

# The Use of Augmented Reality (AR) and Virtual Reality (VR) in the classroom.

Before we can understand how to use these technologies in our teaching, we need to understand what they are. Grier et al (2012) defined augmented reality (AR) as “a live direct or an indirect view of a physical, real-world environment whose elements are augmented by computer-generated sensory input, such as sound, graphics or GPS data.” A simple example would be using a Satellite Navigation system in your car. You are in a real-world environment and the sensory information from the device is guiding the direction in which you are driving, but you are still aware of the world around you. The film ‘Minority Report’ contains copious amounts of AR technology, which is now possible, if not actually being used commonly.

Eichenberg (2012) defined virtual reality (VR) as being an “advanced form of human-computer interface that allows the user to interact with and become immersed in a computer-generated environment in a naturalistic fashion”. Eichenberg, 2012. In this case, we are no longer in touch with the reality of where our ‘real’ body is and are immersed in the virtual world. The film series that started with ‘The Matrix’ is a good example of virtual reality and the use of a headset can result in people becoming so immersed that they get motion sickness while sitting still!

This paper is based upon a review of two Department for Education publications which lay out the Government’s strategy on the use of technology to support learning, and several academic papers around the use of AR and VR in teaching. As a result of this literature review, three areas have been identified to be addressed in this paper, and others which will be the subject of future publications.

The three areas are:

- a) Are AR and VR effective in the classroom? Is there evidence that they are at least as good as ‘normal’ teaching methods?
- b) Are there any ideas about what types of teaching strategies can be used with AR and VR, and whether any are particularly effective?
- c) Are there any subjects for which AR and VR have been proven to be of greater or lesser effectiveness? Is there evidence that this is something that can work in all classrooms or is it a niche idea that will only interest those teaching technology?

## **Effectiveness of AR and VR in the Classroom:**

There is extraordinarily little evidence from Further Education providers in the literature, but a fascinating paper by Allcoat et al. (2021) examined the way that University of Warwick students learned the same material (solar panel efficiency for Engineering students) when it was approached in the traditional lecture format, using an AR system where 3D objects were overlaid on the real-world and using a VR experience where the student was completely immersed in the online environment. Rather than being lectured using slides with graphs to consider the issues that affect efficiency of solar panels, the students using AR and VR were able to interact with a virtual experiment that covered the same material ([Video of the students in action](#)). The researchers tested the students' knowledge of the subject, experience of learning in terms of emotional factors, physical factors and engagement with learning and carried out 4 different tests to evaluate the technology.

After statistical evaluation of their findings, the researchers came to an interesting conclusion. The students in the AR and VR settings had learned the material as well as the students taught in the traditional way, but there were significantly higher scores for emotional wellbeing and engagement. This may have been the ‘novelty factor’ but the evidence is clear that learning is as effective in AR and VR environments as it is in the ‘real world’ and may have a significant effect on the emotional wellbeing of students. Allcoat et al. suggest that AR and VR might be even more successful as part of a blended

learning approach where they are used to supplement more traditional learning tools as there is evidence, from other authors, that blended learning is more effective than e-learning, but this paper does not allow them to confirm or deny this.

### **Teaching strategies for the use of AR and VR in the classroom:**

The pedagogy of AR and VR in the classroom has become the subject of recent literature, though much is from a US context.

O'Connor & Domingo (2017) report on how they have used the virtual environment provided by Second Life in their teaching. They explain the way in which they approached the development of the online resources and how they used these in the classroom, illustrating their work with examples from their own practice. I carried out an evaluation of Second Life last year using this paper as a guide, and it provides a useful tool for consideration of how virtual learning can supplement the physical classroom. The examples from practice provide evidence that this approach can work if the students have access to the Second Life system. Of particular interest is their list of activities that can be completed:

#### **Loop Interactions**

Activities can be extended by arranging for discussions/activities in breakout room to be brought into the larger class environment i.e., looping from class- breakout room - class. Open-ended and student-led interactions can amplify and extend the learning.

#### **Ice Breakers and Community Building**

Giving students an ice-breaker activity at the beginning of the course allows them to learn to use the software/hardware in a motivating and collaborative way which builds group cohesion. This is particularly important in virtual environments

#### **External Speakers**

External speakers can conduct interactive sessions using the audio speech and text chat tools and supported by visuals. In some cases, speakers might ask students to move to a different location where there was additional information for them to consider.

