A Study on Effect of Virtual Reality Learning On Students: Usage on Classrooms

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Abstract- ***Educational environment has faced and continues to face a lack of personnel, especially in fields of activity difficult to be understood like mathematics or physics. For this reason, schools are required to teach their students in classes with more students, being difficult for teachers to explain and exercise with every student individually. This involves blocking the activity during class of both the teacher and the other students. For a better understanding, in all science courses, the teachers usually spend multiple hours on the same subject, at the same time. After completing the subject, students need practice for memorizing and often need the teacher to help with homework. Because an active individual teacher, even virtual, is easier to be understood than a written instruction, the authors propose the use of virtual environments as a 3D Virtual Reality. The use of 3D Virtual Reality offers a number of advantages, including: the possibility of working at the same time while following the instructions, reviewing the course material or following a teacher resolving an exercise without having to interrupt or taking a long time to resolve the homework. This paper presents the possibilities of using 3D Virtual Reality devices for individual learning.***

Indexed Terms- ***Education, Learning, Digital Content, Virtual Reality.***

I. INTRODUCTION

With progressive twenty-first-century 3D virtual technologies, the ability to blur the lines between material reality and digital worlds is proliferating in classrooms across the globe [1-5].

Virtual reality (VR), which can be described as immersive multimedia or computer-simulated reality, replicates an environment that simulates a physical presence in places in the real world or an imagined world, allowing the user to interact in that world [6-15]. VR has a long history – its technical foundations could be traced back to the early 1950s, even though it has been a concept long ago conceived. A common definition of VR focuses on technology and refers to a collection of software and hardware for creating computer-mediated simulation [16-25]

Nowadays VR is a very deep and effective technology on human perception. The VR technology importance creates a new simulated world. VR technology is becoming a special and cost effective application and its future will have a positive impact on technology [26-30].

VR delivers to us in a real world where humans can have strong and easy interface message communications. Moreover, VR technology is capable of humans as a part of new ideas inventions in the world. VR technology provides us widely concepts, which use the expanded sensory relationship with humans. VR manipulates different kinds of environments, which get special goals and enhance the capabilities in architecture, interior designers, and engineers. With the help of VR, multiusers become and execute collaboration, which highlights the human's creativity, and most people can deliver their opinions. VR technology provides an excellent platform, which can stimulate the dynamically real world. As well as VR increase productivity in different business areas and introduce new real world because it is difficult to imagine a graphics workstation [31-42]. The purpose of this short paper is to discuss types, benefit and effective usage of 3D learning.

II. LITERATURE REVIEW

This section included on the virtual reality and related work of effect of Virtual Reality Learning on students: usage on classrooms as following:

- Virtual Reality

If people look at VR history from 1965 virtual world started. It was the first idea generated which is Real Cool, Sound Real, and delivers good realistic actions to viewers. In different decades of research on VR, research details are as under 1960-1962 decades which one multi-sensor stimulated and prerecorded film, which was colored and stereo. Then in 1965, a second idea was demonstrated in the name of "DISPLAY ULTIMATE " based on construction artificial concept and it is reality graphic interaction sound. Figure 1 shows the VR architecture and their mechanism [43-53].

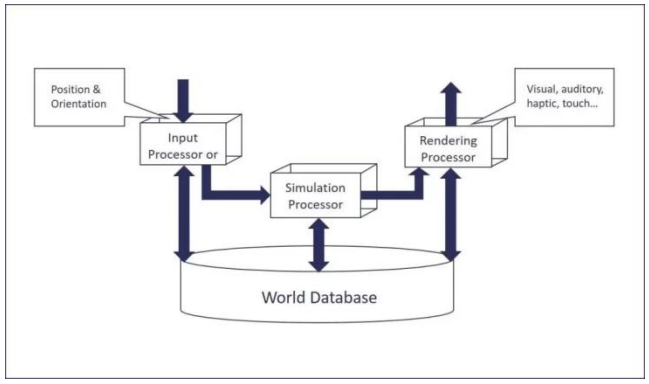

Figure 1: Architecture of Virtual Reality

Virtual reality (VR) is a simulated experience that through hardware and software integration can be like or completely different from the real world. It allows users to interact inside a simulated environment constructed by computer programs. VR technology can create a special region that mimics that of the real world via providing functions such as stereoscopic vision, hearing, touching, and experiencing. VR technology is growing to be intensively popular and widespread as the metaverse ushers in a new era of digital connectivity. It can be effectively used in various subjects, such as education, business, gaming, medicine, new employee training, entertainment, social networking, tour guiding, etc. [54-64]

