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# **Virtual Reality in Education**

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November 2, 2020

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## **I. INTRODUCTION**

The work of harnessing immersive technology with humanity is hardly new in a time of constant technology disruption. Technology engineers keep continuously changing and improving digital or simulated worlds by adopting 360-degree views of any environment. Virtual Reality (VR) and Augmented Reality (AR) are two key categories of immersive technology that are bridging the physical and the digital. In simple terms, VR and AR use technology to create simulated three-dimensional (3D) environments. Virtual reality is known to engage users through their eyes. Human eyes are two inches apart, allowing each eye to see a different picture of the world. Due to this reason, the VR headset contains two distinctive images, one for each eye. The user's brain mixes each perspective and creates a sense of depth (De Moor, 2019). Virtual reality and augmented reality are two seemingly comparable technologies, yet both function rather differently. AR technology stimulates artificial objects just like VR, however, AR does it in the real environment. Simply put, augmented reality is a combination of the real and virtual world, where it takes reality and adds a new and exciting element to it. Nevertheless, AR does not transport the user elsewhere as VR does. Virtual reality's most recognized consumers are gamers as VR enables interaction and allows gamers to move around the virtual world. However, "AR and VR are introducing new opportunities to transform enterprise, particularly in the areas of...media & entertainment, training & simulation in education, defense, real estate, financial services, health, and retail sector" (PS3G, 2019, p. 2). This shows that the possibilities to use these technologies are endless, and it is becoming an increasingly leading technology in numerous fields.

The focus of this work consists of evaluating the past, present, and future of VR and AR, and how its widespread adoption in primary and secondary education is changing the learning process from passive into active. However, before exploring the subject of how VR will drastically alter educational experiences, it is important to examine why the basic concept of education needs to advance in the first place. There is no question that education has evolved over the past two decades. There has been an increase in the accessibility in education, the diversity of students in classrooms, changes in the punishment methods, and how technology has made its way into the classroom, implementing calculators, computers, and e-books. Still, as the world continues to progress, questions are raised about how educators should break free from the traditional teaching model. Currently, “our collective vision for education is broader, our nation is more complex and diverse, and our technical capabilities are more powerful” (Rose, 2012). Yet, society keeps classifying the traditional, four-wall classroom learning style as reliable. It is important to recognize that in order to detach from the traditional education model, educators need to invest in technology. As Elmqaddem explains in *Augmented Reality and Virtual Reality in Education. Myth or Reality*, “The nature of AR and VR promises new teaching and learning models that better meet the needs of the 21<sup>st</sup>-century learner” (2019, pg. 234). Education can grow and progress by integrating VR and AR immersive technologies with the unchanging mid-19<sup>th</sup> Century traditional education system.

Still, two central questions remain behind this paper: what is the educator’s perception regarding VR and AR, and how is this technology taking off in the educational sector? Ever since the general public has widely been aware of virtual reality’s existence –

possibly in the early 1990s, there has been a lot of skepticism towards the topic. Because of the technology's newness and innovation, it has been difficult to convince individuals to recognize that VR and AR technology is a benefit rather than a detriment. It has been even more difficult to convince people of accepting virtual reality into their daily lives. Part of the reason is that individuals do not see the true potential this technology contains and are stereotypically positioning VR solely as a gaming experience.

## **II. TIMELINE OF VIRTUAL REALITY**

As mentioned above, society became fully aware of how VR works and its components in the 1990s. However, these immersive technologies are not new at all. Virtual reality as we know it, with 3D wide vision, motion, and color began to materialize in the 1950s to 1970s. Cinematographer Morton Heilig invented a fully mechanical machine he called "Sensorama" in 1962 (Medium, 2017). Following, in 1968 "Ivan Sutherland and his student Bob Sproull created the first HMD [head-mounted display] for use in immersive applications" (Medium, 2017). The 1980s and 1990s, however, was when "VR was truly pioneering...at places like NASA and a few major universities" (Edwards, 2018). Fast forward to today, recent innovations have made virtual reality more accessible and affordable to the public. This immersive technology is transforming society because it is no longer an idea, but rather a reality that is being implemented in diverse fields. Nevertheless, there is still an impactful barrier between public awareness and technological usability. VR and AR developers such as Oculus VR; a subsidiary of Facebook, HTC Vive, Google Daydream VR, and Samsung Gear VR are revolutionizing

the world, looking for beneficial ways to incorporate VR into different sectors, making the technology more accessible and affordable to new audiences.

