Transforming Visual Experiences Using VR/AR in Education

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Abstract

Perhaps this can be seen even more evidently today, as virtual reality (VR) and augmented reality (AR) are being integrated into the majority of spheres of our existence. Recently, VR/AR technologies is actively used in education as well. Virtual learning is therefore can be described is a great way of enlightening and motivating the students to learn by experience. Some of the important conclusions speak about the positive impact of the VR approach on the level of learner's engagement and the resulting immersion. The practical skills' enhancement is especially notable with frequent use of the immersive simulations and showed a clear improvement compared to the use of conventional methods. As seen in the real world, by using video conferencing technology, learners from all over the world work as a team and the physical distance is not a handicap. In all, VR/AR can make education more diverse, and it can potentially cater for the various learning profiles that may be in a class. These insights therefore provide ground for future research and development of the use of virtual environments in education and training.

Keywords— Augmented Reality, Virtual reality, Experiential teaching, Education, VR, AR.

1. INTRODUCTION

Virtual Reality (VR) and Augmented Reality (AR) is getting embedded and recently there has been massive adoption not only in consumer-based applications but also in various professions. Over the years, the advancement of this technology has been realized and as a result the application in education has also been advanced [1]-[2]. Their major benefit is that they facilitate skills development as the students practice real life situations and soon their practice will be incorporated in virtually all areas being taught.

The term Virtual Reality is as defined first as digital creation of a 3D object and/or environment. But with the development of the VR technologies especially the contemporary VR HMDs there was a dramatic increase in the visualization and interactions and offered the users a very high level of immersion. The term immersion is the keyword in the VR world and it is mostly used to define the level of engagement of the user in the VR world and his non-awareness of the physical world. That is, it is the feeling of being 'there' bodily in a 'here' that is not physical but virtual – a virtual space constructed via images, and sounds and other video stimuli [3].

Furthermore, Augmented Reality offers better appreciation of the user's interaction with the physical environment through overlaying the real environment with other 3D objects which appear real as if they belong to the same plane as the real world objects. The VR technologies are also a new model of the remote education media technology as well. These technologies can transform the learning experience to new areas which are remote from the classroom. In view of this, VR can fill the current scarcities of the online learning practices and takes students from distinct distant places and make them meet and interact in the real world within a virtual environment.

But to apply new technologies in teaching and in order have more interesting students it is a challenging issue, when the technology is evolving faster and no main academic values are tied to it. Besides this, it is also the absence of funds in many educational institutions, which also influences the delay of new technologies' adoption, including AR and even more VR. Higher education institutions are in advance as it tends to obtain institutional support from funded research environments, thereby providing the institutions with the opportunity to 'get their hands dirty' and do the trial and errors before deploying the technologies in the educational process. The primary and secondary schools, unfortunately, are also confined to these technologies that have a lot of VR/AR innovative solutions available for their students' age offered by various education technology companies regarding content as well as curriculum and fun.

VR/AR has several layers and parts, and all these have to combine to make a well-coordinated learning process that can be seen in Fig. 1. User Devices include learners with VR headsets on the client side with the help of the client application. Network Infrastructure aids in ensuring interconnection of the various components of VR and assist to obtain connections with the different client devices. Content Delivery Servers are responsible for storing and making educational contents available to the users. The Virtual Environment recreates settings where education occurs and such setting is managed by the server. Learning Objects that are defined as tangible representations in the 3D space of educational content in ECM include all the content needed in the learning process and their management. Some of these are dedicated to tracking and analysis of usage and the system performance while others are strictly for monitoring purposes but most importantly, the tracking and monitoring are concurrent. Communication Systems help to

achieve interaction between users and instructors in the context of a virtual classroom. Due to their advantages and use in various situations within learning, VR and AR are a subject of many papers that focus on the new trends, the pedagogical uses, the experiences and the challenges of the institutions that implement them.