- Related Work

VR is a very popular technology allowing visualisation of various phenomena and concepts enabling students to better grasp complex terminology definitions. For example, its benefits on learners' attitudes toward mathematics and design activities are investigated in (Simsek, 2016) on 28 secondary school third class students, showing increased positive attitudes and interest in mathematics for the experimental group. Another positive example of VR use, specifically in geometry secondary school teaching, is presented in (Guerrero, Ayala, Mateu, Casades, &Alamán, 2016), where mixed reality technology created by combining tangible interfaces and virtual worlds (Mateu, Lasala, &Alaman, 2014) allowed a more meaningful learning ensuring a higher grade of knowledge retention. VR can also play an important role in VLs (Heradio, et al., 2016), which allow visualising various experiments in subjects such as Physics or Chemistry when certain facilities are not available. It needs to be noted that the use of VL has been shown to provide a similar or increased level on knowledge compared to traditional labs[65-78].

Many studies have shown that virtual reality can be especially useful in education. Virtual reality has already been used in courses such as Biology, Chemistry, Physics, Astronomy, and Medicine [79-82]. Three-dimensional imaging, interactivity, and immersion make virtual reality a useful method that can stimulate motivation to learn and make the learning environment more engaging and effective [83-89].

For example, astronomy is a key issue in science in which students face difficulties. Many children have difficulty understanding concepts such as the size and shape of the Earth, the phenomenon of day and night, the phenomenon of the seasons, and the orbits of the Earth, the Sun and the Moon. Research has shown that many misconceptions of astronomy were found in children from different countries (Parker and Heywood, 1998).

The usual disc-methodical methods of these topics make use of lectures, websites, two-dimensional diagrams, Flash animations, scientifically quality telescopes, and images with NASA space data.

However, Parker and Heywood showed that two-dimensional diagrams that try to represent 3D space are difficult to interpret and do not help to understand these issues.

Also, Pena and Quilez (2001) showed that images and diagrams in textbooks do not always facilitate the understanding of concepts. Misleading 2D diagrams and images can promote misconceptions in children. In contrast, research has shown that the use of virtual reality can pre-emptive spatial perceptions and can provide students with an immersive learning environment.

Virtual and augmented reality technology has also been leveraged in the field of digital, educational applications and games (Pena and Quilez, 2001). At a practical stage, however, the use of virtual and augmented reality in the classroom is at an experimental stage, especially in terms of the extensive use and utilization of corresponding applications in the context of teaching courses and chapters of the curriculum (Huang, et al., 2010) [90-95].

A tool that utilizes virtual and augmented reality applications that are of increasing interest in the educational world, is virtual tours and projections of three-dimensional models and objects. It is a form of virtual tour of open locations, interiors of buildings, works of art and culture, or a virtual processing of objects and models in their three dimensions (Marsh, 2018).

In the case of three-dimensional projection of objects through augmented reality, students have two basic options. One concerns the viewing and processing of the projected models in the three-dimensional imaging environment of smart electronic devices and the second integrates and adapts the objects in real, realistic environments utilizing the camera of the devices and the corresponding augmented reality software (Marsh, 2018).

III. RESEARCH DESIGN

To establish a common ground where applications from two environments can be evaluated fairly, it was important that an educational application that has same features and visuals. This is very hard to come by, where the VR application market is yet widely open to the public and the fact that we are at the same time looking for an educational application that fulfils these requirements. It made more sense that we would create our own application where we could make sure that both sides are represented fairly in the evaluation. Therefore, we chose Design Research as our research approach. Design research is a problem-solving paradigm that evaluates and identifies problems with an artefact. In this case we would be creating our own artefact (Prototype Application) and evaluate it instead of evaluating an existing one and by doing so we will be able to answer our research questions (von Alan, 2004). For instance, Karagozlu (2018) designed an augmented reality application to improve students' problem-solving skills in science subjects.

