

VR/AR IN EDUCATION: IS IT WORTH THE HYPE?

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ABSTRACT (no more than 150 words)

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INTRODUCTION

Education in today's digital age faces the challenge of adapting to the rapid development of technology. Traditional teaching methods are often unable to meet the needs of diverse students who have different learning styles. Augmented Reality (AR) and Virtual Reality (VR) are emerging as innovative solutions that can enhance the learning experience. These technologies allow students to actively engage in the learning process, creating an immersive experience that supports the understanding of complex concepts. According to recent research, the use of AR and VR in education can improve student motivation and retention, as well as provide opportunities for more effective experiential learning.

Traditional study methods rely on passive learning techniques, such as lectures, textbooks, and note-taking, which often limit students' ability to visualize abstract concepts and engage deeply with the material. In contrast, Virtual Reality (VR) offers an immersive and interactive environment that allows learners to experience and experiment with concepts firsthand. For example, instead of reading about historical events or anatomical structures, students can "step into" a historical setting or explore a 3D model of the human body. While traditional methods remain effective for foundational learning and accessibility, VR can significantly enhance comprehension, engagement, and retention by catering to diverse learning styles and making complex ideas tangible and experiential.

However, despite the huge potential of AR and VR, there are still many challenges to be faced in their implementation, such as cost, teacher training, and required infrastructure. Therefore, it is important to comprehensively evaluate the impact of these technologies in an educational context, to understand the benefits and barriers that may arise.

The purpose of this paper is to explore and evaluate the potential of AR and VR in education, focusing on how these technologies can improve student engagement, learning outcomes and skill acquisition. This paper also aims to identify the challenges faced in the implementation of AR and VR in educational environments. By understanding these various aspects, this paper is expected to provide valuable insights for educators, decision makers, and technology developers, so that they can design more effective strategies in integrating AR and VR into the curriculum.

METHOD

The method used in this article is the literature review method, where a comprehensive collection of relevant literature on the topic of VR/AR in education, published within at least the past six years prior to the article's publication date, is carefully gathered, analyzed, and synthesized. This approach ensures that the study is grounded in the most recent and significant developments in the use of virtual reality (VR) and augmented reality (AR) technologies in educational settings, providing a robust foundation for understanding their applications, benefits, challenges, and future potential.

FINDING & DISCUSSIONS

ENHANCING LEARNING EXPERIENCE

VR provides a highly immersive and engaging learning environment, allowing students to actively participate in their educational journey. Unlike traditional methods that rely on passive learning through lectures and texts, VR enables students to explore and interact with virtual environments, making complex and abstract concepts more accessible. For instance, VR facilitates virtual field trips, 3D modeling of the human body, and interactive science experiments, which enhance understanding and retention.

The enhanced learning experience through VR bridges the gap between theoretical and practical knowledge. For example, students studying astronomy can virtually explore the solar system, creating a direct connection between classroom concepts and real-world applications. This level of interaction not only solidifies their comprehension but also inspires curiosity and interest in the subject. However, it is important to consider the cognitive load that some VR experiences may impose, as overly complex designs could overwhelm learners.

Despite its benefits, AlGerafi et al. (2023) emphasize that integrating VR into classrooms faces significant challenges. High costs for equipment and limited accessibility in underfunded institutions pose barriers to widespread adoption. Additionally, while VR excels in visual and experiential learning, it may fall short in addressing the needs of students who prefer traditional, text-based approaches. Combining VR with conventional methods could offer a balanced solution to accommodate diverse learning styles.

BOOST MOTIVATION AND SKILL ACQUISITION

Research indicates that VR significantly boosts student motivation by offering a dynamic and interactive platform for learning. Unlike static materials, VR immerses students in lifelike scenarios, encouraging active participation. In skill-based disciplines like engineering, VR simulations provide a safe environment for students to practice repeatedly, honing their skills without the fear of real-world consequences (AlGerafi et al., 2023).

The hands-on nature of VR aligns with experiential learning theories, where students learn better by doing. For instance, medical students can practice surgeries in a virtual operating room, building confidence and expertise. This kind of practical exposure in a risk-free setting is difficult to replicate with traditional methods. Moreover, VR's gamified elements, such as rewards for completing tasks, further motivate students to engage deeply with the material.

Ensuring the quality of these virtual simulations is critical. Poorly designed VR content may fail to replicate real-world scenarios accurately, reducing its effectiveness. Additionally, over-reliance on VR for skill acquisition could limit students' exposure to real-world unpredictability, which is equally important in technical and medical fields. A hybrid approach, combining VR and real-world practice, could address these limitations.

