Chapter 8

Immersive Learning VR, AR, and Beyond

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Abstract

The article investigates the theoretical and practical elements of integrating immersive technologies in educational institutions all over the world, emphasizing the significance of education for long-term social development. It emphasizes the effectiveness of digital technology in strengthening the learning process, as well as the necessity for research and teaching professionals to constantly enhance the quality of education. The article covers the advancement of augmented reality (AR) and virtual reality (VR) for educational purposes worldwide, identifying patterns, discrepancies, advantages, barriers, and emerging developments. It reinforces prior study theories and emphasizes the tremendous expansion of educational research. The research's contribution is to provide exciting prospects for AR and VR for learning and their advancement by revealing the state of the art in previous articles. VR curriculum has the potential to transform how education is provided through VR that learners can interact with. This chapter investigates how VR education employs AR and VR to promote self-learning, allowing students to conduct their own studies. It explores the various facets of AR and VR in learning, as well as how students and teachers engage with these technologies. The emphasis is on enabling individuals to view and engage with VR, consequently redefining the way learning resources are made available. A systematic review of articles is carried out to explore the impact of VR on learners' experiential learning. The investigations, utilizing a variety of methodologies and contexts, identify nine themes: VR as a pedagogical tool, establishing itself as an educational technology, digital transformation, teaching-learning framework, architectural pedagogy, communication skills, reading and writing abilities, social learning, and experiential learning. VR is employed in a variety of domains, including medicine, engineering, language, and social learning, to foster student involvement and provides personal contact with the environment. The article emphasizes the potential of VR for enhancing experiential learning.

Keywords

Immersive Virtual Reality, Immersive Learning, Augmented Virtuality, Mixed Reality, Augmented Reality, Virtual Reality, Head-Mounted Displays (HMD)

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1. Introduction

During the worldwide pandemic, educational institutions leveraged immersive technology for online learning to strengthen learning efficiency. These technologies allow learners to control and modify the environment, allowing them to witness historical events, perform experiments, overcome difficulties, and experience virtual tours, exhibitions, and concerts. This approach has proven to be successful in improving the educational experiences of students. [1] The incorporation of immersive realities into traditional educational courses has received plaudits over the last two decades, but adoption has been hindered by budgetary and technological barriers. However, recent technological breakthroughs, low-cost hardware, and user-friendly interfaces have led to broad application outside the military and healthcare, with higher education institutions increasingly trying to improve virtual learning experiences [2]. Immersive systems generate virtual aspects of both actual and imagined environments to acquire new data, create new experiences, and deliver insights. They are becoming more common in a variety of sectors; however, it is uncertain if an immersive application operates equally well or more effectively than the present ones in specific assignments [3]. Immersive Virtual Reality (iVR) technology can improve classroom and learning settings, however they frequently lack educational content. A framework based on the Cognitive Theory of Multi-media Learning (CTML) is suggested for iVR-supported learning environments, which incorporates evidence-based educational models with iVR-specific characteristics. This approach addresses the design of iVR learning environments in the context of recent research on multimedia learning [4]. Immersion learning technologies such as virtual reality, augmented reality and educational digital games enhance cognitive learning and offer substantial advantages of teaching and learning by enabling students to experience realistic environments. However, because these immersive environments are different from regular classroom activities current evaluation methods might not be adequate for gauging learning in these settings [5].

In fig 1 shows that Augmented reality (AR), which blends virtual information with the physical world in real time performance is expanding quickly and become more sophisticated and reliable [6]. Ensuring the success and acceptance of AR systems becomes crucial. Evidence suggests potential trends adopting

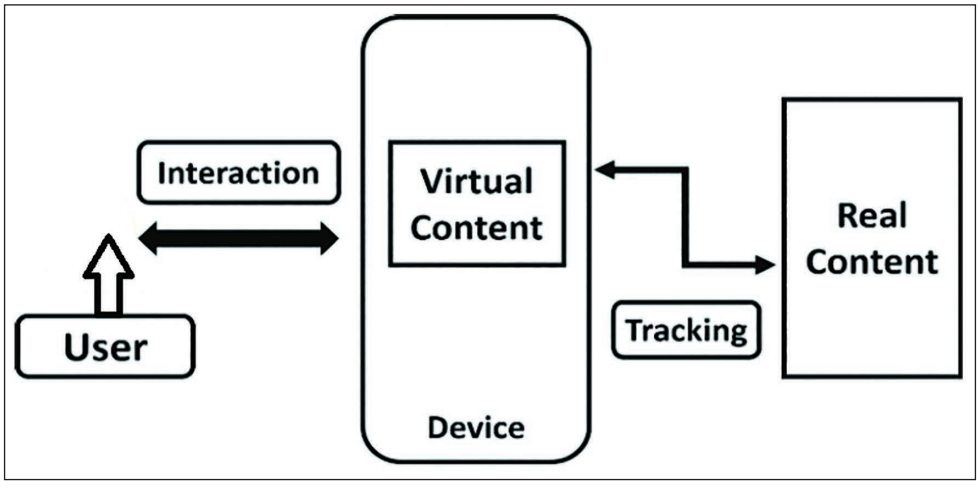

Fig 1: AR architecture comprised by six elements.

