

## Train and educate with the use of technology

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### ABSTRACT

This paper is a breakdown of ways in which technology, in particular, simulation has changed the way we can teach and learn. It looks at the various technologies currently available, together with how they are used today and the possibilities for future development. Technology is progressively used far more within the workplace; hence the uptake of technology within the education sector is paramount. As the equipment used within the workplace has become more sophisticated so has the way in which people are trained to use it. Hence simulation is more widely used, often prior to the novice being allowed to lay hands on the actual equipment. This provides a safer and cheaper alternative, as well as potentially saving injury to both themselves and their future customers. The training aids adopted range from simulators, such as those used in pilot training, to role playing within a virtual environment. The theory behind some of the simulation tools and the history of their development is also included, together with a forecast into possible future developments. There are also problems when technologies replace the actual equipment, these are also highlighted. Studies have been done to assess the student's perception of simulated versus actual environments with mixed results and the factors which influence these will also be examined.

**Keywords:** *Technology, Simulation, Education, Training, New Zealand.*

### INTRODUCTION

As the workplace becomes more technology focused, educational institutes have to adapt to include the newer technologies. This paper looks at the use of one of the modern technologies, simulation, and the way this relates to both the workplace, and within education. These tools along with other technologies are being assimilated into a few educational institutes within New Zealand. Simulation encompasses a large range of tools from virtual worlds to specialist simulators such as flight or space pilot. There are even examples of simulations which use little or no technology such as the Assessment Centres operated by Lum (2005) in which technology in the form of cameras and microphones are used to assess suitability, and train potential employees, but not the Internet.

The use of simulation software has been in use for a large number of years to model projects where it is either too expensive or inconvenient to build physical models. Computer simulation began during World War II with the continuous Monte Carlo Models which produced graphs from data. Discrete simulation probably began in the late 1940s (Nance & Sargent, 2002). In 2009, the Institute of Operations Research and Management Sciences undertook a survey of simulation software. The products they were interested in should be able to run on personal computers and to perform discrete-event simulations. There were 48 products from 26 vendors (Swain, 2009). This gives some indication of the proliferation of such software.

The differences between the three terms games, simulation, and 3D Worlds are that a 3D world is a graphical environment where the player can become completely immersed, yet does not have to bear any resemblance to reality Simulation is an attempt to mimic reality and a game is more of an activity with set

goals and rules (Shepherd, 2007). The Venn diagram shown in Figure 1 indicates how these three intersect and the effects of that intersection. This paper concentrates on simulation although some of this simulation is influenced by gaming and 3D worlds.

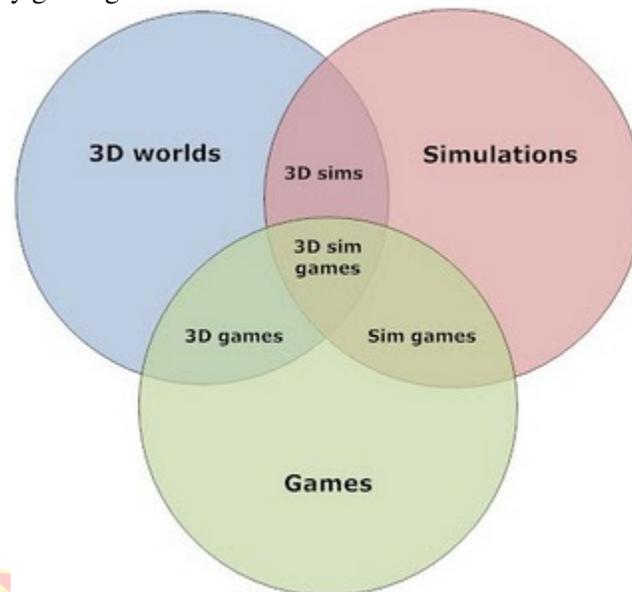


Figure 1. Venn diagram [Source: Shepherd, 2007]

## Type of simulations

### *Virtual Worlds*

3D digital graphics allow artists to express themselves using animations. this has become very popular, giving rise to a large number of applications such as Maya or Cinema 4D (Danaher, 2005). There are two main styles of 3D environments, those which adhere faithfully to natural phenomena, and those which do not; second life is an example of the latter. There are now blended environments which incorporate multi-media with communication tools such as chat to give an overall immersive experience (Chard, 2006).

