

Literature Review

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EDLD 5315

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April 27, 2025

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Abstract

Virtual Reality (VR) is rapidly transforming educational environments, offering immersive experiences that enhance student engagement, comprehension, and retention. This literature review examines the current research on VR in K-12 education, identifying key advantages, barriers, and implementation strategies. Findings indicate that VR increases motivation, supports differentiated learning, and provides experiential opportunities otherwise unavailable in traditional classrooms. However, challenges such as cost, accessibility, and teacher training remain significant barriers. The review highlights gaps in the research, particularly regarding long-term effects on learning outcomes. These insights will inform my action research on VR Immersive Learning Pods, contributing to the broader discussion on integrating VR into educational settings effectively.

Introduction

Virtual Reality (VR) is an emerging technology in education that has the potential to transform traditional learning environments by providing immersive and interactive experiences. The use of VR in K-12 education has gained attention due to its ability to increase student engagement, support differentiated learning, and enhance retention through experiential learning (Mikropoulos & Natsis, 2011). My interest in this topic stems from my ongoing research on implementing VR Immersive Learning Pods in blended learning environments, particularly within FBISD. Given the increasing push for technology integration in classrooms, understanding how VR can enhance learning outcomes is essential for developing effective instructional strategies (Makransky, Mikkelsen, & Lough, 2019).

The purpose of this study is to examine the effectiveness of VR in K-12 education, particularly in improving student engagement, comprehension, and knowledge retention. Research suggests that VR can make abstract concepts more tangible, allowing students to interact with content in ways that traditional methods cannot replicate (Freina & Ott, 2015). However, despite the promising applications, challenges such as high costs, teacher training, and accessibility must be addressed to maximize its impact (Huang & Liaw, 2018). The overarching research question guiding this literature review is: How does the implementation of VR Immersive Learning Pods impact student engagement and learning outcomes in K-12 blended learning environments?

Review of the Literature

Definition of Virtual Reality in Education

Virtual Reality (VR) in education refers to the use of computer-generated simulations that allow users to interact with three-dimensional environments in real time. According to Bailenson (2018), VR provides a sense of presence, which enhances experiential learning by allowing students to explore complex concepts in an engaging way. VR can be fully immersive, requiring head-mounted displays, or semi-immersive, integrating digital simulations into classroom instruction through interactive screens or mobile applications. Research has shown that VR fosters deep learning by increasing cognitive engagement and reducing distractions compared to traditional learning environments (Slater & Wilbur, 1997).

Types of Virtual Reality in Education

Fully Immersive VR

Fully immersive VR environments use headsets such as Oculus Rift, HTC Vive, or Meta Quest to create a completely interactive digital experience. These environments allow students to engage in virtual labs, historical recreations, or simulated real-world scenarios, offering hands-on learning experiences that are otherwise impossible in traditional classrooms (Mikropoulos & Natsis, 2011). The ability to manipulate objects and engage in experiential learning significantly improves retention and conceptual understanding (Jensen & Konradsen, 2018).

Semi-Immersive VR

Semi-immersive VR includes interactive simulations displayed on screens, often used in subjects such as science and mathematics. This type of VR does not require a full headset but still allows students to interact with 3D models and virtual experiments, enhancing conceptual understanding

(Johnson et al., 2016). Semi-immersive VR is often more cost-effective and accessible, making it a practical alternative for schools with limited resources (Makransky et al., 2019).

Augmented Reality (AR) Integration

While not fully immersive, AR is often discussed alongside VR due to its ability to overlay digital information onto the real world. AR applications such as Google Expeditions or Merge Cube allow students to explore educational content interactively while maintaining a connection to their physical surroundings (Freina & Ott, 2015). AR has been found to improve spatial awareness, increase student interaction, and enhance learning motivation (Huang & Liaw, 2018).

Advantages of Using Virtual Reality in Education

Research has highlighted multiple advantages of incorporating VR in educational settings. One of the primary benefits is increased student engagement. Makransky et al. (2019) found that students using VR in classrooms exhibited higher levels of motivation and curiosity compared to those using traditional learning methods. Additionally, VR supports differentiated learning by catering to different learning styles. Visual and kinesthetic learners benefit from immersive experiences that allow them to interact with educational content in a more meaningful way (Huang & Liaw, 2018).

Another advantage is the ability to provide experiential learning opportunities that would otherwise be impossible due to safety concerns, cost, or accessibility, such as virtual field trips to historical sites or science labs for hazardous experiments (Johnson et al., 2016). Furthermore, VR can enhance critical thinking and problem-solving skills by placing students in realistic scenarios that require decision-making and adaptability (Gros, 2007).