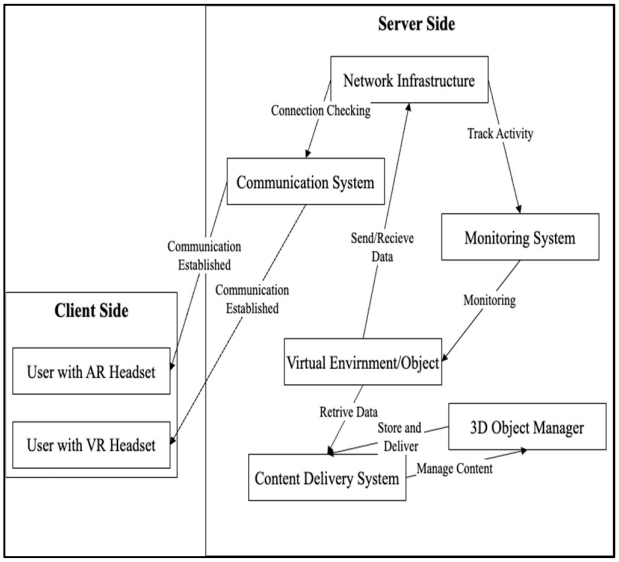

Fig. 1. Architecture Diagram

2. TECHNICAL SIGNIFICANCE

2.1 TECHNOLOGICAL DEVELOPMENTS

Since Virtual Reality (VR) and Augmented Reality (AR) technologies are the most recent inventions, they present an extraordinary opportunity to deliver learning which has not been possible before. Compared to traditional techniques, VR build entirety environments where the student meets content in a virtual three dimensional space. This capability is particularly significant when attempting to visualize items that need spatial orientation such as the architects, engineers, and doctors. For instance, the medical students engaging in virtual reality can perform complicated surgeries without putting patients' health at risk while making them acquire practical knowledge to the full extent. These concerns form the technical rationale of applying VR in education since it helps to connect what students learn in a classroom to what exists in the real world by creating a safe and controlled simulation environment.

AR, on the other hand, places computer generated images on to the real world environment as an extension of it; thereby adding interactivity to physical objects that can be seen in Fig. 2. In learning institutions, this technology can be most effective since students will be able to explore concepts which are in their three-dimensional space and even manipulate them in real time. For example, AR can enrich a biology lesson through which the pupil is presented with realistic 3D models that allow her/him move through the human body and focus on different organs and systems. This also ensures that students understand more easily lessons that are normally complex to grasp and also makes it easier to retain whatever is taught in class. Education theoretical importance of the AR is highlighted by the fact that it provides an opportunity to increase interest in learning processes and match the delivery to individual differences.

Fig. 2. VR/AR Applications

These two technologies, the VR and AR are also enhancing the delivery of education and making it easily accessible and accommodative. The use of VR opens the possibility to deliver educational resources from the other corner of the world to the most remote districts and zones where students will be able to get the best education available without leaving the region. Using AR in teaching could help translators translate simultaneously and display visuals for students who have language difficulties or learning disability, thus allowing all the students to learn at their best. Thus, the fundamental resources of VR and AR like; cloud, internet, intricate graphics processing, are developing apace, making these technologies cheaper and adaptable in educational systems all over the world.

VR/AR applications are used for training across various industries including healthcare, aviation, military, manufacturing, and corporate education. These applications enable users to experience and practice real-world tasks and procedures in a safe, controlled virtual environment.

Furthermore, the adoption of VR and AR in enhancing the teaching and learning environment is creating room for innovative curriculum development that can be seen in Fig. 3. The students are coming up with new strategies of integrating the technologies into the teaching learning process hence making the teaching learning process more vibrant and more engaging. For instance, instead of reading about history in a text book, lessons can be taught in a way that can make students 'travel' back in time and be part of an event during history. This not only enhances the learning process and also assists the learner in developing critical thinking skills when solving problems with in these simulated environments. Technical relevance of the VR and AR in teaching is not just restricted to the content sharing but has become the reason for change in the paradigm of education which is shifting from the traditional methods to easy, fun filled and effective methods of learning.

