

EXPLORING AUGMENTED REALITY (AR) AND VIRTUAL REALITY (VR) RECENT DEVELOPMENT IN EDUCATION

Salman Khan, Mr. Pradeep Kumar Singh

Department of Computer Application, Babu Banarasi Das University, Lucknow, India

Email: Salmankh1627@gmail.com, Pradeep1384@bbdu.ac.in

Abstract

In the field of education, virtual and augmented reality technologies have shown great promise as tools that open up new avenues for immersive learning. Numerous scholars have concentrated on investigating these technologies' possibilities in education from various angles. The influence, efficacy, and potential applications of virtual reality (VR) and augmented reality (AR) in educational contexts are thoroughly examined in this study. With an emphasis on AR/VR applications in education, the study examined current academic publications and reports from 2014 to 2024 using a methodical literature review and content analysis approach. New technologies are tools that are often used in day-to-day activities. These new technologies must be considered in education in order to enhance the didactic process. 150 research publications were chosen for examination using the PRISMA procedure, and our results demonstrate that raising motivation and focus, enhancing students' comprehension, and The most important effects on all learner types are improving performance and information retention. Additionally, we discovered that the majority of academics studying virtual and augmented reality favoured using online polls and questionnaires to gather data. Our investigation gives shrewd data around how instructive teach might offer assistance understudies and instructors by combining these advances with learning analytics and utilizing these innovations can advantage mechanical organizations. Be that as it may, issues counting over the top costs, the require for innovative framework, and the trouble of substance creation were famous as deterrents to wide acknowledgment. Tending to current challenges and leveraging openings will be key to realizing their full potential in upgrading instructing and learning encounters. Proceeded investigate and advancement in this field are fundamental for the viable integration of AR and VR in instruction.

KEYWORDS: - Augmented Reality (AR), Virtual Reality (VR), Educational Technology, Immersive Learning, Technology enhanced learning.

Introduction:

Augmented Reality (AR) and Virtual Reality (VR) have emerged as transformative technologies in the field of education, offering innovative ways to enhance teaching and learning experiences. By mixing computerized substance with the genuine world (AR) or making completely immersive virtual situations (VR), these devices give understudies with intuitively, locks in, and down to earth learning openings. Recent developments in AR and VR have enabled the visualization of complex concepts, virtual simulations for hands-on training, and personalized learning experiences, all of which cater to diverse learning. From virtual science labs to verifiable recreations, these innovations have illustrated noteworthy potential in making strides information maintenance, cultivating imagination, and planning understudies for future careers in a tech-driven world. As AR and VR proceed to advance, they are reshaping conventional instruction strategies, making learning more open, comprehensive, and impactful. This term paper investigates the later progressions in AR and VR in instruction, highlighting their applications, benefits, and future potential in changing learning situations. Devi (2023) highlights the beginning utilize of AR in three-dimensional life systems instruction, a spearheading step that set the arrange for ensuing headways. The period between 1995 and 2009 saw a surge in AR ponders, demonstrating a developing intrigued in investigating its instructive potential (Devi, 2023). AR, complementing VR, overlays advanced data onto the genuine world, enhancing conventional instructive materials. This innovation has changed course readings into intelligently learning encounters and field trips into guided, enlightening ventures. AR's affect amplifies to dialect learning, where it gives moment interpretations and articulation guides, and to information visualization, making complex data more open and reasonable (Shankar et al., 2023). In any case, the integration of these innovations into instructive settings isn't without challenges. Issues such as the fetched of usage, the require for appropriate specialized framework, and the advancement of important substance are critical boundaries. Also, guaranteeing the arrangement of these innovations with instructive goals and educational program remains a basic assignment for teachers and educate (Zhao et al., 2023).

LITERATURE REVIEW

Understanding AR/VR in Educational Contexts Bäck, Wenrich, and Dorner (2021) explore the AR and VR have been progressively received in different instructive areas, counting art instruction, language learning, and common school instruction.the utilize of AR and VR in art

instruction, highlighting how these innovations can change the way art is instructed and experienced. Their think about including art teachers and media specialists uncovers the potential of AR/VR in making and investigating relics, advertising a energetic and intelligently approach to art instruction. The teachers and specialists pointed out different ways of coordination AR/VR in educating hones, such as making in multiplayer mode and investigating antiquities in SocialVR, demonstrating the flexibility. Within the setting of common school instruction, Lytvynova and Soroko (2023) examine the interaction models inside instructive situations utilizing VR and AR innovations. Their inquire about in common instructive institution included creating and actualizing an instructive extend utilizing VR and AR. The ponder found that while the interaction within the instructive prepare utilizing VR needs enhancement, the utilize of AR is superior caught on by instructors and understudies. They emphasize the require for methodological suggestions and inquire about on organizing the VR environment for different instructive purposes, such as understudy inquire about, research facility work, and joint understudy ventures.