Although virtual reality is mostly related to the entertainment industry, in recent years this technology has entered and made a big impact in different sectors. From healthcare to real estate, companies are starting to realize the true potential VR and AR partake in their business. For example, virtual reality has been rising in the automotive industry. In an industry where a lot is at stake – from the safety of the customers to the efficiency of each part of the vehicle, the automotive industry keeps implementing new machinery to advance and stand out in their sector. They use VR technologies to implement innovative ideas and perform virtual car mockups to prevent unnecessary waste of money. Furthermore, the healthcare sector implements these technologies to do medical training scenarios, and uses them as a treatment to help with mental health issues such as psychological therapy and as a way to treat PTSD or phobias. The architecture industry also is beginning to implement VR and AR in its businesses. Due to VR technologies, architects can not only experience what they are designing in the first person, but this immersive technology helps companies explore their projects at the deepest level possible. Elmqaddem further explains, “the fields of application of this technology are unlimited: training with simulators, simulation of surgical procedures, architecture...[and] there are also immersive education platforms” (2019, pg. 237). As Elmqaddem confirms, virtual reality is also revolutionizing the education sector by facilitating learning in a fully immersive, experiential way.

### III. VIRTUAL REALITY AND EDUCATION: FROM K-12

Adopting virtual and augmented reality to the student's learning process transforms the way education has been operating for centuries. It has been known for a long time that "learning by experience leads to better understanding, enhances knowledge recall, and strengthens retention" (Kouri, 2019). Since the Montessori Method of Education gained momentum, society has known that children are eager to learn independently in a well-prepared learning space. Montessori education is a method created by Italian educator, Maria Montessori in the early 1900s that implements unique and innovative learning materials into its teaching curriculum (American Montessori Society, 2018). On a similar note, learning experiences with immersive technologies are positively influencing students' motivation to learn and expand their level of engagement – both points that are vital in order to change traditional education. Merging innovative technologies with learning has posed a big challenge to educational institutions. Skeptics will reason that VR and AR technology will undermine real connections with humans, that it can be expensive and not a smart investment, or that it can cause addiction. Still, these critics do not understand that the benefits of VR and AR in classrooms outweigh the minimal hypothetical risks.

VR and AR companies, including those specializing in the teaching and learning sector, are speedily progressing. ABI Research performed a report on *Augmented and Virtual Reality in Education*, where their research projected that by 2023, \$5.3 billion will be spent for AR in education, and \$640 billion will be spent for VR in education (Kouri, 2019). This comes to show that society does see the potential of joining immersive technologies with the standard educational curriculum. Some teachers are integrating VR

and AR technology into their lesson plans because they are aware that these immersive technologies “can improve and facilitate learning, increase memory capacity and make better decisions while working in entertaining and stimulating conditions” (Elmqaddem, 2019, pg. 237). Numerous immersive education platforms provide teachers the tools to offer captivating classes and engaging presentations. Google Expeditions Pioneer Program allows teachers to guide their students to different expeditions including interacting with dinosaurs, living in the Renaissance, or traveling to the bottom of the ocean, without ever leaving the classroom. Students that have access to VR and AR content through an app can optionally experience a journey through Google’s Cardboard; a small box with lenses that fits onto any phone. Google Expeditions plans to increase its content in history, science, art, the natural world, and is looking to teach students how to create their own virtual reality worlds using editing software (Burch,2019). Another company, zSpace, founded in 2007, is a forward-thinking company that is improving education. zSpace offers compelling lessons for K-12 students, that delivers a large variety of content ranging from the arts, science, and technical lessons. zSpace has been integrated into over 800 schools in North America, with over one million users (Burch, 2019). Moreover, Merge Virtual Reality is an additional company that is awakening children’s minds with VR technologies. Merge offers kid-friendly products such as VR headsets and the Merge Cube, which allows students to hold 3D objects and interact with the item directly, contributing to the learning experience (Burch, 2019). The companies highlighted above are only a few of many that are improving the education system by integrating immersive technology tools. However, not every company works for all the educational stages. Although the end goal of VR and AR in education is to enhance

learning, these immersive technologies serve different purposes from elementary school through high school.