AR systems as the number of senior mobile user rises. Given the growing use of VR and AR in education, a deeper understanding of immersive learning approaches in various fields is necessary. Higher level thinking in virtual and augmented reality learning settings is emphasized in the establishment of a strong conceptual basis for course or content design in order to produce immersive learning experiences [7]. Due to the increasing interest in IVR based training and education, numerous studies have been carried out. The integration of earlier findings into a theoretical framework, however, has not received much attention. The learning process in IVR is described by the cognitive affective model of immersive learning, which draws on earlier immersive educational research. According to the framework instructional techniques for less immersive media could be used for IVR instruction [8].

2. Immersive Learning VR, AR, and Beyond

Augmented Reality (AR) and Virtual Reality (VR) are cutting-edge technological advances with the potential to significantly enhance the educational system. They offer immersive digital experiences that are not achievable through traditional teaching techniques, allowing learners to engage with complicated subject in addition to lectures and textbooks. Furthermore, these technologies allow educators to customize data to particular learning styles, therefore improving the overall learning experience [9]. Emerging technologies, including VR and AR, are transforming education by improving student knowledge and engagement. Product designers and architects effortlessly adopt these technologies, especially distinguished by their originality, rapid expansion, and influence on people's lives. Designers must examine human-computer interactions, and architectural methods must evolve to reflect these new advancements, allowing students to grasp and communicate more effectively [10]. The availability of low-cost sensors, interaction devices, and displays has expedited the application of VR and AR in a wide range of applications. However, creating these applications necessitates a thorough grasp of the topic and particular technical abilities, which are frequently lacking in contemporary Computer Science and Engineering courses [11].

In Table 1 shows that innovative augmented reality (AR) applications in a variety of fields are described in the table. Travel is made easier by AR's ability to improve navigation through AR cues and indicators [12]. AR incorporates spoken reminders, AR pillboxes and discovery technologies to help seniors live independently while they age in place [13]. AR helps with physical rehab and fitness during training by using augmented treadmills and movement guided training programs [14]. Finally, augmented reality is revolutionizing gaming in the entertainment industry by providing immersive involvement through 3D games like Angry Birds etc. AR, VR, Augmented Virtuality (AV), and Mixed Reality (XR) are prominent immersive reality technologies for disseminating cultural information in Virtual Heritage. They augment education by providing personalized interactions and digital information that is adapted to historical and cultural environments. Sensor-based, device-based, tangible, collaborative, multimodal, and hybrid interaction approaches allow for engagement with virtual worlds [15]. XR environments give a breakthrough approach to education by integrating real-to-virtual immersive encounters to provide scaffolded learning points, increase sensorial and embodied experiences, and enable self-determined experience-based learning and aesthetic representation of complicated issues. [16]. XR and mobile visualization techniques are critical for spatial dissemination of data and educatinal institutions. However, there has been limited research on their influence on architectural schooling and the learning experience. To improve building information modeling (BIM) workflows in architecture, engineering, and construction, novel mobile XR (MXR) educational delivery techniques should be explored [17]. The developments of AI and simulated realities as a result of technological advancements has made VR a

Table 1: A summery of AR domain in different area.

Domain	AR Application
Transportation [12]	AR navigation system, Two AR cues, AR indicator
Ageing -in- place [13]	Spoken reminder, AR pillbox, AR discovery and information system.
Training [14]	Augmented treadmill, AR-based gait training program, movement guide.
Entertainment [15]	3D Angry Birds like game, AR table card games.

new technology with educational applications. VR is a computer-generated simulation that lets users interact with a simulated environment, providing opportunities for experiential learning. As a result, they feel more involved and present in the virtually world [18]. IVR's creative teaching methodology which makes use of head mounted displays has revolutionized the idea of a learning environment by enabling students to investigate challenging subjects in ways that area not conventional. Nevertheless, there is still a dearth of research on learning objectives, intervention characteristics and assessment methods pertaining to IVR use [19]. Learners benefit from open and distance learning (ODL), as it enables them to learn without the constraints of traditional face-to-face lectures. Immersive technologies, especially AR, empower participants to supplement their surroundings with 3D objects, while VR immerses them in a simulated 3D environment utilizing HMD [20]. The integration of game-based techniques with VR environments for learning and teaching has an exciting future owing to low-cost software and hardware solutions. Individuals actively engage in these environments, which promote exploration-based learning paradigms. There are multiple evaluations of VR technology and games for educational and training purposes that focus on a certain subject area [21].