Architectural Overview of AR/VR Learning Environments The building system of Expanded Reality (AR) and Virtual Reality (VR) learning situations could be a basic angle of their integration and viability in instructive settings. This system envelops the basic and operational components that characterize how these innovations are utilized for instructive purposes. Encouraging the understanding of these situations, Beck, Morgado, and O'Shea (2023) dive into the instructive hones and procedures related with immersive learning situations, especially within the setting of the instructive metaverse. Their inquire about distinguishes key methodologies and hones utilized in immersive learning situations, uncovering the different approaches and strategies that can be utilized. This think about underscores the require for instructive hones to be in concert with innovative capabilities, guaranteeing that the learning encounters are important and relevantly pertinent. The structural system of AR/VR learning situations is characterized by a few key components. Client interaction and engagement are basic for viable learning, requiring plans that are natural and locks in. The innovation must adjust with instructive techniques and hones, as the learning encounters got to be important and relevantly important. Customization and adaptability are imperative, permitting situations to cater to diverse instructive needs and techniques. The fundamental mechanical foundation, counting equipment and program capabilities, underpins the immersive and intelligently highlights basic for AR/VR situations.

Classifying AR/VR Educational Tools: Types and Modalities The classification of Increased Reality (AR) and Virtual Reality (VR) instructive instruments includes a differing range of sorts and modalities, each custom-made to meet particular learning goals and client needs. This investigation into the different AR/VR instructive apparatuses uncovers how they cater to diverse learning styles and prerequisites, adjusting to the advancing scene of instructive innovation. In their consider, Brown et al. (2023) examine the adequacy of distinctive non-visual modalities in AR/VR learning situations for STEM instruction, especially for understudies who are blind or have low vision (BLV). They compare a vibro-audio condition, which combines gadget vibration with sound-related substance, to a normal dialect condition that gives a total depiction of the substance. The discoveries recommend that both modalities are practically identical for learning graphical data, showing the potential of AR/VR tools to suit different learning needs through different tangible modalities. This inquires about highlights the significance of tactile modalities in AR/VR apparatuses, upgrading openness and inclusivity in learning situations.

Technological Milestones in AR/VR for Education Chen et al. (2021) talk about the integration of AR/VR innovations with fake insights (AI) in conventional social instruction. Their inquire about investigates the utilize of "AR/VR+" innovation in improving the educating and learning of conventional culture in colleges and colleges. The think about highlights how AR/VR advances, whenb combined with AI, can lead to imaginative instructing modes that are shrewdly, modern, and innovatively progressed. This integration speaks to a critical turning point within the application of AR/VR in instruction, displaying the potential of these innovations in making more energetic, intuitively, and personalized learning situations.

Evaluating Current Innovations in AR/VR Learning Tools.

The scene of Increased Reality (AR) and Virtual Reality (VR) in instruction is ceaselessly advancing, with current developments altogether upgrading the learning encounter. Farsi et al.(2023) dig into the discernments and selection of VR as an guidelines instrument in instruction, especially among undergrad understudies. Their consider explores the degree to which VR is right now utilized in instructive settings and the variables impacting its appropriation. The inquire about uncovers that whereas VR has developed as a major instrument in instruction, challenges hold on in its usage. These challenges incorporate the

learning prepare, situation of back appraisal factors, and the behavioural deliberate to proceed utilizing VR. The study's discoveries propose that in spite of the potential of VR in upgrading instructive encounters, its victory depends on tending to these challenges and adjusting VR instruments with the.

Future Trends in AR/VR Educational Technology. Emerging trends suggest that the way that teaching and learning are done will change significantly as augmented reality (AR) and virtual reality (VR) become more prevalent in education.

