

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 2; February 2026; Page No. 300-303

Received: 21-12-2025
Accepted: 23-01-2026

Indexed Journal
Peer Reviewed Journal

Augmented reality and virtual reality: Shaping the future of immersive experiences

¹Himanshi, ²Vandana Verma, ³Ella Rani and ⁴Priyanshu Shekhawat

¹Research Scholar, Department of Extension Education and Communication Management, Chaudhary Charan Singh, Haryana Agricultural University, Hisar, Haryana, India

²Associate Professor, Department of Extension Education and Communication Management, Chaudhary Charan Singh, Haryana Agricultural University, Hisar, Haryana, India

³Assistant Professor, Department of Extension Education and Communication Management, Chaudhary Charan Singh, Haryana Agricultural University, Hisar, Haryana, India

DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i2d.3055>

Corresponding Author: Himanshi

Abstract

Augmented Reality (AR) and Virtual Reality (VR) are transforming digital interactions by seamlessly blending real and virtual worlds. While these technologies have been in development for decades, recent advancements have enhanced their potential, particularly in education. AR overlays digital elements onto the physical environment, while VR immerses users in simulated spaces, offering innovative ways to enhance learning and engagement. This paper examines the evolution of AR and VR, their expanding role in education and the critical challenges limiting their widespread implementation. Despite making learning interactive, barriers such as high costs, complex setups and the need for technical expertise hinder their adoption in classrooms. Additionally, research on their long-term impact remains limited. Beyond traditional education, AR and VR serve as powerful tools for knowledge extension, especially in rural and agricultural contexts. They enable interactive demonstrations, skill-building and real-time simulations, making complex information accessible at grassroots-level communities. Their integration into extension services can revolutionize knowledge dissemination, bridging the gap between theoretical instruction and practical field applications. The study further discusses the classification of AR and VR experiences, their advantages and existing limitations that must be addressed for successful adoption. By analysing existing literature and technological trends, this paper highlights the future possibilities of AR and VR in reshaping education and fostering interactive learning environments.

Keywords: Augmented reality, virtual reality, immersive learning, interactive environments

Introduction

Technological progress consistently drives significant changes in every era. Augmented reality (AR) as well as virtual reality (VR) are prime examples of this evolution. While often perceived as new, these technologies have a rich history. In the 1970s, Daniel Vickers developed the first virtual reality headset at the University of Utah, featuring two screens that allowed users to immerse themselves in virtual environments by simply moving their heads. Shortly thereafter, the DataGlove was introduced in 1982, effectively tracking hand and finger movements and relaying this information to a computer (Fuchs *et al.*, 2011) [6]. The term "Virtual Reality" was popularized in the United States by Jaron Lanier during the 1980s. Around the same time, researchers Thomas Caudell and David Mizell coined the phrase "augmented reality" in 1990 to describe how electricians utilized head-mounted displays to assemble intricate wiring harnesses.

The 1990s marked a significant technological boom for AR and VR, setting the stage for the advancements we see today. Recent developments in augmented reality and virtual reality demonstrate that these technologies are essential components of modern immersive interactive

systems, enhancing user engagement and creating dynamic user experiences.

The objective of this paper is to examine the evolution of AR and VR, their expanding role in education and the critical challenges limiting their widespread implementation. These advancements facilitate new levels of interaction, engagement and innovation in educational sectors. In the context of extension education, AR and VR offer innovative approaches for reaching communities and grassroots-level learners. These technologies can be leveraged to deliver interactive training, virtual field visits and hands-on agricultural demonstrations, thereby improving knowledge transfer and adoption of modern practices. As AR and VR technologies continue to evolve, they will transform the ways we learn, work, play and connect.

Augmented Reality (AR)

According to Adami & Budihartanti (2016) [1], augmented reality (AR) is a technology that creates 3D objects that are displayed on a screen by interactively combining real and virtual objects. AR allows users to see computer-generated objects in real time, whether they are 2D or 3D. Augmented

reality is a method of "adding" computer-generated input to the real environment while viewing it in person or through a camera or other device that produces real-world visuals.

Virtual Reality (VR)

Virtual reality is a "Human immersion in a synthetic world" (Seidel and Chatelier, 1997) ^[12]. Virtual reality is a technology that allows users to enter and interact with a virtual world. This is because VR is a computer-based technology that combines specialised input and output devices to allow users to interact directly with the virtual environment as if they were in the real world. High immersion, which is an immersive experience that immerses the user in a virtual environment that surrounds them and makes them feel as though they are a part of it, will be the outcome of using virtual reality devices. A human-computer concept that simulates the future world is called virtual reality (VR). Online, people can virtually explore the world. Virtual reality (VR) is an artificial application created by different technologies in real-world settings. Human sensory experiences can be simulated or replicated in virtual reality. The majority of virtual reality uses the sense of sight to create a virtual environment.

