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THE ROLE OF MIXED REALITY IN THE EDUCATION SECTOR***

Abstract: Emerging technologies and the benefits they bring with them are increasingly entering every pore of society. A new trend combining virtual reality (VR) with the real-world scenarios, which is reflected in mixed reality (MR) devices, primarily in the HoloLens headset, which allows users to explore the mixed reality world and control their movements (even without using their hands), are increasingly finding their way to education sector. The subject of this paper is the analysis of the impact and advantages of mixed reality (MR) devices in education, with a special focus on building communication and student cooperation in the learning process. This paper aims to inform education experts about the advantages of integrating these new technologies into the classroom to boost student motivation, enhance students' comprehension of the material being taught, and assist underachievers in overcoming obstacles to learning. The advent of immersive technologies has made it possible for students to learn remotely, which has shown to be very useful during the pandemic. Complex trainings, experiments, and group projects may now be conducted in virtual environment apart from reality, which can help students become more skilled and enthusiastic without worrying that the results will be less effective than they would be in a traditional setting.

Keywords: Virtual reality (VR), Mixed reality (MR), Education, Students, Learning processes.

INTRODUCTION

A blend of virtual and real components displayed on a single display is known as mixed reality (MR) (Milgram, Kishino 1994). The terms VR (Virtual reality) and MR are used interchangeably in the literature, however, it is necessary to clearly distinguish these two terms in order to avoid confusion (Yung, Khoo, Lattimore 2017). It might be said that MR depicts various locations on the continuum where actual and virtual objects combine (Pan et al. 2006).

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Users can take a more independent and dynamic part in their experiences by utilizing immersive technologies (Ostrom et al. 2015). Technological advancements have altered how humans perceive virtual and physical environments. Throughout the upcoming years, numerous industries will benefit greatly from this new technology (Berg-Vance, 2016). Mixed reality technology is being used more and more by a variety of fields, including engineering and medical research, to explain experiments that were previously impractical in a classroom setting. Furthermore, the cost-effectiveness of simulating practical understanding in the classroom has increased because to technology like mixed reality (Gerup 2020).

Current new technologies have already had an impact on the sector of education, including mixed reality. Some indicators include the prevalence of online learning, huge open courses, and remote learning. Students' ability to understand and relate to the intricate ideas and concepts found in science can be substantially enhanced by an immersive and experiential learning setting. Furthermore, by actively integrating students in practical experiences and simulations, previous research from a cognitive standpoint has demonstrated that students can improve their comprehension and retention of scientific subjects by using mixed reality (Weng et al. 2019). The most significant benefits of MR in education include training, remote collaboration, instruction and task visualization, design, and decision-making. Through practical, hands-on activities that require students to use their spatial knowledge, these technologies help to facilitate learning, as well as the delivery of theoretical components in the classroom (Forrester Consulting 2021). Additionally, the MR can prevent some of the negative effects of VR, such as headaches, blurred vision when fully submerged in VR, and a loss of spatial awareness that can cause nausea (Kim et al. 2021).

MIXED REALITY: DEFINITION AND CONCEPTUALIZATION

With the aid of computer technology, mixed reality (MR) reflects the modeling of classes in the actual world and is thought to be a continuum in the interaction between virtuality and reality. This scale places real space on the left and virtual space on the right. With the primary goal of combining real and virtual surroundings to create a sizable area where virtual and real items interact and cohabit in real time for user scenarios, mixed reality (MR) stands for everything between augmented vitality and augmented reality (Aruanno, Garzotto 2019). Real and virtual objects are combined in MR simulators, which fuse both worlds together to form a hybrid (Ohta, Tamura 2014). MR systems have three important characteristics: the first involves combining virtual and real objects, the second relates to real-time interaction, Lastly, mapping real and virtual objects to foster interaction between them is the third feature (Hoening et al. 2015).

The US Army implemented the first MR prototype in 1990. In order to improve the efficiency of the implemented systems, this virtual device refers to the overlay of the registered virtual item on the user's real location (Rosenberg 1992). Due to the difficulty in specifying what exactly MR is, experts have described several characteristics according to which MR is a continuum, a combination of real and virtual, is linked to certain hardware (e.g., HoloLens), and more and more experts mention that it is used for training

purposes, as well (Speicher et al. 2019). Mixed reality is frequently used as a synonym for augmented reality. However, it represents a superset of AR in the sense of a mix of real and virtual objects within the framework of a single screen (Milgram-Kishino 1994).