Kulikova and Poddubnaya (2023) concentrate on preparing aspiring teachers to integrate mobile apps, augmented reality, and virtual reality into the classroom. Their efforts highlight how crucial it is to train teachers to utilise these tools efficiently. The study emphasises the necessity of specialised training courses to build professional proficiency with AR and VR technologies. This pattern suggests that the job of the instructor will change from imparting information to acting as a facilitator who uses technology to improve student learning.

METHODOLOGY

The influence, efficacy, and potential applications of augmented reality (AR) and virtual reality (VR) in education are the main topics of this study's approach, which is organised around a thorough the approach is described in depth in the parts that follow.

Data Sources: Academic databases, journals, and conference proceedings served as the study's main sources of data. Peer-reviewed publications, research papers, and reviews were accessed using major databases including Google Scholar, IEEE Xplore, Web of Science, and Scopus. Peer-reviewed publications, research papers, and reviews were accessed using major databases including Google Scholar, IEEE Xplore, Web of Science, and Scopus.

Search Strategy: Using particular keywords and phrases associated with AR and VR in education was part of the search strategy. They featured "Augmented Reality in Education," "Virtual Reality in Learning," "AR/VR Educational Impact," along with "Future Trends in AR/VR Education." To efficiently combine these phrases and hone the search to guarantee the data's relevancy and recentness, the search was restricted to English-language publications published between 2014 and 2024.

Selection Criteria: In order to find pertinent papers, the selection procedure first screened titles and abstracts. Then, the full-text articles were examined to make sure they satisfied the inclusion requirements. Studies that provided distinctive perspectives on the uptake, difficulties, and advancements in AR/VR education were given precedence. Studies that contributed to the knowledge of AR/VR's educational impact, had a sizable sample size, and had a sound methodology were chosen.

Data Analysis: Content analysis of the chosen literature was used to analyse the data. Important themes, patterns, and discoveries were found and grouped according to a number of criteria, including future trends, stakeholder viewpoints, instructional implications, and technology developments. The goal of the analysis was to compile the information in order to offer a thorough grasp of the present situation and possible applications of AR and VR technologies in education. The results were then combined to create a logical story that addressed the goals and purposes of the study.

RESULT AND ANALYSIS

The findings and analysis of the systematic review are presented in this part in accordance with the aforementioned study questions. Of the 150 research (such as surveys, reviews, systematic reviews, meta-analyses, experiments, and case studies) that were part of the study that followed, 64% were published in journals, whereas 32% and 4% came from book chapters and conferences, respectively.

Q1: What is VR and AR studies distribution for the educational systems during the selected timeframe? As illustrated in Fig. 2 for three educational levels—higher education, K–12, and industrial training—we discovered that, when the distribution of studies examining VR and AR integration in education was examined across the years of publication, the number of research articles increased steadily from 2015 to 2020. Nonetheless, the number of K–12 publications increased significantly in 2021, surpassing the number of publications on industrial training, which saw a decline in published research as compared to 2020. Additionally, taking into account the vocational educational system, the published research within the indicated time show fluctuations in the educational system.

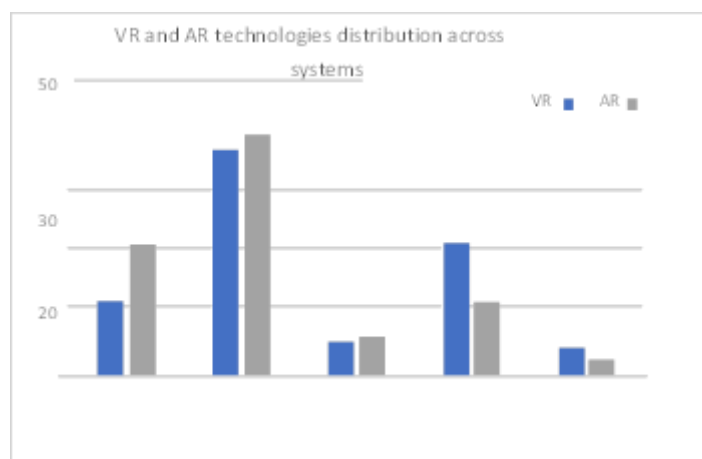


Fig. 1 Distribution of VR and AR studies

Q2: Which educational system has benefited most from VR and AR technology integration and the dominant technology in each educational system?