SUPPORTS PERSONALIZED LEARNING

VR fosters personalized learning by adapting to individual students' paces, styles, and needs. It provides immediate feedback and allows learners to revisit challenging topics as often as necessary, creating a self-directed learning environment. This is particularly beneficial for students with diverse learning styles, as VR can tailor content to meet their specific requirements.

Personalized VR environments empower students by giving them control over their learning. For example, a language-learning VR program can adjust vocabulary difficulty based on a student's progress, ensuring an optimal challenge level. Similarly, in subjects like mathematics, VR can guide students through complex problem-solving exercises, offering step-by-step assistance when needed. These features reduce frustration and build confidence, which are crucial for long-term academic success.

The success of personalized VR learning depends on its integration into curricula. Educators must receive adequate training to utilize VR effectively and ensure that its use aligns with educational goals. Additionally, there is a risk that excessive personalization may isolate learners, reducing opportunities for collaborative learning. Balancing individual learning paths with group activities can help maintain a well-rounded educational experience.

THE IMPLEMENTATION OF VR IN EDUCATIONAL FIELDS

From the findings above, we now shift our focus to the actual implementation of VR in educational fields, exploring its impact and effectiveness. Research conducted by Durrani and Pita (2018) highlights that the medical education field leads in adopting AR/VR technologies for teaching and learning. Their study demonstrates that the outcomes of using these technologies are consistently positive, with significant improvements in understanding and applying complex medical concepts. Interestingly, the study also reveals that 11 out of 12 educators in this field took the initiative to design and develop their own AR/VR applications, showcasing not only the adaptability of this technology but also its versatility in meeting specialized educational needs.

Another prominent area of VR/AR integration is engineering education, where, unsurprisingly, all reviewed studies reported favorable outcomes. This highlights the potential of VR/AR to enhance hands-on learning, allowing students to engage with simulations and scenarios that would otherwise be too costly or impractical in a traditional classroom setting.

These examples underline the tangible impact of VR/AR in specific educational fields, proving that its integration is not merely a novelty but a practical, effective tool for enhancing learning. Further reinforcing this, Durrani and Pita (2018) found that out of the 38 studies they reviewed, a remarkable 92% confirmed that VR/AR technologies significantly enhance concept delivery. By replacing passive learning methods with interactive and exploratory approaches, VR/AR empowers students to engage deeply with study cases, fostering a more immersive and impactful educational experience.

However, while the integration of VR/AR has shown promising results in combinational educational fields like medicine and engineering, its application in more general contexts, such as among undergraduate students, presents unique challenges. Research by McFaul and FitzGerald (2019), which employed a realist approach to examine student responses, provides critical insights into these challenges. Their study specifically analyzed how VR could be utilized to improve students' presentation skills, comparing the initial expectations with the actual outcomes.

The findings revealed significant barriers to successful VR/AR implementation in this demographic. Technical issues, such as hardware or software malfunctions, were cited as one of the primary obstacles. Furthermore, the confidence level of students while engaging with the technology played a pivotal role; some students were hesitant to fully immerse themselves, lacking the motivation or incentives to invest time and effort in mastering the tools. As a result, only a small percentage of students showed genuine engagement and recognized the potential of VR/AR for enhancing their learning experiences.

Adding to these challenges, AlGerafi et al. (2023) highlight that existing research on this technology has primarily focused on technical aspects rather than establishing a strong

theoretical foundation for its application in education. While it is true that this area has shown promise as a research subject, it remains underdeveloped in the educational field. Another challenge highlighted is the high cost of implementing this technology.

From these perspectives, it becomes evident that while VR/AR demonstrates undeniable potential in conveying complex concepts and enhancing study cases, its practical adoption still faces hurdles. Bridging the gap between innovation and practical application requires addressing technical shortcomings, reducing costs, and fostering student engagement through well-founded learning strategies. Without these steps, the widespread use of VR/AR in education may remain limited to niche or well-funded settings.

CONCLUSION

Virtual Reality (VR) presents a transformative approach to education, offering an immersive and interactive learning experience that stands in contrast to traditional study methods. While traditional education typically relies on lectures and textbooks, VR allows students to actively engage with complex concepts by exploring virtual environments, conducting experiments, or studying subjects like anatomy in 3D. This hands-on approach not only helps students better grasp challenging material but also stimulates motivation and enthusiasm for learning, creating a more engaging and dynamic educational experience.

Moreover, VR supports personalized learning by adapting to individual students' needs, allowing them to progress at their own pace and receive immediate feedback. This customization enhances the understanding of content and fosters skill acquisition in a safe, controlled environment. While traditional methods offer consistency and accessibility, VR provides a unique opportunity for students to learn through active participation, which may lead to deeper retention and improved outcomes. As the technology continues to advance, VR has the potential to significantly revolutionize the educational landscape, offering a more effective and engaging way for students to learn.

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APPENDIX