Fig. 3. VR/AR Applications

2.2 Tools and Technologies

The use VR and AR in education has been greatly boosted by the leading IT firms who have equally contributed different tools and gadgets in this area. Meta (originally founded as Facebook) has been the trailblazer in VR through its Oculus hardware that is one of the leading platforms for applying immersive education. Through the Oculus for Education campaign, students get to be in engaging learning environments that are beyond the conventional classrooms. Another of Meta's products is Horizon Workrooms – it is designed to foster collaborative VR, this way students and educators can cooperate as if all participants were in the same room. They cut down on distractions and improve learning by dedicating all the significant amount of time usually spent in the class towards group learning and projects.

Google, another dominant influential player in the VR/AR education domain, provides Google Expeditions, with helps teachers to take students around the globe virtually. Therefore, the strength to Google Expeditions is that an educator and learner has access to the vast array of resources or pre-prepared content that is easily searchable by subject matter. In addition, Userlike significantly solves issues of integrating XR technologies into organizational work processes since it integrates with Google Workspace, making it possible for schools to incorporate the Mirra VR experiences into their current digital environments seamlessly. The use of Google's tools in learning opens the opportunity of collaborative work of teachers, who can create and share lessons, as well as students – working on projects together.

Microsoft has also advanced much further in the field of mixed reality with its help of Microsoft Mesh. As it is a combined physical and digital platform, student solves using the 3D interface in real-time that can be seen in Fig. 4. As it has been highlighted, Microsoft Mesh complements plenty of enterprise solutions, such as Microsoft Teams and Dynamics 365, giving educational institutions a clear and solid foundation to develop and deploy MR experiences. The robust development ecosystem backing Microsoft's platforms guarantees that educators can find a variety of tools and applications that will enable them augment their mixed reality education in order to make learning fun and interactive.

Fig. 4. VR/AR Applications

Reflecting on the contribution of Unity Technologies to the development of VR and AR content, it is should be analyzed that the company offers its products with Unity Reflect and Unity Learn. Unity is well known as a most suitable cross-platform development environment for VR application and it provides educators and developers with tools necessary to create custom VR educational content. Another work interactive feature identified is real-time collaboration which is especially useful in subject areas such as architecture and engineering achieved through Unity Reflect. At the same time, Unity Learn offers a vast number of tutorials linked to the application that can assist educators, and their students, to pick up VR/AR development effectively. The Support+ for Custom Educational Experiences in Unity helps institutions to make VR/AR content responsive to teachers' curriculum requirements and offer learners a personalized learning experience that can be tailored to their learning preferences and goals.

2.3 Sustainability and Societal Concerns

What concerns on the example of VR and AR can be considered as threats regarding the advancement of these technologies in education is that they can deepen the gap between the rich and the poor. These technologies call for massive funding on expensive hardware and networks, software and, equipment, a factor that makes it difficult for under-funded schools especially in the developing world. Such a digital divide may result in a situation where only learners in institutions with adequate funds can reap from these enhanced learning resources at the expense of the others. The opportunity to use modern technologies in education may be divided deeper which means that some children will have access to the latest technologies and others will be left behind again+. This has a bearing of how the provisions of VR/AR tools can be worked on in ways, which do not lock out the students who are in a position to benefit from the enhanced technological intervention in their learning.

On the same note, VR and AR technologies are equally as effective though trigger some issues with regard to diversity. It must be emphasized at this point that not all students will

be able to interact with these technologies for learning due to one reason or the other including but not limited to, physical disability, sensory impairment, or learning disability. For example, students with visual or auditory impairments may undergo difficulties in the interaction with the VR environments which contain a big proportion of the visual and auditory cues. Further, the design of these technological technologies does not address the needs of every learner as might be required for a learner who requires special considerations. In order to make effective use of VR/AR tools in education it is important to choose the tools that are accessible for all learners, with or without certain physical or mental impairments.

One major disadvantage of VR/AR especially in the usage by students is that students tend to spend long hours in the virtual space minimizing their interaction with real people hence affecting their social relations and overall health status. Even though these technologies provide approaches to developing exciting and differentiated learning environments, they can result in learners' isolation as well. Some of the disadvantages are: With a considerable amount of time spent in these virtual environments, the students may feel isolated from other students and the normal community provoking feelings of isolation and rejection. Moreover, one of the strengths is also one of the weaknesses, because VR is highly influencing the students' senses and too intensive stimuli sometimes contributes to emotions such as sickness or anxiety within the lesson, or those students who have mental issues, or in the case of students who are not very young, but the use of VR provokes them to be like children. VR/AR benefits should therefore be used reasonably together with face-to-face interactions that allow social learning and stimulation; student's welfare must be put into consideration.