The educational systems that used VR and AR technologies, as well as the most common technology type in each system, will be covered in this research topic. The relevant results will be given in the next subsections. Educational systems. 48% (73 studies) of the studies were connected with the HE level after we looked into VR and AR educational studies to find the most educational systems (see Fig. 3). However, the K–12 and IT levels (around 20%, according to 32 studies) tied for second position. VE was the third educational system to implement these technologies, accounting for roughly 9% of the 14 studies. Five research, or 3% of the VR and AR investigations, lacked proof of their instructional nature. These studies were ranked fourth.

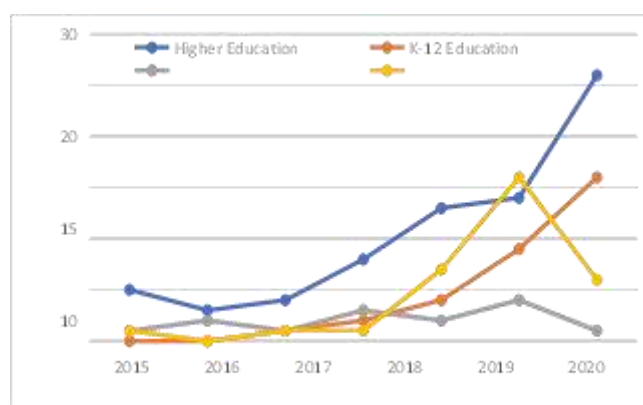


Fig. 2 Educational systems distribution

Dominant technology. This ponder found that the entire number of VR utilization over all the instructive frameworks was 86 (see Fig. 3). HE (45% (39 thinks about) was the most elevated among other instructive frameworks, as appeared in Fig. 4, taken after by IT (27% (23 ponders) instructive framework, K-12 (15% (13 thinks about) and VE (7% (6 ponders) levels, individually. In comparison, AR utilization come to 88 (see Fig. 3). Figure 5 appears that HE (48% (42 ponders) was moreover the most elevated instructive framework for these technologies' selection. The moment instructive framework was K-12 (26% (23 thinks about). IT (15% (13 thinks about) and VE (8% (7 studies) were the third and fourth, individually. There's no apparent or identifiable sort of instructive thinks about VR utilization (see Fig. 5) and (3% (3 ponders) AR utilization (Identification, 2021; Fernandez, 2017; Guilbaud et al., 2021; Kavanagh et al., 2017). VR and AR industry specialists detailed that immersive and intelligently computerized substance is anticipated to be the major application in instruction inside the another two a long time (Statista, 2021a, b).

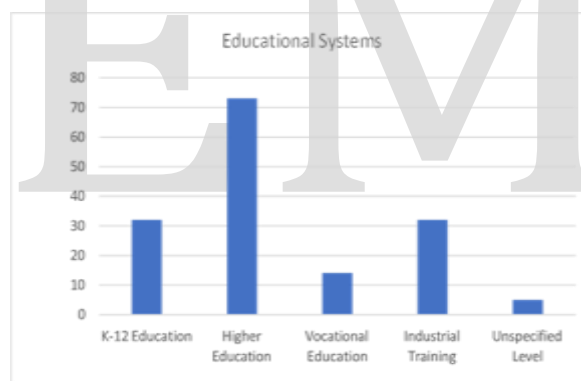


Fig.3 VR and AR technologies distribution

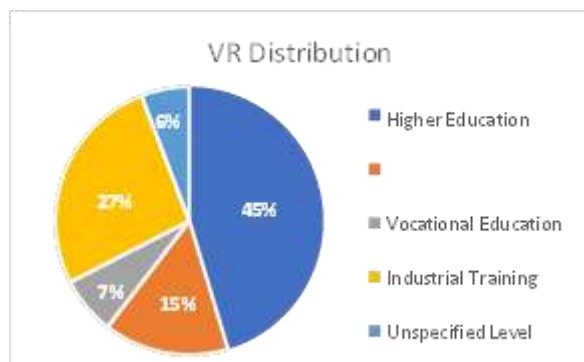


Fig. 4 VR distribution

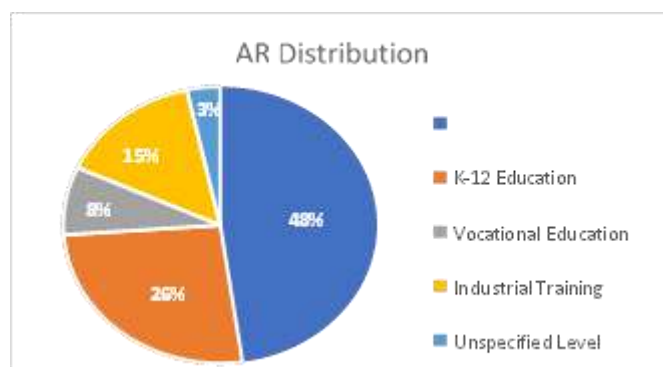


Fig. 5 AR distribution

Q3: What data collection tools are VR and AR educational researchers using?