- Analysis on Adoption of VR in classrooms

VR has shown great promise in improving teaching and learning methods, particularly in a post-COVID-19 world, where there has been a wide application and acceptance of technology in learning, even in less privileged countries and societies. As was mentioned in previous sections of this paper, many empirical studies have reported VR's positive impact on education across various subjects and at different levels of study, including higher education. However, authoring VR learning content is not an easy task; creating 3D models and providing an immersive learning experience is a complex process.

Currently there are many other mobile HMDs in the market following the Google Cardboard idea. Simple and cheap wireless HMDs that works in combination with an android or iOS devices and uses the stereoscopic display and the head tracking of the device. But Samsung had an idea of improving the wireless HMD experience that utilized mobile devices by introducing their own upgraded version building on top of the Cardboard idea[96-101].

Figure 2: Key Features of Samsung Gear VR

A. Storyboard Design

1) Menu Display
In this main menu, there are two choices of material that can be chosen by the user, the material of the solar system and eclipse material.

2) System design
In this process the author design the Game Design Document that include the main aspects about the game such as the rules, scoring, visual design, and leveling. Also, Collect and make the assets that used in the game likes sound assets and 2D or 3D models. Assets collected from the Unity Assets Store or another resources. Process of making scene in Unity according to the storyboard that already made with arrange all of the 3D assets, text, music, and adding visual effect. Avatar also added to represents the presence of the teacher and the students in virtual world. Adding the control function to the player such as pointer interaction, select, and grab object with processing the input value from controller device. Connecting one device to another so they can interact inside the virtual world. Implement object spawn and also player's movement synchronization using Photon Unity Networking.

This study aims to design a multiplayer-based learning media applications by utilizing a HMD device and device controller as an input and output device and a server to process data that can be used in multiplayer (Figure 3). Data input received will be displayed in the form of an avatar and interaction with virtual environments which will then be processed by the server so that it can be received and observed by all players. In order to realize this final project, a system design that describes the concept and work of the system is made [102].

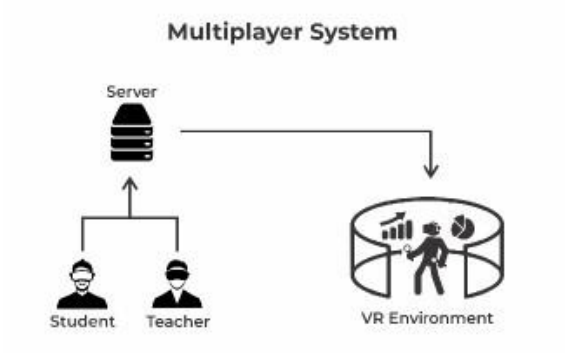

Figure 3: System Design

3) Solar System Material
In the material of the solar system, students will be confronted with spawner where later on this spawner will appear a planet randomly from the eight planets in the solar system. Students are asked to place the eight planets in the appropriate order, then observe the eight planets in the solar system revolving around the sun.

By making it as realistic as possible we made sure to calculate the distance and the rotation speed of the planets. When the user is in a planet scene they are still able to see the other planets orbiting around the sun to get a different point of view of our solar system. Both the VR and non-VR versions of the application have the exact layout, text, models and scenes [103].

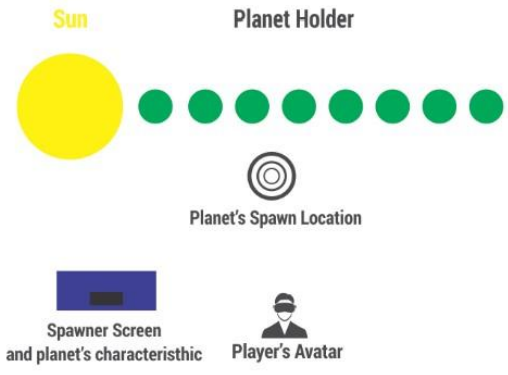

Figure 4: Solar System Scene Plan.

4) Making game design
Inside the VR class for planets learning, for example, there could be game developed as a tutorial. Students have to identify the accurate position of each planet in our solar system relative to the sun and answer a bank of questions about each planet in our solar system [104].