For children, learning is an adventure— everything is new and exciting, and one could assume that they are easily wowed. Nevertheless, because kids find everything new and exciting, their attention span is usually short. A report from Ohio State University concluded that “exploration seems to be a major driving force during early childhood...it is because young children need to explore to help them understand how the world works” (2020). Introducing VR and AR to their education curriculum early on can provide children with the ideal skills they need to prepare them for future stages. In kindergarten and elementary school, young learners are introduced to the base of education. Students begin to familiarize themselves with subjects such as writing, math, and science. However, aside from school subjects, early education is where students begin gaining essential life skills such as critical thinking, focus and self-control, problem-solving, and taking on challenges. If educators integrate VR into the elementary and kindergarten curriculum, the experiences will “stimulate students’ motivation and increase their engagement level, which are fundamental factors for achieving learning goals” (Kouri, 2019). Presently, as VR and AR become more popular and accepted by individuals, some educators have started to integrate and connect these technologies into their classroom curriculum. However, throughout this research, it was challenging to find detailed studies of VR used solely for elementary learning. Jaime Donally, columnist of EdSurge explains, “I’ve found educators trying to make existing tools fit. The error I see many beginning to make is forgetting about the diverse needs of our younger students or, worse, pushing tools intended for older students on younger ones” (2020). Nevertheless, I found that



overall, the immersive technology tools used in elementary school are simple, easy-to-use tools, that focus on games where students can explore letters and shapes, the human body, or ones that tell stories. Some examples of these companies include disruptED, Mr. Body, which forms part of Merge Virtual Reality previously mentioned in this research, and Wonderscope by Within (Donally, 2020). If educators are careless during the implementation of VR technology into school curriculums, it could become a challenge. Therefore, kindergarten and elementary schools must explore the right strategies for students to use the technology safely and effectively.

Virtual Reality and Augmented Reality are most common in Middle School and High School curriculums because some VR tools are more complex, which require multi-step instructions for students to follow. Another reason that VR and AR technologies are utilized more in secondary learning is because teens have a greater sense of safety and recognize that other students might be around them even though they cannot physically see them because of the headset. There have been confirmed successful cases that indicate the effective integration of VR in education. Kiley Sobel and Catherine Jhee interviewed teachers from all levels to learn about how they use VR and AR in their classrooms. The study highlighted a middle school teacher who was incorporating VR and AR in his math lessons. He tasked students to design a water park in a software with specific guidelines for them to follow. In this assignment, students were able “to master mathematical concepts of area, perimeter, and volume and to develop their spatial reasoning and a sense of scale” (Sobel, Jhee, 2020). Integrating technologies in lesson plans not only enhances learning experiences, but it allows students to acquire knowledge in a way they have never done before. Virtual reality unlocks completely new

digital simulations with endless possibilities to learn. An alternative study from Foundry10 shared that some middle school and high school teachers had their students create their own VR content. They explored subjects in history, science, art, and social issues (Castaneda, Pacampara, 2016). Following, a study was conducted in Beijing where two groups of students were taught the same material, yet one learned it through traditional classes and the other one through VR. The group that was taught the traditional way scored 73% and the virtual reality group scored 93% (Vlasova, 2020). Middle School and High School teachers should see these examples as success cases. Nevertheless, it is understandable that integrating VR in the day-to-day curriculum is and will probably continue to be challenging for educators. However, teachers should prioritize students and understand that these immersive technologies are tools that help students better understand the classroom material, which, consequently, helps increase their learning.

