool for “shaping and arranging textual elements to explore and express ideas, emotions and values.” Adobe is a leader in creative software technology. It is the professional standard across many creative industries and is freely available to all students across the NSW Public School system as part of Adobe’s licensing agreement with the Department of Education (DoE). DoE staff can access all Adobe’s applications at home for a minimal yearly cost. I use various Adobe applications weekly in my classes and was very keen, in regard to the application of XR as a creative tool, to see where Adobe was heading in this field.

Adobe Max is Adobe’s annual creative conference, which sees 14,000 people from around the world come together to immerse themselves in creative opportunities and inspiring speakers. As part of my tour I attended the 2018 Adobe Max Conference in Los Angeles to learn as much as I could about how Adobe was being used in XR creation. I attended a range of lectures and workshops ranging from VR on a Budget to Creating Professional and Immersive AR/VR Content. Through these lectures, and also the keynote speakers, I was able to see that the main way that the Adobe applications are used currently to create VR content has a particular focus on 360 video. Adobe’s flagship video editing software Adobe Premiere has recently been extended to include the ability to edit 360 videos within the VR environment – giving producers a better understanding of how the finished product will be rendered.

2019, however, will see the release of Adobe’s new tool [Project Aero](https://www.adobe.com/products/projectaero.html). This application will give creators the opportunity to create augmented reality experiences that fully integrate with other Adobe applications without the need to code – avoiding a barrier to entry for creators. Augmented reality will offer students the chance to mix the digital and physical worlds. This offers numerous teaching applications, particularly in relation to science and the humanity subjects.

Currently the creation of fully VR experiences requires a high-level understanding of 3D modelling and coding. Industry-standard programs, such as Unreal Engine and Unity 3D are freely available to all students and teachers and provide the opportunity for creating highly professional and immersive experiences. The complexity of the software means that it will not be appropriate for many students to use, however, for senior-secondary students studying software design and development the opportunity to create in the VR space is available. Marie Graham and a select group of her students at Mount Vernon are currently learning Unity 3D together in order to develop the skills necessary for their class project.

Google also offers the opportunities for teachers and students to use their applications for creation. Google Expeditions, while vast in its viewing content, also allows teachers and students to create their own unique tours using their [Tour Creator](https://vr.google.com/tourcreator/) application. This ensures that experiences can be created which link specifically with the Australian curriculum, however, also provides new opportunities for students to display their learning. Google has also created Tiltbrush, which is a fun VR 3D painting application. As VR technology becomes more commonplace in schools, perhaps HSC visual arts students may begin creating their major works in this new VR medium.

## The future of XR in education

It was clear from my study tour that XR is an exciting concept that is being investigated in the educational sphere. It was equally clear, however, that we are at the very beginnings of the meaningful use of XR technologies in education. Even my investigations at Dougherty Valley High School, a school adjacent to the hub of technology - Silicon Valley, demonstrated that the use of XR is limited. As previously stated, cost remains a significant barrier as does good education content, though it seems that XR is a technology that has gained a great deal of traction in the commercial sphere with new developments in both the physical hardware and software experiences being released regularly to the public.

Oculus, owned by Facebook Inc., are one of the main producers of high-end VR headsets. Their Oculus Rift system allows for immersive, graphic-rich experiences, but also comes with the requirement of a high-end expensive computer to allow the applications to run. In September 2018, however, Facebook CEO Mark Zuckerberg announced the next development in VR technology – the Oculus Quest. This HMD has six-degrees of freedom giving the user the ability to move through virtual space, rather than simply standing in one spot and inbuilt sensors, allowing users to move and interact with their surroundings, but without the need for a high-end computer to run the display or the sensors. It will also sell for a price point of $ USD399, which makes it viable for schools to purchase sets. In addition, while the current state of highly immersive educational content is limited, once more schools have VR headsets the educational market will become more tempting for software producers and the amount of good education content should increase.

External venues are also increasing the availability of VR for educational purposes. Museums, galleries and many libraries are incorporating a VR component to their exhibitions. Brookline Interactive Group in Boston is an integrated media and technology education centre and a community media hub for the people of Brookline in Boston. It provides equipment, training and facilities for locals to hire in a similar fashion to a local library. It operates in the same building as Brookline High School and it allows the students to use the facilities during the school day. A new and exciting section of the hub is their public VR lab. The lab provides training and equipment for artists and media makers in Boston/Brookline, and offers low-cost VR Toolkits for libraries, arts and cultural organisations and educational facilities. Schools, other than Brookline High School, can also come and use their facilities free of charge.

As mentioned previously, VR World in NYC is a commercial establishment offering VR experiences for the public. However, they also have aligned certain parts of the NY curriculum to match with their VR experiences. VR World allows schools to bring their students in on Science, Technology, Engineering, Arts and Mathematics (STEAM) field trips which are carefully designed for various age groups and which are approved by the NYC Department of Education. This allows for schools in the NYC regions to access and harness VR content now without the need for the high initial financial outlay. With new commercial establishments starting to appear in Australia, including a similar concept to VR World located in Sydney, perhaps the NSW DoE could investigate mapping some NSW curriculum requirements in a similar way to the NYC Department of Education. This would allow the opportunity for schools here to offer their own students an exciting and educational VR experience, while at the same time investigating whether investing in a more permanent VR program at the school is viable. The inclusion of the VR and AR kits in the department’s new STEMshare Community Project initiative should allow for a similar investigation.

# Conclusion

To instil the virtue of life-long-learning among our students we, as educators, must be willing to disrupt our personal status quo and engage with new teaching strategies and ideas. Particularly the ideas that reach the lower levels of Edgar Dale’s cone of experience, providing greater opportunity for deep learning for our students through real or simulated experiences. During my study tour I have engaged with different XR experiences that demonstrate the powerful ways in which this technology can be used for educational purposes.

It is clear, both from my investigations and from my daily readings of technology blogs, that XR, and in particular VR, is becoming more mainstream. Over the years, we have observed that as technology becomes more accepted and widely used the options increase as the price decreases – often quite significantly. This is already being observed with the soon-to-be-released Oculus Quest, which demonstrates a significant upgrade to the technology while reducing the price that is required to start seriously engaging and experimenting with VR. The hype around XR technologies is increasing. Each week there are stories online outlining developments in hardware and new games and experiences to try.

Will XR technologies immediately transform teaching pedagogies within schools both here in Australia and overseas? From what I have read and researched during my tour; I do not think so. At least not in the near future. The cost is still too prohibitive and meaningful, educational content is sparse. What is clear, though, is that, while not currently being used widely in schools, VR and AR have the ability to be a useful and powerful tool for teachers to explore with their students. New technologies inherently bring excitement and amazement for the user. They promote inquisitiveness and communication and may encourage the disengaged student to participate. Even if, at present, these are the only benefits our students are gaining from using XR technologies doesn’t that alone warrant its use, or at least an investigation into its possible implementation?

I think it does.

At least in my reality.

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