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Work-in-Progress—Immersive Learning: Challenges and Trends

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Abstract. Immersive technologies provide innovative opportunities for interactive and engaging learning taking advantage of real-world scenarios and simulations to provide practical situations for learners, helping them better prepare for real-world challenges and enhance their employability. This work-in-progress paper explores the challenges in achieving the full potential of immersive learning such as affordability, content creation, and accessibility. Furthermore, the latest trends such as immersive learning technologies are highlighted. In this paper, the aim is to contribute to a clearer understanding of Immersive Learning in terms of its current state and future prospects which provide valuable information for researchers working in advancing immersive learning technologies.

Keywords: Immersive Learning, Virtual Reality (VR), Augmented Reality (AR), Extended Reality (XR).

1 Introduction

Immersive technologies are changing the way teaching happens at all levels, enabling new forms of learning that are nowadays known as immersive learning, allowing students to experience situations that traditionally are not commonly available in a classroom setting [2,3,6]. Immersive learning has its roots in early 20th-century experiential instruction, eminently championed by figures like John Dewey [15]. Immersive learning allows students to have hands on experiences favoring learning-by-doing over traditional lecturing combining play and learning and making lessons more exciting and memorable. The goal is to help students really understand and remember what they are learning, making it real and interesting [9-10]. These tools elicit curiosity in learners enabling them to investigate concepts in 3D and do hands on exercises that make complex topics easier to understand, providing new ways of learning [9-12].

There are several advantages to using immersive learning. By immersing students in lifelike simulations via the use of technologies such as virtual reality and augmented reality, difficult subjects can become more manageable. Because students actively participate in their education, this hands-on approach fosters higher levels of engagement and drive. In addition to providing a secure setting for rehearsing real-world situations, immersive learning environments also promote critical thinking and practical skills. These tools go beyond conventional approaches by meeting individual requirements and supporting a variety of learning styles. Because of these benefits, immersive learning improves comprehension while also increasing students' enjoyment and sense of purpose in their academic path [16]. Immersive learning benefits from the fast advancing of technologies and pedagogies, such as virtual reality (VR), augmented reality (AR), gamification, and personalized learning, facilitating engagement and interaction.

The following are some of the potential advantages of immersive learning [4, 21,24,25]:

- Enhanced Engagement: Immersive experiences capture students' attention and generate a sense of presence, making learning more engaging and memorable.
- Better Understanding: Because students interact with knowledge in a dynamic fashion, immersive learning can promote better comprehension and recall of complicated subjects.
- Personalization: The future of immersive learning will most likely feature more personalized experiences that adapt to individual learning styles and interests.

- Worldwide Collaboration: Because virtual classrooms and collaborative environments are possible, immersive learning can encourage worldwide relationships that cross geographical borders.
- Real-World Readiness: By delivering actual, hands-on experiences, immersive learning is expected to better prepare learners for real-world difficulties and occupations.

Although immersive learning and immersive technologies provide benefits to learners, they also present noteworthy challenges, such as issues of accessibility, content creation, and privacy concerns, which must be understood and addressed to ensure that such pedagogical approaches and the technologies that support them are used safely to their full potential [4-6]. Immersive technologies include a diverse array technology that are covered under the umbrella term of extended reality (XR), such as virtual reality (VR), Augmented Reality (AR), and Mixed Reality (MR. The evolution of immersive technologies has brought about significant changes in both commercial hardware and software capabilities [11,12]. Immersive technologies have enabled growth in methods, theories, and interaction approaches enabling natural interaction directly in a mix of real or virtual three-dimensional context, transcending the nature of 2D environments, and offering enriched and engaging 3D experiences [1, 13,14]. Despite the natural interactions enabled by 3D environments, the relative novelty of such interaction for users which are used to desktop and mobile applications, introduce a learning curve that can be more complex overcome than more established user interfaces. The extent of input and output modalities for interactions provided by immersive technologies is in response to new interface modalities, which can range from traditional 2D interfaces to 2D spatial interfaces, to diegetic 3D interfaces, enabling new opportunities to devise new interactions approaches [1,3]. The quintessence of immersive learning lies in its capacity to bridge the gap between theory and real-world applications [7,8]. Virtual environments coupled with simulations of real-life scenarios, supports learners in the acquisition of required abilities and skills to explore complex, real-world challenges.