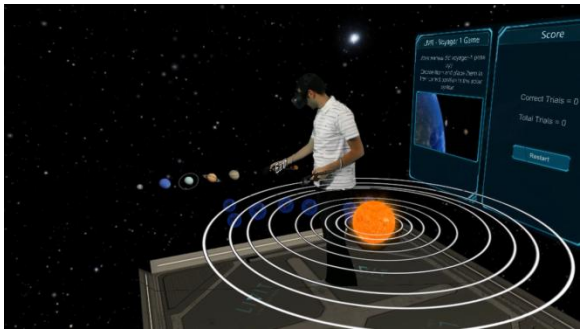

Figure 5: Space – Planets Game

IV. GENERAL FINDINGS

According to the data we collected from the population sample regarding the use of VR technology in classrooms. The majority of people we interviewed have used an educational VR before.

The VR experience was pleasant for the most part, there were no issues for most participants to navigate and explore the application. The issues that did occur were mostly about not being able to locate the touchpad location on the HMD or the blurriness of the text. The majority of the participants found VR to be an interesting and enjoyable experience. One student mentioned:

”I feel really concentrated compared to the mobile app, the main reason is that I don’t get disturbed by the surroundings and just focus on what I’m supposed to do.”

and another student who never tried VR before said:
”I’m amazed, I never used virtual reality before but I would love to learn more about our solar system now.”

Another student compared to VR application with the mobile application and said:

”I didn’t care to read on the mobile app but now when it’s in front of me I just want to read it.”

However, at the same time there were participants who did not find the VR application as appealing, one of them said:

”I don’t know if I learn more on the VR application, because I’m so busy looking at everything else that I don’t read the text.”

and another mentioned that:

”It would be awesome to have an actor reading the text for you, it would be nice for kids to learn. Audio could improve it.”

Regarding the learning aspects of the VR application, a female student told us:

”Since a lot of people learn better with emotions so here when you see the earth you can instantly associate it and might help you learn better, it’s really nice.” It was also pointed out to us by a male student that: ”The VR app presented a different scale, more than what mobile ever could.”

A teacher at Lagman high school also said: ”I would be a happy student if I used this technology, A happy student leads to good results.”

- Challenges of VR adoption on classrooms

An interactive educational content, such as adaptive or intelligent learning systems, has always had its challenges (Obeidat, 2009). Moreover, those systems have interoperability issues (Rey-López, 2008) and, hence, remain an area of active research. As with other rich, interactive, intelligent educational content, XR educational content can be challenging to develop. VR requires intensive graphics capabilities to achieve smooth implementation and worth (Velev&Zlateva, 2017). Many teachers have stated that they face limited availability of instructional designs when it comes to applying VR/AR content in the classroom. This refers to the limited materials offered in VR/AR with no guarantees that these materials would suit the students’ learning goals (Alalwan et al., 2020). Moreover, the interoperability of VR content across platforms is also hard to

achieve, and, hence, VR is often delivered as a proprietary solution (Velev&Zlateva, 2017), that is created or owned by an organisation or an individual [105].

During interviews, it was found that one concern that was raised by a few participants who at the time did not experience anything said that they believed longer exposure with the VR application would result in headaches. There were also a few other participants who experienced motion sickness, disorientation and minor headaches while testing the VR application.

V. IMPLICATIONS FOR FUTURE STUDIES

Based on our findings, we propose several implications for future research to address the limitations of the current literature. First, although researchers have been interested in assessing the learning effect of AR instruction, the literature lacks a systematic and in-depth analysis of different types of learning effects (e.g., cognitive, meta-cognitive, emotional, etc.).

CONCLUSION

This paper believes in the value of XR in education while realising the hurdles blocking these emerging technologies from being part of mainstream educational tools. It recognises that with educational XR, the challenges faced by educators come from multiple perspectives: technical, educational and social. Therefore, it presents varied available solutions that would allow institutions to choose a suitable route, with, hopefully, few technical challenges, in order to focus their attention on both the educational and social aspects of an immersive learning experience. The result should be a learning experience that is an integrated and integral part of the overall learning process. It should have correctly defined learning objectives that can be realised through matching learning activities to produce learning outcomes that can be clearly measured and assessed.

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