#### **Student Interaction**

This is enforced by requiring students to engage in activities that meet the learning intentions of the session. This can continue outside of the synchronous and there is evidence that the fact that they are interacting as an avatar creates the social presence demands of meeting face-to face.

#### **Interdisciplinary Activities**

VR allows teachers to plan interdisciplinary, cross-institution connections more easily. Without the constraints of rooming, time of day etc. tutors can create a more expansive environment in which different classes can meet for discussions, joint projects etc.

#### **Social or Educational Extensions**

Tutors can structure interactions in the classroom so that they integrate external measures and activities. For example, there could be links built to 'Skills for Success' or other forms of recording of student's skills, knowledge and behaviour development.

#### **Role-Playing**

The ability to have students within a virtual environment simulate the experience and cultures that they are studying is a powerful learning tool. Role-playing provides opportunities for students to practice social and behavioural interactions within the safety of an educational setting. There are many freely available online settings in which students can be immersed to allow for this facility.

#### **Shared Problem Solving**

VR allows students to be brought together to solve problems. This is a powerful social learning tool which also bonds students into coherent social groups. If virtual building is possible, students could work together to build virtual artifacts as part of demonstrating their solution.

#### **Assessment**

All the forms of assessment that are possible in a classroom can also be carried out in the virtual world, but it is possible to integrate assessment methods into the activities in a way which may not be possible in reality – for example, a student could demonstrate their understanding of the International Space Station by entering a virtual version.

#### **The Skies the Limit**

There is no limit to what can be done within a virtual environment. Since tutors decide what is possible within the educational learning space, imagination and practicality are truly the only limits.

Fegely et al. (2020) present the *Blended Learning Virtual Reality Inquiry Framework*, an evidence-based framework for the use of VR with a blended learning approach. This framework provides a way to consider planning for the use of such an approach. The lesson planning framework is presented here with most of the detail removed.

*A Blended Learning Virtual Reality Inquiry Framework* lesson:

When planning, and having identified lesson intentions., tutors develop a **Compelling question** that will focus the lesson for students by providing an interesting line of inquiry to guide the VR experience. This may involve problem solving, teaching or convincing others, analysing different timelines or even working within a hypothetical scenario. Once this is done, the tutor can make their **VR choice(s)**. They select VR experience(s) to meet the learning intentions and compelling questions for the lesson.

**Step 1: Introduction** Pre-teaching to the whole class before entering the VR experience. Tutor introduces lesson topics, build students background knowledge, shares the compelling questions, and confirms their expectations for behaviour in the virtual experience. Students create a hypothesis they wish to test as their answer to the compelling question

**Step 2: Group VR experience.** As a group, students become immersed in the VR environment and take part in authentic exploration of that environment, guided by the teacher. Students collect information that will help them to test their hypothesis.

**Step 3: 'Three Centers' rotational activities.** Students are divided into 3 and take part in a round-robin which includes teacher-led small group, collaborative, and independent digital activities. Students will rotate successively from one activity to another after set time periods. These activities are used to allow students to test their hypotheses:

Teacher-led small group: In teacher-led small groups, tutors guide students through a reflection upon the VR experiences.

Collaborative: Students discuss their thoughts and feelings about the VR experiences and defend their hypotheses about the compelling questions.

Independent digital: Students reflect upon their VR experiences and independently use the Internet to search for additional information they need to build context and meaning related to their experiences.

**Step 4: Closure.** Students will present their answers to the compelling questions or create artifacts which demonstrate their new knowledge, in the whole group setting

### **Is AR and VR for all teachers? Is there evidence it works for all subjects?**

There is no research that looks at subjects and the efficacy of AR and VR. There is a paper by Johnston et al. (2018) which is a content analysis of the pedagogies that underlie the various AR and VR systems that were available at that time. This showed that 24/36 were primarily tools for experiential learning, though there were example of direct instruction (in language learning) and discovery learning (in specific vocational areas and in the ability to visit museums and galleries online). Secondarily, 13/36 used discovery learning models. This tells us the AR and VR are particularly well suited to any learning where the student can gain from experiencing something new, and discovering from it, but that in some specialist areas other pedagogies can also be supported.

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