This survey paper on the challenges and trends in immersive learning employed a systematic research methodology to ensure reliability and validity. Data were collected through a comprehensive review of academic literature and industry publications. Both qualitative and quantitative analysis techniques were applied to interpret the data. This paper explores immersive learning, highlighting, and analyzing the challenges that prevent its full realization and the patterns that aim to reshape education. Such analysis aims to provide those interested in the subject that wish to adopt (or guide the adoption of) immersive learning with an understanding of issues and barriers to adoption. Namely, this paper presents:

- A discussion of challenges in immersive learning
- A review of latest trends in immersive learning
- An examination of the potential of immersive learning in the future
- A structured and concise overview of the key elements of immersive technologies in education.

The rest of the paper is organized as follows: Section 2 provides a detailed explanation of challenges in Immersive Learning. Trends in Immersive Learning are reviewed in section 3. Finally, the potential of Immersive Learning and conclusions are discussed in sections 4 and 5 respectively.

2 Challenges in Immersive Learning

In this section the main challenges that educators and organizations have when putting immersive learning strategies into practice are illustrated, see Fig.1.

2.1 Accessibility Challenges

The accessibility of immersive technology is a primary problem. To engage in immersive learning, students usually need to have access to certain technology, hardware, and software. Prerequisites frequently include computers with high specifications, recent mobile devices for augmented reality, or virtual reality headsets. Because not all students have the funds to purchase such equipment, this presents an accessibility barrier. This problem can be made worse by socioeconomic differences, which can lead to a digital gap that affects how equally immersive learning is adopted. Taking action to ensure that all students have access to the required hardware is imperative to address this issue [17-19].

