Interactive Learning: The Use of Virtual Reality in UiTM Education System

Anis Hasliza Abu Hashim
Norfiza Ibrahim
Mazliana Hasnan
Roslan Jamaludin

ABSTRACT

Current rapid development in Virtual Reality (VR) technology has led to many successful applications that are very useful in many fields such as in learning and training in many disciplines. VR technologies have been evolving during the past few years, leaving research laboratories and finding application in a number of areas. Virtual reality promises the creation of environments that are vivid, lifelike, and highly interactive, and where the user will be able to emerge in a synthetic world that may not exist or may be too difficult or too dangerous to visit in a real-world situation. Many examples of where VR has been used for educational purposes around the world. Each has shown a level of success even though the technology was extremely limited. It seems that the successful of the area was attributed to the flexibility offered by the virtual environment. There is no doubt that the students who used a VR based system enjoyed themselves. It is highly likely that this factor contributed to the sense of fulfillment that the students reported. The main objective of this paper is to introduce the use of virtual reality in educational field and convey the knowledge and the applications that have been done and currently being done in the virtual reality area. UiTM could benefit the technology of VR in many ways as this technology is becoming very well-known and easy to access.

Keywords : *Virtual reality, interactive, educational*

Introduction

Virtual reality is becoming more important nowadays. The use of its applications in many fields has led to many companies and researchers to invest in and investigate the technology and what it can offer them. Virtual reality has becoming more powerful and cheaper each day compared to the early days where this technology was considered rare and complicated. Over the years, virtual reality has been greatly improved and this has made the technology easily accessed whether at work, school or at home. There are many virtual reality applications which can be found in the educational field.

What is Virtual Reality?

Virtual Reality (VR) was initially invented by Lanier, the founder of VPL Research in 1989. It is also known as 'Artificial Reality' (Krueger 1970s), 'Cyberspace' (Gibson 1984), and recently, 'Virtual Worlds' and 'Virtual Environments' (Gibson 1990s). Virtual reality is a computer-generated simulation of a three-dimensional environment, in which the user is able to both view ad manipulate the contents of that environment (Matsuba & Stephen 1996).

Virtual reality involves using advanced technology that allows user to interact and immerse into the computer generated environment and manipulate the objects in the same way they would manipulate them in the real world. It requires various multimedia peripherals, to produce a simulated environment so the user will be able to hear, visualize and interact with the artificial environment. The nature of virtual reality is that the experience in participating with the environment. The user of a VR system has the freedom to explore the world and interact wit it in new and exciting ways. The whole idea is to be an integral part of the virtual environment and to have a direct effect on it in the same way that the user has on the real word (Matsuba & Stephen 1996).

There are a lot of VR applications being developed which covers a very wide field, from medical to architectural, games and education. VR applications provide such benefits to the user, for example, to treat patient with phobias such as fear of flying.

Mainly, there are three different kinds of VR, categorised by the quality of the immersion that is being provided (Cronin 1997). Desktop is the most common form of VR which typically consists of a standard desktop computer. It is the least expensive form of VR and user might feel least immersion of the environment.

Second, a semi-immersive VR system attempts to give the users a feeling of being at least slightly immersed by a virtual environment, which is often achieved by different types of so called workbenches and reach-in displays.

The third form of VR is usually referred to as being fully immersed. Head-mounted display unit allows user to be isolated from the outside world. There are a few fully immersive VR hardware that have been developed, for example CAVE. It is a room which the walls around the user produce images. The issue with VR is that, to support a full immersion environment, it will be very costly and time consuming. VR is a technology that cannot be left out for the applications that in reality does not exist yet, cannot be accessed and too dangerous or too expensive to give up.

VR Systems

As a guideline, a virtual reality should have the three following characteristics:

- response to user actions,
- real-time 3-D graphics,
- a sense of immersion

Since immersion is the important aspect of a virtual reality systems, it is necessary to understand it before getting involve in it. VR gives the effect of immersive by placing a person into the simulated environment that gives him the feeling of being inside the environment.

A Head-Mounted Display

This VR hardware allows people to associate most strongly with VR. It is a combination of four things, one or two display screens, some optics, a set of stereo audio speakers and a tracking system. The tracking system measures the location of user's head and hand while observing the environment.

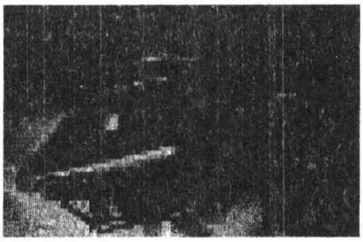

Fig. 1: A Head-Mounted Display

Desktop VR

Instead of a head-mounted display, a large computer monitor or projection system is used to present the virtual world. This is a well-liked choice for business users due to the insufficiency of existing head-mounted displays. It could also be described as a window on a world. High-speed renderings are very important to achieve in desktop VR so as to obtain a real-time response with every input. The low cost of desktop VR systems make them so attractive for many applications with low budget.