Researchers studying VR and AR have mostly relied on conventional data gathering techniques, but they also need to be aware of new data collection technologies as they offer valuable insights into fresh learning data. For example, observing students' gazes, brain waves, and motions may indicate how simple and well-liked the learning application is as well as potential choices that students may make. According to (Mikhailenko et al., 2022), "gaze fixation, fixation duration, and the number and duration of visits are of great importance in predicting decision making." Additionally, using these techniques can yield data that is more accurate than that of traditional technologies. For instance, students may fill out surveys with inaccurate information, which might mislead the researchers. However, limiting data manipulation could be possible by employing innovative data gathering techniques (such as gazes and brain waves). As a result, it offers thorough research. Lastly, (18) studies lacked a clear and identifiable mechanism for gathering data (Bistaman et al., 2018).

Table 1. Data collection tools in VR and AR studies

Data collection tools	F
Questionnaire & Survey	50
User testing	20
Interviews	15
Observation	10
Other	9
Comments	4
Assessment & evaluation	2

Q5: How do VR and AR educational applications relate to Learning Analytics?

Immersion experiences have the capacity to gather enormous amounts of data, which Learning Analytics can then analyse. Important information on how learners interact, engage, and perform with the learning material may be gleaned from this study. By enabling tailored teaching and guaranteeing that learning objectives are met, the retrieved data may then be used to enhance educational experiences (Carter & Egliston, 2023). Few papers (11) had used the Learning Analytics (LA) approach with VR and AR educational-based applications, according to a thorough analysis of the link between LA and these technologies. There were several benefits to this integration. LA aims to understand the VR and AR learning environment as well as learner interactions (Birt et al., 2019).

CONCLUSION AND FUTURE RESEARCH

The impact of integrating VR and AR has been examined in the available systematic reviews. Nevertheless, this study was restricted to a single area or study within one or two educational institutions, focussing on VR and AR technology. However, a study examining the effects of VR and AR technologies from the viewpoints of educators and learners in a variety of fields and within all existing educational institutions was not found. Along with defining the used data gathering techniques, the research propensity of educational institutions, and their adoption of VR and AR technologies, it also addresses the impact of Learning Analytics integration with VR and AR applications. In order to inform various educational institutions and industrial organisations about the potential benefits to students and educators when choosing to adopt VR and AR with Learning Analytics technologies, as well as how these technologies will advance education and training, we therefore made the decision to fill this research gap. By looking at 150 ponders, our comes about appear that exploring these innovations has expanded over time and looking almost VR and AR integration inside K-12 appears to pull in future analysts. In this ponder, we moreover found that VR and AR can progress inspiration and consideration, decreasing the burden of instructing and preparing and also making up for the lack of customary educating strategies. We too found that Learning Analytics can give important data to organizations, instructive teach and teachers approximately learners' execution, any shortcomings within the VR and AR applications, and

which learners require customized learning methods. Moreover, we asserted that Higher instruction was the dominant instructive framework which AR was the foremost well known innovation inside the distinguished period. Too, surveys and online studies were favored information collection instruments by VR and AR analysts. This inquire about has too asserted that VR and AR integration will drastically alter different instructive frameworks, and analysts can take advantage of the extricated VR and AR learning information to supply change and help to learners, teachers, instructive teach, and the learning environment. Joining these advances will build up an free and certain learner who already utilized to get information at a specific time from teachers. In expansion, it can flawlessly get ready learners for their future careers, which without a doubt will emphatically affect the economy. Teachers will moreover discover additional time to create learning substance since these innovations will diminish the burden of instructing. Encourage, Learning Analytics will help in overcoming any conceivable learning issues some time recently they happen. Instructive educate and organizations will moreover spare cash and secure their learners and gear as the VR and AR recreation diminishes the reliance on physical gear and dodges potentially dangerous results.

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