Categories of Augmented Reality Experiences

The typical AR experience can be broadly categorized into three types of AR systems, as illustrated in Fig. 1.

- 1. **Fixed AR:** This system is anchored to a specific location, which means users are limited to that area and must relocate the entire setup if they wish to change locations. One of the key advantages of fixed AR is that it eliminates the need for location tracking, allowing for enhanced control and computing power. This results in a more immersive and realistic AR experience. Fixed AR systems can be implemented both indoors and outdoors. For example, museum exhibits and industrial applications.
- 2. **Mobile AR:** Distinct from AR that runs on mobile phones, mobile AR refers to systems that users can deploy in various locations. The portability of the required hardware grants users the freedom to use AR interfaces virtually anywhere. However, this flexibility comes with a trade-off in computational power. Given that smartphones are ubiquitous in developed regions, mobile AR often leverages these devices as the primary platform, making it widely accessible.

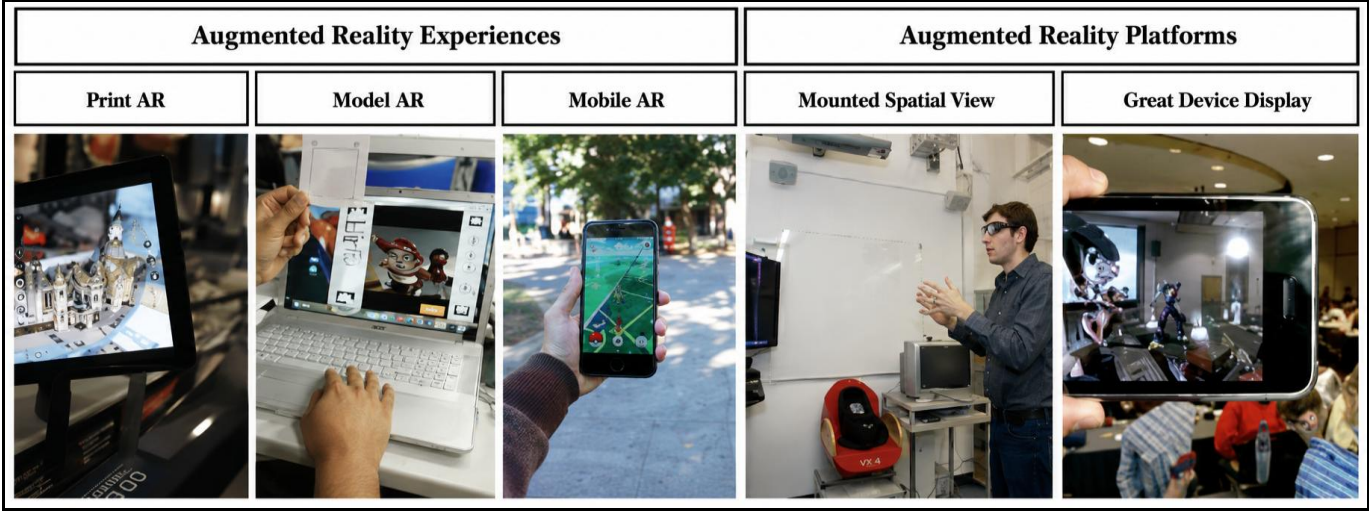


Fig 1: Types of augmented reality experiences and accompanying platforms

- 3. **Mixed AR:** Combining elements of both fixed and mobile AR, mixed AR offers some level of transportation convenience, although it is not as straightforward as mobile AR. This is due to the necessity of wearable technology, as the computer system must accompany the user. This challenge can be partially addressed by integrating the equipment with vehicles, enhancing portability. Nevertheless, advancements in portable technology continue to enhance the viability of deployable mixed AR systems.

Categories of Virtual Reality Experiences

Virtual Reality (VR) experiences can be classified into three primary categories, as illustrated in Fig. 2, each offering distinct levels of immersion and interactivity.

- 1. **Non-Immersive VR:** Non-immersive VR is widely used but often not recognized as 'true' VR due to its limited sensory engagement. Non-immersive VR employs motion sensors to track user movements, translating them into actions within a virtual

environment displayed on a screen. A familiar example of this category is the video game Wii Sports, which does not necessitate head-mounted devices, although tactile controls are utilized to interact with the virtual world. And Desktop VR in which a 3D virtual world is shown on a standard computer monitor.

- 2. **Semi-Immersive VR:** Offering a blend of real and virtual elements, semi-immersive VR is often utilized for training and educational applications. A prime example is a flight simulator, where physical controls provide genuine input, while screens display virtual instruments and environments. This setup allows users to engage with both real and simulated components of the experience.
- 3. **Fully Immersive VR:** Delivers the most realistic and engaging environments. It requires a head-mounted display to create a sensory experience with a wide field of view and can be enhanced with programmable full-body haptic feedback for a truly immersive interaction. Examples include virtual shooter gaming zones.