In the public realm, virtualization technologies have been used and applied more extensively thanks to wireless MR Head Mounted Displays, which have benefited people's well-being, personal lifestyle and conceptualization (Kalantari 2017). In the age of technologically mediated communication and digital living, there is an increasing need for the individual to adapt to the common culture (Baltezarević et al. 2020). These technologies are meant to work together, allowing for simultaneous communication and instantaneous information retrieval (Park, Jayaraman 2021). Mixed reality devices consist of four cameras (used to understand the environment), four microphones arrayed, an inertial measurement unit, an ambient light sensor, an energy-effective depth camera, and a photographic video camera. They also have a holographic processing unit that recognizes movement, voice and speech. MRs are optical waveguides consisting of three layers for blue, green and red (each with diffraction characteristics) (Microsoft 2022). Communication technologies can improve user experience (Lemon, Verhoef 2016). Visual communication design has the effect of directing people to what to think, what they need or what they want. If the information is presented in a way that attracts the audience and convinces them to take action, in this case we can say that visual communication has been successfully designed (Baltezarević, Baltezarević 2015). With vision-based devices, users can use hand motions to engage with the MR world (Lv et al. 2015), also, by using an MR headset, they are able to move around freely in the MR setting (Evans et al. 2017), which, rather than taking its place, enhances the user experience in the actual world (Chuah 2018).

With its ability to provide remote first-person visualization, integration, manipulation of interactive 3D content from actual world scenarios, and multi-directional audio and visual communication, the HoloLens 2 is undoubtedly the most well-known mixed reality gadget (Martin et al. 2020). Unlike other MR devices, HoloLens (produced by Microsoft) enables exploration of the MR environment by controlling movements and mapping positions, without using hands (Evans et al. 2017). In addition to being used for marketing or medical purposes (for example - training young surgeons), and for communication and educational purposes (Brondi et al. 2016), by adding virtual content to the exhibition space, MR enhances the visual experience of art, as well (Hughes et al. 2004). It is anticipated that 5G technology would improve communication efficiency, enabling users to connect in new ways (Wang 2020).

MIXED REALITY IN THE EDUCATION SECTOR

Virtual technology is well known for its ability to facilitate communication (Jovanović 2015). The entire virtual culture and computer communications demonstrate the inextricable link between technology and society (Baltezarević-Baltezarević 2016). Based on cognitive theories for information processing, the adoption of augmented reality can reduce the cognitive load and positively affect the cognitive fluency (Kang et al. 2020). Mixed Reality has the potential to significantly improve people's quality of life (Shockoe 2022). Highly immersive experiences facilitate specific autonomic nervous

system response patterns (Dillon et al. 2002). Physiological reactions enable a more accurate evaluation of task performance and subjective ratings by providing details about individual experience episodes (Liebold 2017).

It was commonly stated that the lack of immersion in today's digital technologies led to teacher and student exhaustion, lack of practical insight, and difficulties understanding and processing instructional content (Selvaraj et al. 2021). Immersion displays have been demonstrated to aid in information retention and improve memory recall compared to non-immersion displays in the educational setting (Ventura et al. 2019). The students in the class gain practical understanding and experience of the subject matter being taught through the use of mixed reality, which combines sophisticated virtual and reality simulation (Maas, Hughes 2023). By enabling learners to directly perceive, manipulate, and interact with complicated structures, mixed reality can assist alleviate cognitive load by diverting the brain's attention from trying to grasp the data and instead focus it on comprehending, digesting, memorizing, and applying it (Techtrends 2019). Essential to mixed-reality experiential learning is interaction, which lets students engage with the environment and take an active role in their education (Patil et al. 2020). MR devices provide training, communication, and simulation. While in the same physical location, users can interact with virtual worlds simultaneously thanks to local multiple user apps (Hoppe et al. 2020).

Through sophisticated simulation that offers teachers and students in the classroom sensory and emotional experiences, MR technology enhances the sense of pleasure and delight (Marto et al. 2020). Educators can use the features of MR, such as visualization of space, engaging interactive simulations, as well as virtual adjustments, to better align concepts related to learning, and student demands. This can lead to profound learning opportunities (Alizadehsalehi et al. 2019). With an instructional strategy catered to each learner's own needs, personalized learning enables each learner to go at their own optimal speed. This principle is followed by modern interactive learning programs, which maximize the learner-relevant and meaningful content. This idea can be modified and expanded upon in an MR learning environment. With AR overlays, students might get personalized, real-time feedback while studying challenging material or working on complex tasks. The surroundings, experiment, and virtual overlay can all be video recorded by the system while it is learning or doing MR-supported experiments (Thomas 2016). Mixed reality (MR) facilitates user involvement and feedback, which is beneficial for students and individuals with learning disabilities. Incorporating mixed reality into educational pathways also improves student engagement by providing them with opportunity to explore and retain knowledge better (Tang et al. 2018).