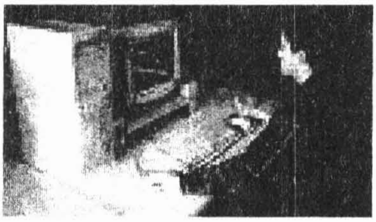

Fig. 2: Desktop VR

VR in Education

"If there are limits on the human ability to respond to learning environments, we are so far away from the limits as to make them presently inconsequential. Throughout human history to date, it has been the environments, not the human beings that have run up against limitations (Leonard 1968)."

There are several reasons why VR should be regarded adequate to deal with aspects that are important in education and knowledge construction, even at university level. Winn (1993) identifies three kinds of experiences that fully immersive VR allow and which are not available or even possible to achieve in the real world. It is important in learning that users are allowed to make mistake. First, VR technology allows changes in the relative sizes of the user and the objects in the virtual environment. The user could join with and even step into atoms and electrons, while on the other hand, it could obtain a sense of distance in the universe by visualizing planets and moons. Second, immersive VR makes use of multi-sensory cues to interact with the user which allows the designer of the virtual environment to use interface devices to present information that is not available to human senses in a direct and clear manner. For instance, variations in the intensity of sound may be used to indicate the current level of radiation, and different places could be given different colors that correspond to the current temperature in that area. Third, VR allows the creation and visualization of representations of objects and events that have no physical form in the real world, by combining aspects of the first and second category.

The ability to work with abstract and multidimensional information is a crucial skill in today's society (West, 1991), not only in the academic world but also in other field as a whole. Traditional methods of displaying and visualizing models and data, for example on computer screens or in books, are in two-dimensional and so much alike to their nature while in reality these models are in three-dimensional object. VR gives the opportunity to the students to explore and interact with the models on different points of view.

In most academic areas, such as math, science, engineering and statistics, success on behalf of a student depends to a large extent on his or her ability to envision and manipulate abstract information (Gordin et al. 1995). Until now, the development of the VR technology has concentrated more on applications to fulfill the requirement of training and simulation for educational purposes. This field of application includes a vast number of vehicle simulators, such as space shuttles, airplanes, cars etc.; medical training such as surgery and telemedicine; as well as a host of military utilisation within combat simulation and group communication and training. As for training and simulation purposes, the use of VR applications and technology has proven useful and successful. The reason is that by using this technique, it allows user to make mistakes during the learning process, which in reality cannot be accessed.

The properties of a good VR are like those of a good teacher; it allows the student to explore the basic laws of a new domain; location, scale, density, interactivity, response, time and level of intensity can be varied (Piet et. Al). For educational purposes in general, VR has been widely proposed as a significant technological breakthrough that possesses an immense potential to facilitate learning (Youngblut 1998). Reasons for this are that VR allows students to visualize abstract concepts, to take part in and interact with events that for reasons of distance, time, scale, safety or money would not otherwise be conceivable. Despite this promising potential, there seems to be a very little amount of VR applications today that concentrate solely on learning as distinguished from training.

Learning and training are two different things. These two may be difficult to separate and also dependent on each other. Learning consists of acquisition of information that is provided by the, in this case, virtual environment. Training, on the other hand, involves mainly responses from the user on the environment itself. Training arises from actions carried out by the user on the environment, while learning results from contextual inputs (Gorzerino et al. 1997).

VR facilitates new kinds of learning experiences that are highly perceptual in nature, and which enable the students to be immersed within the environment visually, auditory and haptically. In our view, it would be feasible to create virtual environments where difficult and abstract models, intangible phenomena or intellectually demanding processes are modeled and with which students can take part and interact. The idea is that students are better able to master, retain and generalise new knowledge when they are actively involved in constructing the knowledge through learning-by-doing. This constructivist view of learning has gained considerable ground in recent years, with supporters that range from those who see it as a useful complement to traditional methods, to those that argue that the whole curriculum should be reinvented (Youngblut 1998).

With the traditional approach, students learnt and understood by knowing the facts, rules and examples. This creates problems to many people as they learn what they are supposed to. This might cause, in short term, the students to pass tests and exams, but they do not really understand the subject and fail to apply the knowledge in the future. From the weakness of the instructional approach comes the idea of exposing students to experiences that trigger insights and thus, lead to better understanding of the phenomenon as a whole. Some academics are worried that the fact of this kind of understanding is sometimes difficult to convey and, hence, difficult to assess on the part of the teacher and the academic world. Learning-by-experience is a powerful way of gaining knowledge and understanding. With the technology of VR, it could enhance for better understanding to the students. It helps the students to obtain understanding.