One area of the application of digital 3D graphics is in virtual worlds. A virtual world is a computer based simulated 3D environment which allows users to inhabit and interact with each other (Kumar et al., 2008). The most famous example is Second Life, where people can join the community and even invest real money, which is then converted into the currency used within the virtual world. It is a totally fabricated world and allows its members to represent themselves as a software agent (bot) or graphical agent commonly known as an avatar. A 3D world which is true to an actual real life environment or situation is a 3DSim, but as this paper is only interested in these, it will be assumed that all Virtual worlds referred to within this paper are in fact 3D sims.

Industry have embraced this technology in a number of ways, one of which is in the planning of their factories to allow optimisation of layout to give the highest efficiency, and cutting down lead time between various operations (Waurzyniak, 2015). They do this by importing the data and modelling the real life processes, as in the example portrayed in Figures 2 and 3 which were used in a chocolate factory to create a “virtual factory” (Back et al., 2010). In the 1980’s the only tools available to help with this type of planning was diagrammatic and textual based.



Figure 2. Avatar in the virtual factory [Source: Back et al., 2010]



Figure 3. The real factory floor [Source: Back et al., 2010]

### ***Interactive task oriented simulation***

Simulation is one of the tools used for gaming, and as a training tool in a number of areas such as operating machinery, flying planes and driving. In these cases a virtual environment is built, providing a number of scenarios, which the operator may experience in real life. This allows a semi-automated system to enable and test the person's ability to act appropriately, thus eliminating the need for risking expensive equipment as well as preventing harm to people, equipment, and the environment. Multiple attempts at a solution may also be allowed, which fine tunes the problem solving aspect of the training and encourages the critical reactions necessary to become an automatic response making them faster and more appropriate.

Trades can also use simulation to allow a safer environment for people to learn in. Figure 4 shows the equipment used to train welders at all levels. These may include those who are experienced and are checking their technique before attempting their regular certification, and novices who have no previous experience or expertise.



Figure 4. Welding Simulator [Source: Electric, 2016]

When the researcher had a go on this equipment, the trainer explained that they use this to train the muscles and teach techniques, before allowing people on the real equipment. The personal experience of the researcher can support the claims made by the equipment manufacturer that it teaches such things as: Body position, Gun angles, Travel speeds, Gun position and Welding techniques allowing her to achieve 80% in all of these, thus allowing clearance to progress onto the live equipment, which is still to be achieved.

Simulation is used extensively within health care both as a means to predict outbreaks of disease and subsequent progression of these outbreaks, and training students to perform specific procedures without the associated risks. People can practice procedures on manikins which react to the treatment in a similar way to a real patient, thus minimising the risks associated with practising on a real person. There is also research being undertaken into the use of simulation to perform procedures and operations from a distance, allowing specialists to widen their geographical impact. The progress in this area is progressing at a rapid pace with diagnosis and some treatments already being performed this way. A medical practitioner cannot be an expert in every field, so these methods allow the experts to become available to a wider group of people.

Simulations as a research tool are also becoming more popular, with the rapid development of computer modelling to test possible theories before trying them on more expensive equipment. The processes which are being simulated can be run multiple times, change a number of different variables, and observe the effects of these changes on the outputs. This cannot often be achieved easily using other methods (Berends & Romme, 1999).

#### ***Other uses of simulation***

When the weather prediction is given on the TV or Phone, the predictions have been modelled using simulation and taking previous weather patterns and looking for trends or past experience. Climate change prediction also uses simulation to attempt to show the effects of climate change. The prediction of election results also uses simulation together with mathematical models to attempt to predict the outcome. All of these, as with any computer based software rely on the correct factors and data being input.

Sometimes some of these are incorrect or missing vital pieces of information, which have an effect on the results, thus giving an incorrect prediction.

A lot of simulation is used both in space training and training for expeditions into unfamiliar territory. This includes preparing the astronauts for space travel, and testing equipment to be used within alien environments. There are also programs which act as a tour guide through space. The original computer games were based on space travel with Space Invaders being one of the earlier ones. These games have become more sophisticated and have used simulation tools to try and reproduce the experience of space for the user. Some are more true to life than others.

### ***Impact on education***

Virtual environments have been used within education for a number of years now, giving people access to parts of the world, or historical events they would otherwise not have been able to experience. Even the teachers are using simulation tools to train and learn how to handle specific behaviour within the classroom before they enter one in real life (Bouki, Mentzelopoulos, & Protopsaltis, 2011). This means that when a similar situation arises during a teaching session, the teachers who have been exposed to these simulations are more likely to act with confidence and implement appropriate solutions.