Regardless of how willing teachers are to introduce VR and AR into their lesson plans, there are recognizable barriers to adopting these technologies. First of all, the responsibilities of a teacher will plausibly change. Presently, the instructors' primary task is to provide thought-out lessons and deliver the learning material to his/her students. If VR and AR become a regular, everyday tool that students use, the teacher's role will change towards facilitating learning. Rathner, Fong, and Sevigny's *Virtual Reality in Education* research further explains, "traditionally, education placed emphasis on the teacher rather than the student, such that the teacher was considered most important in determining what is learnt. However, this model has been consistently challenged and usurped by student-oriented learning and teaching styles..." (2019, pg. 70). Instructors that include VR and AR in their curriculums empower students to actively learn the

material rather than simply accept it as truth. Teachers can use VR and AR as a medium that keeps students engaged and expands their knowledge while guiding them through the process. However, “teacher integration of new technologies is highly influenced by their beliefs” (Bower, DeWitt, W.M. Lai, 2020, pg. 2214). Call it technological inexperience, training impediments, lack of confidence, or skepticism; the future of redefining education no longer depends on lack of innovation but rather on an educator’s choice to surpass the challenges and adopt the new technologies inside their classroom.

#### **IV. BARRIERS TO VR ADOPTION IN THE CLASSROOM**

Research has shown that immersive technologies in the classroom have been recognized to develop student learning experiences. However, “teachers are an important cohort with relation to technology adoption, because their capabilities and views will have the longest impact and potential to affect change” (Bower, DeWitt, W.M. Lai, 2020, pg. 2216). Many obstacles make the implementation of virtual and augmented reality in schools difficult. Even though the immersive technology’s elevated price, sustainability, and technical challenges are strong points that influence skeptics’ judgments, this paper will uniquely address the emotional concerns that educators and parents have concerning how VR in the classroom will affect students.

In 2018, Common Sense Media, an educational non-profit, surveyed parents living in the United States regarding their views toward virtual reality. The survey shared that the three major concerns parents had regarding VR were that children spent too much time with the technology, that they could have easy accessibility to sexual or violent content, and that they would suffer a lack of social connections. However, 84% of parents

of 8 to 17-year-olds believed that VR could provide educational experiences for their children (Common Sense, 2018). Interestingly, this study revealed that even though parents were concerned with how virtual reality would affect their children, more than half still considered that the technology could be measured as an asset in their child's education. Apart from Common Sense's study results, there are many other misconceptions regarding VR. One of the most common arguments is that too much screen time will hurt the student. While a valid point, parents, and teachers should recognize that using VR technologies in education is not entertainment; it is a tool that allows "students to gain a deeper understanding of abstract or complex subjects and phenomena that is relatively difficult to understand only by text, picture, and video" (Kouri, 2019). Following, parents and teachers should comprehend that the school curriculum will be planned in a way that educators guarantee the technology is safe, productive, and that it is used in moderation (Sobel, Jhee, 2020). A second misconception regarding virtual reality is that VR can reduce human interaction. Nevertheless, Lisa Castaneda and Marc Pacampara argue, "Even though VR is an 'individual' experience, a high level of community between teachers and students emerge in each classroom as they collaborated together, in groups, to create and interact with content" (2016, pg. 7). Far from reducing human interaction, VR in education allows students to interact, communicate, and collaborate with each other, building leadership, problem-solving, and spatial intelligence skills. Shadowing, skeptics also argue that virtual reality lacks flexibility, restricts teachers' control over the material, and prevents adaptation to accommodate students' needs. Criticizers claim that by using virtual reality in classrooms, students are set to follow the rules that the technology imposes and are not able to do

otherwise. They believe that using VR and AR technologies in classrooms impose challenges because students will not be able to ask questions, receive answers, or take part in discussions (Kaminska, et al., 2019, pg. 13). However, what these individuals are unaware of is that the implementation of VR and AR in classes will not disregard the teacher-student relationship. VR and AR are tools that will significantly enhance the connection between teachers and students, both in online learning and in an in-person classroom setting.