Dede et al. (1997) tries to approach this challenge to learning-by-experience with what he calls reflective inquiry. Through experience, students can construct, extend and modify their mental models through the discontinuities between expected and actual behaviors of a given phenomenon. Before students enter the virtual learning environment they are asked to describe the phenomenon they are about to experience, and predict its behavior. After the students have experienced the phenomenon they are once again asked to describe it, for example, to explain why what they thought would happen did, in fact, not happen. In this way teachers are to some extent able to assess a student's knowledge and understanding of a phenomenon, and the student is at the same time is forced to try to make his or her understanding conscious and explicit.

Examples of VR Applications Designed for Learning

There are quite a few numbers of educational worlds of VR applications existed that are used to enhance learning.

The reason might be because of VR technology and software were developed based around military research and space exploration where defined processes and known chain of commands are essential while the need for understanding might be considered secondary. However, there are a few VR applications which have been developed for academic fields and which to varying degrees make use of immersive VR and the constructivist philosophy of learning. The vast majority of educational uses of VR have involved pre-developed virtual environments which students visit alone to learn some basic concept. Other educational uses require students to develop their own virtual worlds in which to explore their knowledge of a given subject. A third category of virtual educational environments include multi-user spaces and distributed VR applications, where students in groups form knowledge (Youngblut 1998).

ScienceSpace is a collection of virtual worlds designed to explore the potential of multisensory perception, physical immersion and constructivist learning in order to enhance science education (Dede et al. 1997). It consists of three worlds in various stages of development; NewtonWorld, MaxwellWorld and PaulingWorld. In NewtonWorld, users experience the laws of motion from multiple points of view. In this virtual environment, neither gravity nor friction is present and the users can interact with bouncing balls and see, hear and feel collisions between the balls and the virtual environment.

In MaxwellWorld, users build electrostatic fields and are able to manipulate representations of force and energy within the virtual environment. They can change their frame of reference to an egocentric view by becoming a test charge that is influenced by the forces of the electric field, and they can also experience and manipulate the phenomenon through an exocentric field of reference. One reason behind the construction of this world is that students often seem to confuse the concepts of force and energy, indicating that they do not fully understand the meaning of the representations that are traditionally used (Dede et al. 1997).

In PaulingWorld, users can explore the atoms and bonds of a set of five different molecules, ranging from simple to highly complex. Users can view, navigate through, superimpose and manipulate these molecules to gain a better understanding of how they appear, something that is much more difficult to achieve using two-dimensional interfaces and models.

A common identifier for the three ScienceSpace worlds is that they all utilise direct manipulation and multimodal interaction, allowing students to interact directly with objects in the virtual environment without having to shift their attention from the phenomenon of interest to manipulate menu systems or other cumbersome interfaces. ScienceSpace worlds also produce multisensory cues to convey intangible information. These have been found to engage learners and direct their attention to important behaviors, patterns and relationships. Dede et al. (1997) also recognises that enabling students to experience phenomena from different frames of reference appears to facilitate the learning process, and being immersed in a three-dimensional environment appears to be highly motivating for students, inducing them to spend more time on a phenomenon.

A project in a completely different field, archaeology, called the Vari House, has made use of simple desktop VR technology. Two linked virtual environments show the excavated Vari site in Greece as well as the complete Vari house as reconstructed by archaeologist. The reconstruction shows both the interior and exterior of the building, and students are guided in their exploration of the environment by answering questions that are thought to help develop critical thinking about archeology and the findings. The goal of the project is to integrate archaeological data with advanced computer graphics to support education, data analysis and the preservation of the cultural heritage of the Vari region (Youngblut 1998).

Users might identify some aspects of the Vari House project that could be enhanced by the use of fully immersive VR, which the current use of desktop VR does not have the capability to fulfill. First, allowing students to be fully immersed by the virtual environment may enhance the application, providing the users with a richer and deeper experience that could provide a sense of "being there". Second, the desktop VR approach does not allow for complete user control and navigation within the virtual environment. Third, the Vari House does not allow multi-user cooperation and communication.

Another project in the same field is called the Learning Sites project, which encompasses some of the limitations of the desktop VR approach of the Vari House project. In this virtual environment, users are able to explore a number of ancient archaeological sites that have been created by rendering of precisely recorded data from the real sites (Keppell et al. 1997).