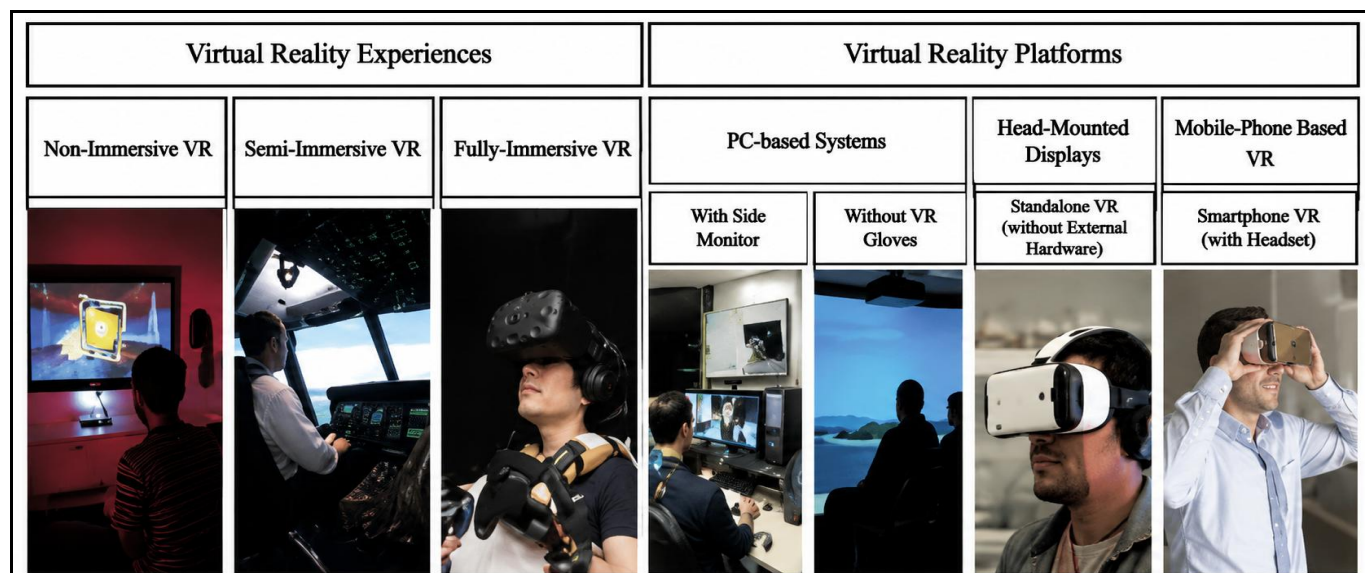


Fig 2: Types of virtual reality experiences and accompanying platforms.

Each of these categories plays a significant role in how we engage with technology and virtual environments, providing

varying degrees of experience depending on the user's needs and objectives.

Advantages of using AR

Author	Advantages of AR
Coffin <i>et al.</i> , 2010 ^[4]	By adding virtual annotations and illustrations to real objects, teachers can help students better understand what they are learning in the classroom.
Burton <i>et al.</i> , 2011 ^[3]	It establishes a learning environment that is connected to the traditional classroom so that students can learn outside of the school's boundaries and during non-class hours.
Singhal <i>et al.</i> , 2012 ^[13]	It Facilitates smooth interaction between virtual and real-world settings and permits object manipulation using a tactile interface concept.
Saidin, N. F., Halim, N. D. A. and Yahaya, N., 2015 ^[10]	AR features can assist students become more involved in the learning process and enhance their visualisation abilities. The characteristics can also assist teachers in providing clear explanations and facilitating students' comprehension of the material.

Advantages of using VR

Author	Advantages of VR
Dede, 2005 ^[5] ; Antonietti <i>et al.</i> , 2001 ^[2]	It strongly complements the constructivist learning theory because the students feel empowered and engaged because they have control over the learning process.
Pantelidis, 2010 ^[8]	The interactive nature of virtual reality transforms students from passive learners into active learners, improving student motivation and their sense of control over their own learning.
Sala 2013 ^[11]	Virtual reality can help students learn abstract concepts because they can experience and visualize these concepts in the virtual environment.
Hussein and Natterdal, 2015 ^[7]	VR is especially effective in subjects needing an interactive environment and it promotes involvement and active learning more than mobile applications.
Potkonjak <i>et al.</i> , 2016 ^[9]	In a simulated environment students can learn about the potentially dangerous consequences of failure from failing to follow procedures or exceeding design specifications without physical damage to equipment or loss of life.