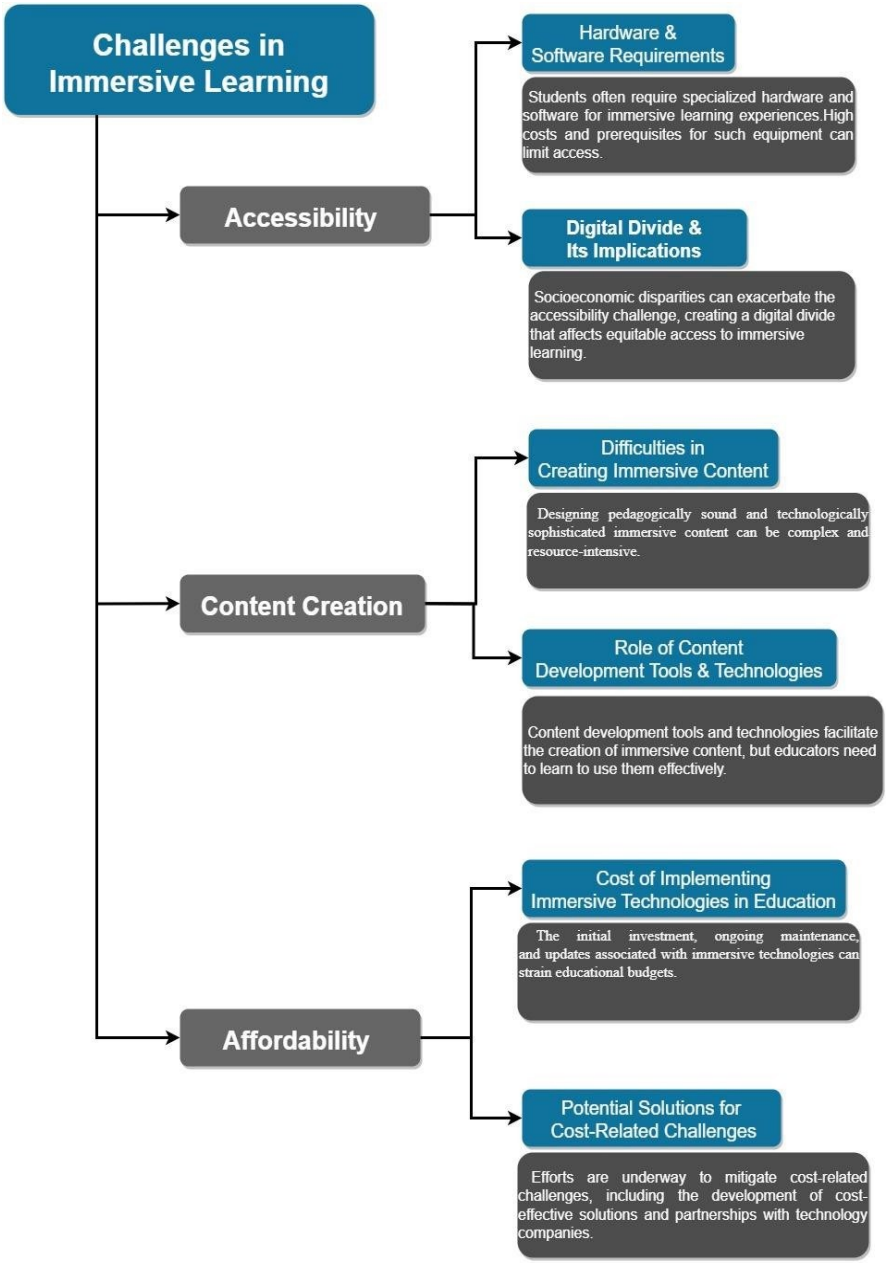

Fig. 1. Challenges in Immersive Learning.

This digital divide caused by digital literacy and access to computing is particularly evident in immersive learning. Lacking access to engaging technology can put students from poor families at a disadvantage in educational environments where these resources are increasingly important. This raises ethical questions and highlights the need to close the digital divide so that all students, regardless of their economic situation, can benefit from inclusive education. [17, 20-22].

2.2 Content Creation Challenges

Interesting and pertinent information is necessary for immersive learning experiences. The process of creating immersive content that successfully grabs and holds learners' attention can be difficult and resource intensive. It is the responsibility of content designers to create technologically advanced and pedagogically sound scenarios, simulations, and interactive features. This is a difficulty that also affects instructional designers and professors, who might need to receive training in producing immersive materials [6-8,23]. Many content production tools and technologies have been developed to address the challenges of content creation. By facilitating the creation of immersive content, these technologies help educators create and deploy immersive learning experiences more effectively. However, applying and integrating these tools into educational practice is not without difficulties. In

addition to knowing how to use these tools, teachers must ensure that the content they create aligns with learning goals and standards [3,5,8]. These challenges could be mitigated through the development of immersive content libraries that provide an index of immersive learning experiences that are available to educators.

2.2 Affordability Challenges

A. Cost of Implementing Immersive Technologies in Education

For educational institutions, the expense of integrating immersive learning technology might be a significant hurdle. The cost covers both the initial hardware and software purchase as well as continuing upkeep and updates. It can be difficult for educational institutions to set aside funds in an era of tight budgets so they can completely adopt immersive learning [4, 6,18].

B. Potential Solutions for Cost-Related Challenges

The affordability challenge could be mitigated through web technologies, creating immersive learning content that runs on any device would reduce the need for education institutions to purchase headsets while still allowing students access to the content. Mobile based VR and AR solutions could also work for certain experiences, implementing a bring your own device (BYOD) approach. Virtual reality manufacturers have also recently launched initiatives to address the issue of affordability. These include partnerships to provide access to hardware and software to educational institutions for free or at a lower cost, creating more affordable immersive technology solutions. Additionally, research is being conducted to show how inclusive learning is more cost effective in the long term in terms of better learning outcomes and reduced training costs in occupational contexts. It is clear from these constraints that comprehensive approaches are needed to successfully integrate blended learning into the educational process. The following sections in this article consider the most recent developments in inclusive learning, which may help address some of these issues while also creating new directions for innovative teaching [1,6,17].

3 Trends in Immersive Learning

Many of current trends have evolved in the field of immersive learning, each with the potential to improve the educational experience in a way that is distinct from the others. The four main trends covered in this section are gamification, personalized learning, augmented reality, and virtual reality as shown in fig. 2.

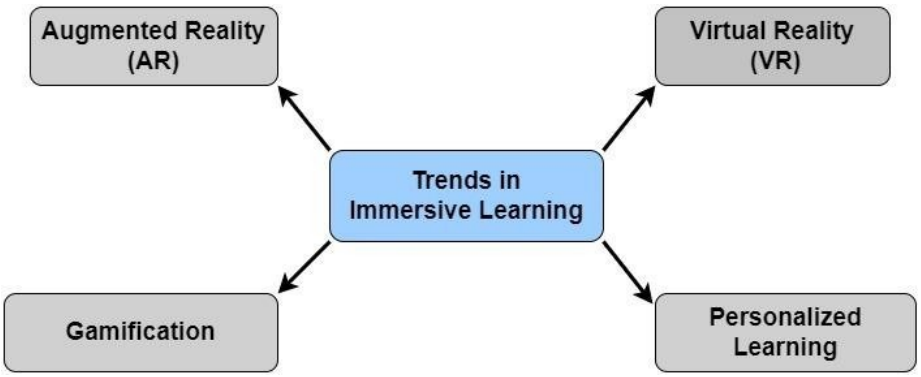

Fig. 2. Latest trends in Immersive Learning.