Technology is now an integral part of society, so the people who maintain and build this technology are in high demand. There is a real shortage of qualified people with appropriate skills worldwide, so any aid to training people in this field is an asset, and considering that simulation makes extensive use of technology makes sense to use it to train technologists. Simulation software allows students to watch how their changes to equipment affect the overall running in real time. This helps in the training in such areas as hardware design and development, architecture and operating systems (Black & Komala, 2011).

In a case study of Alsaaty (2014) showed that the students' results improved after using the simulation game. This game was designed to enhance their knowledge of business processes by allowing them to manage a virtual company. The number of functions was variable, which allowed the game to be played at different levels of complexity making it valid for all levels of students.

As part of this research, the researcher was invited to look around the simulation labs within the health faculty of her institute, by the person who designed and operated them. A few observations were made by the lecturer involved that not all uses of simulation are positive. One example of negative influence which he quoted was of a student who, as part of the simulation killed a patient, and was told they had killed the patient and to go home and think about it, which provided little or no learning, in fact, it could have prevented them from returning to the course. This strongly indicates that if simulation is to be used it must be managed appropriately and incorporating good constructive feedback. The recommendation is to video record the scenarios while the student is performing them, and then use these videos in a debrief session to indicate positives, and the areas where improvements could be made. The equipments shown were manikins with a wireless connection to a booth, which was not visible to the students, but where the instructor could watch and act as the voice of the manikin when questions were asked about symptoms. Some symptoms such as pneumonia or seizures could be triggered by the instructor. The researcher has been invited into this booth when simulation classes are being held. Actors are also used to mimic other patients and relatives to provide distractions and give a more realistic environment.

Another way of using simulation is by using virtual worlds. One method is by allowing a number of different students to inhabit together in a virtual world, which acts as a real life environment. These students could conceivably be from different cultures, geographical areas, and be part of different courses. This fosters such things as communication, team work, and the how independent the students are. In assessing simulation tools the following criteria must be considered:

- Number of participants allowed

- Level of structure – variations, dependencies etc.
- Educational objectives – what are the learning outcomes?

In order for these to be satisfied the factors of communication, interactivity, setting and recording capabilities have to be considered (Chodos, Gutierrez, & Stroulia, 2012). Ideally these simulations should be able to be adapted for the various departments within the healthcare environment for example: ER, Psychiatric, Post OP and ICU.

In all these cases simulations do not replace real work experience but allow the students to be able to practice in a safe, economical environment before they enter the real environment. Hopefully this will mean a lower overhead in materials, lives and equipment damage. In theory, it should also reduce stress levels for the students as they will already be familiar with the procedures. As the instructor who taught welding said “They teach muscle memory” so some things will be second nature by the time the student arrives on the job.

### ***Future possibilities***

Over a great number of years, simulation has developed from partial simulation on a single platform to a multi-platform, multi-user and distributed system. This means that it has developed into its own separate discipline (Sun & Wang, 2008). As electronic communication becomes more reliable and faster, the ability to develop simulations which are closer to real time and real life will be greater. The processing power needed to drive such systems is becoming freely available and the trend for more processing power to become cheaper has not stopped. The number of systems available is growing by the minute, but as with all software development the quality is dependent on the ability of the people developing this software.

Virtual reality is in the mainstream as the hardware gets smaller, lighter, and cheaper. It is possible to gain a virtual reality experience with a Smartphone and a set of cardboard glasses known as Google cardboard. Development on these Virtual Reality platforms is growing, thus giving more options for the user of the hardware. Mainstream media are currently experimenting with 360 degree cameras to enable their productions to be viewed in a virtual environment. Think of some of the futuristic television programs such as Star Trek or movies such as the Matrix series, how far are we from realising the tools available within them?

The main aim of the current research seems to be to bring all the available ideas and tools together to provide a rich and user friendly system in as many areas as possible, while reducing the cost of these tools. The future looks very exciting, and if the speed of the past developments is anything to go by, these ideas will permeate through all aspects of our lives. Education appears to have taken up the challenge of using modern technology, and is embracing it at all levels as a means to produce better prepared graduates. These developments also allow for opportunities to open up education to more of the worlds’ population.

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