Because developers recognize the value of collaborative learning in the classroom, they are bringing VR, AR, and MR technologies that allow students to collaborate on projects, visit educational locations, and take part in lectures even when they are not in the same physical location (Kazendi 2017). When compared to normal museum visits, the study found that the interactive MR experience increased participants' interest in and contentment with the exhibits and provided a more vivid and immersive learning environment. The metaverse can also be studied in terms of interaction, since mixed reality has the potential to improve the metaverse environment, as well (Mogaji et al. 2023).

Students will benefit from the immersion by better understanding the course material, which is essential for maintaining high academic standards (Fidan, Tuncel 2019). It is believed that glasses-based augmented reality will overtake screen-based augmented reality in the coming years (Balistreri 2022). Although various issues have arisen, such as a lack of learning experiences comparable to those seen in traditional educational settings. By providing students with interesting and enjoyable learning opportunities, mixed reality technology will enhance the present digital learning approach (Huges et al. 2005). Challenges in executing tasks during a crisis highlighted the novel possibilities offered by digital technologies (Baltezarević-Baltezarević 2021). VR requires minimal physical interaction, and its use has increased during the Covid-19 pandemic (Rueter 2020).

CONCLUSION

Although the technology of mixed reality (MR) still has a lot of room for improvement and for finding new useful functions in the educational sphere, it is undeniable that it provides with a certain level of convenience. A review of the literature found that with devices that enable the mixing of virtual reality and scenarios from the real environment great progress can be achieved in the education sector. MR can improve the process of learning, communication and cooperation, but also help those who have difficulties in mastering the material to achieve outstanding results. Also, this technology has shown that it can be very useful in crisis periods, as was the case with the pandemic Covid-19, because students are able to continue their education process without interruption, from the armchairs of their homes.

Because of its qualities, mixed reality in education provides teachers with new and inventive options to explore with students. They promote more participation during school hours, enhance interpersonal connection, and may be utilized to teach any topic because it is simpler to see and hear something rather than describe it. Students and teachers can use mixed reality gadgets to travel back in time and engage with objects or people who no longer exist. Finally, MR technologies overcome geographical limits, which benefits both student safety and the educational institution's budget. It is indisputable that digital innovations, including MR, are increasingly and precisely finding their use value in education. In the years to come, a greater number of research studies in this area will show more precisely what the advantages of implementing these technologies in learning processes really are.

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УЛОГА МЕШОВИТЕ СТВАРНОСТИ У СЕКТОРУ ОБРАЗОВАЊА

Резиме

Нове технологије и предности које доносе са собом све више улазе у све поре друштва. Нови тренд који комбинује виртуелну стварност (ВР) са сценаријима из стварног света, који се огледа у уређајима мешовите стварности (МР), првенствено у слушалицама ХолоЛенс, које омогућавају корисницима да истражују свет мешовите стварности и контролишу своје покрете (чак и без коришћења руку), све више проналазе пут до сектора образовања. Предмет овог рада је анализа утицаја и предности уређаја мешовите стварности (МР) у образовању, са посебним фокусом на изградњу комуникације и сарадње ученика у процесу учења. Циљ овог рада

је да стручњацима из области образовања укаже на предности примене ових нових технологија у образовном систему у циљу повећања мотивације ученика, побољшања њиховог разумевања садржаја који им се предаје, али и пружања подршке ученицима са слабим успехом у превазилажењу изазова учења. Појава имерзивних технологија омогућила је ученицима да уче на даљину, што се показало веома корисним током пандемије. Сложени тренинзи, експерименти и групни пројекти сада могу да се спроводе у виртуелном окружењу независно од стварности, што може помоћи ученицима да постану вештији и ентузијастичнији без бриге да ће резултати бити мање ефикасни него у традиционалном окружењу.

Кључне речи: виртуелна стварност (ВР), мешовита стварност (МР), образовање, ученици, процеси учења.

Рад је предат 16. јануара 2024. године, а након мишљења рецензената, одлуком одговорног уредника *Баштине*, одобрен за штампу.