Moreover, VR can create personalized learning environments where students can progress at their own pace. This self-paced learning helps reduce anxiety in learners who may struggle in traditional classroom settings, while still challenging advanced students through dynamic content pathways. VR also allows for immediate feedback, which reinforces learning and encourages students to self-correct and reflect on their understanding of the material (Anderson & Dill, 2000).

In collaborative VR settings, students can work together in virtual spaces, fostering teamwork, communication, and social-emotional skills. This kind of virtual collaboration mirrors real-world remote work environments, helping students develop digital literacy and soft skills that are increasingly valued in modern careers. Additionally, the novelty and interactivity of VR often re-engage students who are typically disinterested in conventional instruction, making it a valuable tool for supporting at-risk or disengaged learners (Jensen & Konradsen, 2018).

Finally, VR provides educators with data and analytics on student interactions within the environment, which can inform differentiated instruction and support data-driven decision-making. When used effectively, VR is not just a supplement to education but a transformative tool that enables deeper learning and skill-building aligned with 21st-century competencies.

Barriers to Implementing Virtual Reality in Education

Despite its advantages, implementing VR in education presents several challenges. One of the most significant barriers is cost. High-quality VR headsets and software can be expensive, making widespread adoption difficult, especially in underfunded school districts (Mertler, 2019). Another challenge is the learning curve associated with using VR technology. Teachers may

require extensive professional development to integrate VR effectively into their curriculum (Gros, 2007).

Additionally, concerns about screen time and motion sickness among students have been raised, necessitating further research into best practices for incorporating VR safely into the classroom (Slater & Wilbur, 1997). Furthermore, equitable access remains a significant issue, as not all students have the same opportunities to engage with VR due to technological disparities in schools (Mikropoulos & Natsis, 2011).

Beyond these primary barriers, there is also the issue of curriculum alignment. Many educators struggle with finding VR applications that are directly relevant to state standards or district-level objectives. Without clear guidance or pre-approved resources, teachers may be hesitant to invest time in tools that may not yield measurable academic benefits. Another critical concern is technical support; schools may lack the IT infrastructure or personnel necessary to maintain and troubleshoot VR equipment consistently, leading to frustration and underuse.

Additionally, administrators may resist allocating funds toward emerging technologies without concrete evidence of long-term effectiveness. This skepticism can delay pilot programs and make it harder for early adopters to gain institutional support. Lastly, student privacy and data security are emerging concerns. As VR tools become more advanced, they often collect data on user movements, engagement levels, and interactions within the virtual environment. Schools must ensure that these platforms comply with student privacy laws such as FERPA and COPPA. This adds another layer of complexity that must be addressed before widespread implementation can occur.

Summary

The literature on VR in education suggests that it has significant potential to enhance student engagement and learning outcomes. The ability to create immersive and interactive learning experiences makes VR a powerful tool for differentiated instruction and experiential learning. However, challenges such as cost, teacher training, and accessibility must be addressed for widespread adoption. Future research should focus on long-term studies to assess the sustained impact of VR on academic achievement. It is vital to utilize this technology not as a temporary trend or gimmick, but as a foundational tool for delivering meaningful, lasting learning experiences. When implemented effectively, VR can help shift students from being passive recipients of information to active participants in their own educational journey.

Fostering collaboration and self-directed learning is a key strategy in sustaining the innovation of immersive learning environments. Creating ongoing Professional Learning Communities (PLCs) will allow educators to collaborate, share best practices, and refine their approaches to using VR effectively in the classroom. These communities will support teachers through continuous dialogue, modeling, and shared learning experiences. Additionally, self-directed learning will be encouraged, empowering educators to explore VR tools at their own pace, which helps them become confident and intentional in their integration of technology.

Leadership in the rollout and sustainability of this innovation will be distributed among a diverse and passionate group of stakeholders. Technology specialists will take the lead on the setup, training, and troubleshooting of VR equipment. Instructional coaches and curriculum leaders will facilitate the professional development sessions, ensuring alignment with educational standards. Teachers will play a vital role in modeling effective use in classrooms, gathering data, and providing feedback within their PLCs to refine the implementation over time.

Furthermore, failing to innovate presents a real risk of increasing disengagement among students and further widening the gap between education and the evolving digital world. If we do not act, students may leave school underprepared for careers that demand technological fluency and adaptability. By embracing immersive learning, we take an intentional step toward preparing students to be future-ready, critical thinkers who are empowered to navigate and shape their environments.

The outcomes of immersive learning speak volumes. Students are not merely absorbing facts—they are building essential skills in critical thinking, creativity, communication, and collaboration. This transformation in learning opens doors for students to become leaders, innovators, and changemakers in an increasingly complex world. By connecting the emotional and philosophical foundation of our "Why" with the practical, actionable strategies of our "How," we build a compelling case for this innovation. Immersive learning is not just a concept for the future; it is a powerful reality we can bring to every classroom today with the right support and vision.

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