In this virtual environment students are able to fully control the interaction with the model. For example, if a specific wall painting interests a particular user, that user may investigate that specific area in more detail while completely ignoring the rest of the site. Highly developed virtual environments such as the Learning Sites may attract users from several different fields, ranging from small school children taking guided tours in groups with their teacher, to real archaeologist doing real work, on to tourists just having plain fun. The list could go on indefinitely, but even if this still remains in the realms of science fiction, work in this direction is being carried out and the utopia might not be so far away as one might imagine.

Yet, another project worth mentioning is the Zengo Sayo. This is a virtual Japanese-style tatami room that is designed to provide an approach to teaching some basic aspects of the Japanese language. The Zengo Sayo makes use of immersive VR, and is aimed towards college students (Youngblut 1998). This field of application should prove a very promising area for VR, since it is a commonly held view that it is difficult learn to speak a language without being immersed into an environment where the language is spoken. VR opens up tremendous possibilities in this area. Imagine being able to put on your head mounted display and be immersed into a French café or not a smoky English pub, and be able to interact and communicate within the environment.

The Global Change project intends to develop knowledge and understanding of basic relationships among causes and effects of global environmental change. The immersive virtual environment contains different views of the Seattle area, and through inquiry based scenarios the users are allowed to change the levels of a host of variables such as industry and cars. The users can see the effect of these factors on the environment, and they are able to move back and forward in time. Otherwise, the Global Change project shows that learning and simulation is not always easy to differentiate between, and more importantly, this differentiation is not always necessary. This example expands the use of VR in education to the social sciences as well, and we may imagine numerous other possibilities in this field, including politics and economy to mention a few.

Woodward (1992) identifies the possible contributions of VR technology for students with disabilities. Not many VR applications have been developed to cater with disabilities person due to lack of research in this area. It is important to stress this matter as to ensure equitable access to advanced technology for students with disabilities.

Virtual Reality in UiTM

As the technology of VR is growing everyday, UiTM could benefit some of them. There are still a lot of fields in VR which we can learn and explore. A lot of research can be carried out by using this technology which can benefit the researchers and students. Applications such as simulation surgery can assist the students to practice the surgery in the virtual environment. This could safe patient's life and eliminate faulty. Chemistry students could experiment the mixture of high explosive chemicals in the simulation world without having to worry about the possibilities of getting burn in the explosion. UiTM also can build its own Virtual Reality centre where a lot of users could benefit from it. The fly through the building is very well-known for the architectural purposes. This VR application is very useful for town planning students as they can design and organise the area with high density of population easier. With the application, they can design and plan on how to manage the evacuation of the civilian if any problem occurs in the area.

VR can enhance, motivate and simulate students' understanding on the area which traditional learning style has proven difficulties, inappropriate and costly. Traditional learning environment expected students to learn by listening to the teacher or reading a book for a particular subject. However, in some circumstances, this type of learning is not feasible. Dede et al. (1997) argues that the mastery of abstract science concepts requires learners to build mental models about a phenomenon that often must incorporate invisible factors that represent intangible concepts, items and abstractions. One problem involved in doing this is that students generally lack real-life analogies on which to build these mental models, simply because there are no such events that can be perceived in the world as we know it. Because of that, learners cannot draw on and relate to personal experiences for these phenomena.

Conclusion

There are many applications for VR. VR training can significantly reduce the cost of delivering training and could decrease faulty. For example, surgeons could rehearse a surgical operation on a virtual patient before attempt the real person. More and more educational VR applications have been developed to assist students in understanding more about the subjects. Not only students can travel and navigate into the VR environment, they also can manipulate and physically explore the object inside it. VR environments can support not only student's spatial awareness but also temporal. User perception time affects user acceptance, ease of use and the level of realism of a virtual learning environment. VR has become a substantial and ubiquitous technology and subsequently go into the applications for education, learning and training. Although VR applications have shown many benefits, it still has some drawbacks.

VR is extremely expensive, the graphics are still not good enough and there is still a slight but perceptible time lag between the user's body movements and their translation in Cyberspace. The use of VR systems needs refinement. People using VR head gear sometimes complain about chronic tiredness, lack of initiative, drowsiness, irritability or nausea after using it to interact with a virtual environment for a longer period. This paper has introduced virtual reality technology and applications that is related to educational and training. It also introduced some examples of applications from different aspects of VR.

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ANIS HASLIZA ABU HASHIM, MAZLIANA HASNAN & ROSLAN JAMALUDIN, FTMSK, Universiti Teknologi MARA Pahang. anishasliza@pahang.uitm.edu.my, mazliana@pahang.uitm.edu.my, roslan961@pahang.uitm.edu.my

NORFIZA IBRAHIM, FTMSK, Universiti Teknologi MARA Perlis. norfiza@perlis.uitm.edu.my