3. Methodology

Virtual reality (VR), AR and other cutting-edge technologies are used in immersive learning to create dynamic, captivating worlds that mimic real world situations. The process starts by determining the learning goals and creating experiences that these technologies can improve or duplicate [22]. While AR superimposes digital data onto the real world for context driven learning, VR enables complete immersion and simulates situations for skill development. In addition to encourage active learning these experiences are frequently combined with tests and real time feedbacks. While data analytics monitors learners progress to personalize experiences content production incorporates 3D modeling, spatial interaction and adaptive learning tools [23].

4. Recommendations

Based on the thorough literature review of the immersive learning technology currently being employed in the education domain, we, propose following recommendations for future.

- Immersive learning technologies, particularly video conferencing, are widely employed in remote education for enhancing learning efficiency.

- Immersive technologies are employed in academic educational spaces to educate professionals in many economic sectors for professional competences, as well as to create social and emotional experiences and solve environmental challenges.
- IVR technology offers the advantage of repeated practice in a secure setting with limited resources, that has an intrinsic value. Although emotional behavioral change has been extensively explored in non-educational environments, it remains an important field for future studies.
- Technological developments, additional creative material, and the ability of educators to design individualized IVR experiences will all improve IVR's potential as a teaching tool. However, deploying this technology requires substantial theoretical and experimental evidence to assure its appropriate and comprehensive application.
- AR and VR technologies offer an immersive and dynamic learning environment, increasing students' interest in the subject. Learning is made more fascinating and engaging by their enticing visual and aural signal as well as their capacity to generate virtual worlds and simulations.
- By enabling students to explore and engage with instructional materials in authentic settings, AR and VR technologies increase the relevance of the material. By presenting new ideas and concepts in a more engaging way, they also increase student engagement and enthusiasm while improving comprehension.
- AR and VR technologies especially for those with physical and cognitive problems enable students with special needs to experience virtual settings at their own pace and on their own terms, thereby increasing accessibility to learning.
- By keeping up with the most recent advancements students can design creative applications and gain a competitive edge in the job market by making sure they use modern tools and processes to effectively contribute to the quickly growing VR and AR industry.
- VR and simulations have the ability to save lives in educational settings by teaching coping mechanisms and aiding in disaster relief efforts. They significantly influence innovative design methods, especially throughout the stages of planning, evaluation and appreciations.
- VRs promote learning, memory, and concept retention by offering compelling material and positive control, as well as increasing satisfaction, creativity, and self-efficacy. They also help in creative design and experiential learning, particularly in VR-enabled learning environments.

Conclusion

Immersions technologies are employed in educational settings for a number of purposes, including training future archaeologists, architects, engineers, pilots and doctors, the study found. By using these technologies an inclusive learning environment is created that accommodates each students' needs and abilities and guarantees that they can perform their tasks effectively. Because it offers a more customized and efficient learning experience, this method is particularly beneficial for children with specific needs. Through computer generated animation and simulation, VR allows people to interact in a virtual setting. It is a component of interactive, experience learning when students take part in the process. By encouraging creativity in their learning process, BR aids in both teaching and learning. Nevertheless, it is frequently used in a limited number of realistic subject areas. VR and AR technologies have the potential to revolutionize education by providing students with an immersive and captivating educational experience. With the help of these technologies, students can interact with sounds, images and simulations which piques their interest in the material. They can also develop appealing virtual environments, which improves the learning experience. This research article explores the numerous categories of immersive

reality technologies, including AR, VR, AV, and MxR, as well as their enabling technologies, from a VR perspective. It assesses the possibility for these technologies for creating a contextual connection among individuals, reality, and simulation, as well as their capacity for promoting collaboration and interaction in virtual environments. The study also contrasts several interaction modalities, including physical, collaborative, multimodal, sensor-based, device-based, and hybrid interfaces. According to the review, immersive virtual reality (IVR) improves learning in around half of cognitive assessments, particularly in complicated and conceptual problems that require spatial comprehension and visuals. While many research revealed no substantial benefit, a few showed negative consequences. Most procedural activities benefited from I-VR, and virtual skill learning was successfully implemented in real-world challenges. CAMIL integrates areas including VR, multimedia, educational psychology, and technology for demonstrating how IVR could enhance knowledge acquisition and transfer. However, limitations in this subject include an absence of learning theories as well as a lack of theoretical and methodological depth, as pointed out by recent reviews and meta-analyses.

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