3.1 Virtual Reality (VR)

Virtual reality (VR) is rapidly popularity as an educational tool, giving students the opportunity to explore realistic computer-generated landscapes for an immersive learning experience. Virtual reality has several advantages in the education sector. This allows students to experience topics directly and overcome the limitations of the traditional classroom. Virtual reality VR can explore remote locations, recreate historical events, and even delve into complex scientific ideas. Numerous case studies have demonstrated the impact of virtual reality on education, particularly in enhancing engagement and student motivation. The immersive nature of virtual reality not only increases engagement but also promotes knowledge retention and understanding [2,5,11].

3.2 Augmented Reality (AR) and Mixed Reality (MR)

Augmented Reality (AR) and Mixed Reality (MR) are a remarkable tool for enriching real-world experiences since they superimpose digital information on top of the real environment. Unlike VR, AR and MR augment the physical environment with digital material rather than replacing it [13]. AR and MR have found uses in a variety of sectors in immersive learning. For example, it can transform a traditional textbook into an interactive, multimedia experience. Students can use their devices to point at AR markers to access additional films, 3D models, or historical facts. AR is also employed in museums, where students can use AR apps to bring exhibits to life. Anatomy apps that allow students to visualize human parts in 3D by pointing a smartphone at a text- book image are examples of AR-enhanced teaching [1,6,8,13].

3.3 Gamification

Gamification is the process of incorporating game features and mechanisms into nongame environments to make learning more interesting and motivational. To increase motivation and engagement, gamification components such as points, badges, leaderboards, and quests have been implemented into educational environments. There have been numerous gamified learning environments developed. Gamification is used in language learning apps by rewarding points for right responses and measuring progress. Gamified components are used in online courses to encourage completion of modules and tests. These examples demonstrate how gamification can be used to make learning more fun and effective [1,4,6].

3.4 Personalized Learning

Personalized learning caters educational experiences to the requirements, preferences, and learning styles of individual learners. Personalized learning in immersive learning entails tailoring the material and delivery techniques to each learner. This can involve altering the simulation challenge level, providing more resources based on student performance, and providing options for learners to explore virtual settings [1,5]. Personalized learning can result in better learning results and higher student satisfaction. Learners are more engaged when the content they are exposed to is relevant to their interests and abilities. However, adopting personalized learning can be difficult since it requires robust data analytics and adaptive technologies to successfully adjust the experience. Furthermore, when collecting and exploiting student data, privacy and ethical aspects must be taken into mind [1,4-6].

4 The Potential of Immersive Learning

Immersive learning's future indicates a wide number of possibilities that could potentially change the way education takes place. Immersive learning is positioned to play an increasingly important role in education as technology advances and educational paradigms alter [1,4,6,8]. Immersive experiences are projected to become increasingly sophisticated, accessible, and seamlessly incorporated into educational environments as technology advances, having transformational effects on education.

As immersive technologies and immersive learning develops the there is potential for [4,6,8, 9, 13,15,17,19]:

- Widespread Adoption: As technology and software become more affordable, immersive technologies are expected to be introduced into mainstream schooling.
- Blended Learning: A combination of traditional classroom instruction and immersive learning experiences could become the norm, resulting in a balanced and successful learning environment. This could become particularly advantageous for distributed or remote learning, where students cannot come together to the same physical space but can meet and interact in a virtual environment in a similar way they would in a physical space.
- Assessment and Feedback: More robust methods for assessing student achievement and providing timely, adaptive feedback may be part of the future of immersive learning.
- Career Preparation: Immersive learning may help individuals prepare for a variety of jobs by providing realistic simulations and hands-on experience in sectors ranging from healthcare to engineering.
- Global Reach: Virtual and augmented reality can help students cooperate across borders and cultures by facilitating global educational connections.

5 Conclusion

This paper explored Immersive Learning to provide insights on its challenges as well as promising trends. The investigation of challenges includes issues with accessibility, content creation, and affordability. Moreover, this paper outlines developments and trends in Immersive Learning such as the use of virtual reality, augmented reality and mixed reality, gamification, and personalized learning, which have the potential to transform the educational environment. Each trend makes a unique contribution to improving the educational experience by creating interesting and dynamic learning environments. Finally, the potential of immersive learning is discussed. The short overview provided by this paper is intended to help educators, researchers, and policymakers better understand the current state and future prospects of immersive learning technology. Future work will require further developed approaches to overcome the challenges identified.

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