Challenges of Augmented Reality (AR) and Virtual Reality (VR) in Education

1. High Cost of Hardware

- Significant financial investment required for AR and VR devices.
- Many schools and colleges may find these costs prohibitive.

2. Complexity of Technology

- AR and VR tools are relatively new and can be complicated to use.
- Educators and students without prior knowledge may struggle with effective implementation.

3. Maintenance Issues

- Hardware and software require regular maintenance.
- Technical problems can disrupt classes and affect the learning experience.

4. Potential for Distraction

- Immersive experiences may divert students' attention.
- Can hinder concentration and information retention during lessons.

5. Limited Research

- Research on AR and VR in education is still in its infancy.

- Insufficient comprehensive studies to assess effectiveness and impact on learning outcomes.

6. Need for Further Investigation

- More research is needed to understand the full potential of AR and VR in educational contexts.
- Complexity of implementation in classrooms warrants deeper exploration.

7. Technological Expertise Gap

- Many educators may lack the necessary skills to integrate these technologies properly.
- To maximize the benefits of AR and VR in education, institutions must invest in comprehensive training and ongoing technical support for educators.

Opportunities for Engagement

- Despite challenges, AR and VR can enhance learning experiences when implemented correctly.
- With proper tools, resources and training, these technologies can make education more immersive and engaging.

Conclusion

AR and VR are reshaping education by creating interactive and immersive learning experiences. Despite challenges such as high costs and technological barriers, continued advancements are making these technologies more accessible. With proper training and investment, AR and VR have the potential to revolutionize education, bridging the gap between theoretical learning and practical experience. Future research should focus on long-term learning outcomes and scalability in diverse educational settings. For extension education and grassroots level development, AR and VR present transformative opportunities. By providing immersive, easily accessible learning experiences, these technologies can empower local communities, farmers and field practitioners with up-to-date knowledge and best practices. AR and VR will be crucial in bridging the technological gap and improving knowledge extension services at grassroots levels with sustained investment and research.

References

1. Adami FZ, Budihartanti C. Penerapan Teknologi Augmented Reality Pada Media Pembelajaran Sistem Pencernaan Berbasis Android. *Jurnal Teknik Komputer AMIK BSI*. 2016;2(1):1-6. DOI:10.31294/jtk.v2i1.370
2. Antonietti A, Imperio E, Rasi C, Sacco M. Virtual reality and hypermedia in learning to use a turning lathe. *Journal of Computer Assisted Learning*. 2001;17(2):142-155. DOI:10.1046/j.0266-4909.2001.00167.
3. Burton EP, Frazier W, Annetta L, Lamb R, Cheng R, Chmiel M. Modeling augmented reality games with preservice elementary and secondary science teachers. *Journal of Technology and Teacher Education*. 2011;19(3):303-329.
4. Coffin C, Bostandjiev S, Ford J, Hollerer T. Enhancing classroom and distance learning through augmented reality. In: Herrington J, Montgomerie C, editors. *Proceedings of ED-MEDIA 2010-World Conference on Educational Multimedia, Hypermedia & Telecommunications*. Chesapeake (VA): AACE; 2010. p. 1140-1147.
5. Dede C. Planning for neomillennial learning styles. *Educause Quarterly*. 2005;28(1):7-12.
6. Fuchs P, Moreau G, Guitton P. *Virtual Reality: Concepts and Technologies*. 1st ed. Boca Raton (FL): CRC Press; 2011. DOI:10.1201/b11612
7. Hussein M, Nätterdal C. The benefits of virtual reality in education: A comparison study. Gothenburg: University of Gothenburg; 2015.
8. Pantelidis VS. Reasons to use virtual reality in education and training courses and a model to determine when to use virtual reality. *Themes in Science and Technology Education*. 2010;2(1-2):59-70.
9. Potkonjak V, Gardner M, Callaghan V, Mattila P, Guetl C, Petrovic VM, *et al*. Virtual laboratories for education in science, technology, and engineering: A review. *Computers and Education*. 2016;95:309-327. DOI:10.1016/j.compedu.2016.02.002
10. Saidin NF, Halim NDA, Yahaya N. A review of research on augmented reality in education: Advantages and applications. *International Education Studies*. 2015;8(13):1-8.
11. Sala N. Applications of virtual reality technologies in architecture and in engineering. *International Journal of Space Technology Management and Innovation*. 2013;3(2):78-88. DOI:10.4018/ijstmi.2013070104
12. Seidel RJ, Chatelier PR. Virtual reality: training's future? Perspectives on virtual reality and related emerging technologies. Vol. 6. New York (NY): Springer US; 1997. p. 1-222.
13. Singhal S, Bagga S, Goyal P, Saxena V. Augmented chemistry: Interactive education system. *International Journal of Computer Applications*. 2012;49(15):1-5. DOI:10.5120/7700-1041