## **V. THE FUTURE OF VR AND AR IN EDUCATION**

The success of remote education programs has never been more important than it is today. Due to the coronavirus outbreak life took an unexpected turn that affected learning across all borders. Schools were forced to shut their doors and unexpectedly transition to teach remotely. Perplexed and flustered educators began adapting their teaching curriculums to fit an online learning style. Distance learning is challenging for educators because not all students are suitable for this kind of learning style, and not all subjects are best taught via this medium. It is challenging to fight against the students' loss of concentration due to external distractions, their lack of peer-to-peer interaction, or their struggle with work-life balance. Since the new school year arrived in August, there have been teachers that "have had to start thinking about how to keep students engaged from afar— especially those who already struggle in the classroom" (Morley, 2020). Some teachers believe that using VR and AR in their lesson plans helps students form a connection with the material, without even being in the classroom. Morley reasons that teachers "don't necessarily need to have VR goggles and cards to take their students to

the digital world. Even just taking an online virtual tour of a museum or zoo can help students engage in lessons in a new way (2020). Luxembourg educational researchers Haas, Kreis, and Lavicza performed a study about using AR in distance learning in a school in Luxembourg. The study focused on an elementary school math class that had already been using this technology in their in-person school curriculum. The report explained that “younger students were experiencing difficulties in following-up [with] courses...in schooling at home” and displayed how working with AR was a beneficial experience for them (Haas, et al. pg. 34). Nevertheless, due to the short amount of time that has passed, no detailed results of the study have been recorded. Additionally, I have not been able to locate any thorough reports in the United States about VR and AR being used in online learning since the pandemic.

In a time of adjustment and change, virtual reality can serve as a solution to some recognized challenges of online learning. Some of VR’s prominent benefits for students include enhanced engagement, improved retention, an increase in motivation, and concretizing abstract concepts (Elmqaddem, 2019, pg. 239). Following, VR also has the ability to ignore other surrounding distractions because of its simulation-based technology. Virtual reality in the classroom is also beneficial to teachers in an online learning structure because they can contribute “to the development of creativity in students, ensuring effective participation of students to the course, students’ being able to carry out the course with their own pace” (Elmqaddem, 2019, pg. 239). Though a noticeable advantage, it is understandable that VR is not yet taking off in the distance learning setting. Although willing, society is not yet prepared for this technology to be

integrated into online education programs. Many logistics have to be planned, such as the accessibility of the technology or the right Internet access and speed.

As the impacts of the Covid-19 pandemic continue to bring uncertainty for schools at all levels, educators know that it is important that learning continues, even if it cannot happen in an in-person environment. Schools are preparing themselves with the best learning resources and methods of teaching. Now more than ever, teachers should be eager to apply all tools that will allow them to alleviate the process of learning and revolutionize it in a way that helps all students understand the information, no matter their learning style (Vlasova, 2020). In today's altered education curriculums, the main goal should be to prioritize the student. Having VR in the classroom helps students improve attentiveness since they can "concentrate on literally what is in front of their eyes, and in a way, they are being 'forced' to interact with their studies and exclude any potential side stimuli" (Vlasova, 2020). VR and AR in education will continue to become more popular going forward. Technology is always adapting and improving, which will significantly change the potential for VR and AR. For starters, 5G will become more accessible in the future, which will lead to a faster and bigger data transfer, and in turn, will greatly increase the use of immersive technologies. Additionally, artificial intelligence will begin to merge with VR and AR and successively, improve both technologies. Lastly, content creation is becoming easier and more accessible to people and this will allow students large libraries and platforms of VR and AR content (Justice, 2020). Due to these developments and others to come, virtual reality and augmented reality in the classroom will become more available than they currently are.

## **VI. CONCLUSION**

The main objective of this paper was to explore how K-12 schools felt about integrating VR and AR in the curriculum, and whether there were any examples of the technologies being applied in the classroom. In fact, there are numerous proven advantages of using VR and AR in education. Implementing these technologies in the classroom offer powerful learning experiences for students that help them remain focused and stimulated, and shifts their learning by concentrating more on practice rather than theory. In the research, I learned that many teachers are using the technologies and also foresee a positive future for VR and AR in education. However, unsurprisingly, there are some educators resistant to changing their views and adopting VR and AR in their lessons. It is indispensable that educators participate in introducing these technologies into the classroom if they are looking to achieve positive student learning outcomes. Nevertheless, to provide a deeper learning experience for students, it is realistic to conclude that the answer is a combination of both the immersive technology and the teacher's lesson plan; one solution cannot replace the other. Some successful cases were mentioned of VR and AR technologies in classrooms, yet further research must be done to determine VR and AR's effectiveness during online learning, due to the Covid-19 pandemic.



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