For instance, even though the use of VR and AR can offer almost live-like tests, such systems might not replace practical experience. For example, when it comes to the job like medicine or engineering it is very important to have the experience in order to develop the skills and the judgment needed for the job. Though it is understandable that all real-life situations can easily be replicated in VR/AR to teach students theoretical concepts and experiment with different scenarios, the actual value of the technology is rather limited as it cannot teach students how to feel the presence of an object or face an unpredictable situation. This limitation could result in distance between knowing and doing especially if majority of the student experiences are conducted online. Teachers should take advantage of VR/AR as supplementary tools but they have to ensure their students get enough practice to acquire working model skills.

In the positive side of the giving VR/AR technologies, environmental education has numerous benefits. They can build environments through which students can learn about ecosystems, climate change impacts or disasters with the hope of preventing them in certain environments. It is possible that such experiences help in developing an appreciation for environmental problems and promote active engagement of the students in their own lives. But small consideration should be paid to the ecological cost of manufacturing and utilization of these technologies. The hardware used in VR/AR manufacture and disposal falls under electronic waste while the energy requirements of these systems to run are also fairly large. It is thus up to the developers and educators to find out how to make the use of VR/AR in enhancing environ-mental education procedures sustainable by campaigning for better production techniques and encouraging students to use it responsibly and sustainably.

CONCLUSION

The incorporation of the Virtual environment alongside the real environment has been a revolution in delivering and acquiring knowledge in education. The appropriate use of these technologies presents the capability to revolutionize current learning processes by providing students with effective personalized learning tools in forms of virtual and augmented reality that are interactive, engaging and creative. Augmented reality and virtual reality have a potential to present cases, concepts, and models that are difficult to explain otherwise, offer practical experience with a material that cannot be used in a regular class, and build scenarios that are not possible in an actual classroom. This way of education delivery not only gets students' attention but also helps to improve the learning and memory of complicated material. Despite the current innovations in use of VR and AR in education, as they continue to advance and grow their use in education sector will also increase as they hold the potentiality to enhance ways of learning by making them more dynamic.

Studies conducted to date have indicated that application of both VR and AR in learning is already underway in schools besides the basic level inclusive of the secondary and even the tertiary institutions. The use of these technologies is especially high in the professions that call for spatial awareness and hands-on practice in the training, for example, medicine, engineering, and the sciences. In these contexts, VR and AR enhance the delivery of content as students can practice skills and visualize processes which are a positive factor on student learning. However, there were noted some difficulties in applying of VR and AR technologies such as high price of equipment, specialists' requirements, and the constant creation of materials for education. However, based on the advancement of studies, it was revealed that the obstacles experienced when using VR and AR in teaching enhance the understanding of the subject; hence, there is a possibility of its wider use.

The study in this paper shows that VR and AR uses are on the rise in education, as evidenced by the rising number of publications and implementation of the technologies in

elementary, high school, college and university settings. These countries are the technological pioneers as they are the ones who've embraced these technologies into their systems of education. These countries are setting examples, not only in the way research and pilot studies have been carried out, but how actual and efficient VR and AR programs are being executed, to augment learning among students. The information that those pioneers offer to educators and researchers around the world is priceless as they can learn from their models and, at the same time, learn from their mistakes as well.

All in all, VR and AR have the potential of bringing a significant change in the education system and helping students get more practical, realistic experience that would have been otherwise impossible. That said, there are concerns about the current expansion of the technology, but the upside is that the utilization of the technology can support improvements in student's learning experiences and effectiveness. Based on the study, the field is progressively growing since there has been leaps of improvement with more research and implementation success giving direction to the field. The work is still in-progress to discover and develop these technologies for their optimum usage in educating the learners. VR and AR are expected to play a significant role in the future of learning and that is why it is vital that institutions are consistent with the upcoming trends.

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