

DOI: 10.5281/zenodo.19100063

THE REVOLUTIONIZATION OF EDUCATION IN SOCIETY 5.0 - THE ROLE OF VIRTUAL AND AUGMENTED REALITY IN CREATING IMMERSIVE LEARNING ENVIRONMENTS: LITERATURE REVIEW

Nozizwe Fundiswa Fakazi¹ and Andrew Enaifoghe²

¹Department of Information Studies University of Zululand South Africa. Email: FakaziNF@unizulu.ac.za

²Department of Public Administration, University of Zululand, Republic of South Africa (RSA). Email:

*EnaifogheA@unizulu.ac.za. Orcid ID: <https://orcid.org/0000-0003-4890-9179>

Received: 01/02/2026

Accepted: 05/03/2026

Corresponding Author: Enaifoghe Andrew
(EnaifogheA@unizulu.ac.za)

ABSTRACT

The study examined the revolutionization of education in society 5.0, looking at the role of virtual and augmented reality in creating immersive learning environments in the institution of higher learning. Society 5.0 envisions a human-centered, technology-integrated future, necessitating the evolution of education to address the requirements of a digitally evolved society. This literature study examines the transformational capabilities of Virtual Reality (VR) and Augmented Reality (AR) in developing immersive learning environments that correspond with the objectives of Society 5.0. This research analyzes how VR and AR technologies improve student engagement, promote experiential learning, and facilitate tailored education, utilizing a diverse array of academic sources. The assessment underscores essential applications in fields such as STEM, medical, and vocational education, where immersive technologies have shown considerable educational advantages. It also tackles issues including accessibility, affordability, and the necessity for educator training. The results indicate that although VR and AR are not universal solutions, they provide potent instruments for transforming education into interactive, inclusive, and future-oriented experiences. This analysis identifies deficiencies in existing research and suggests avenues for future investigations, highlighting the necessity of multidisciplinary collaboration and governmental endorsement to fully harness the educational potential of immersive technologies within the framework of Society 5.0.

KEYWORDS: Virtual Reality, Transforming Education, Collaboration, Student Engagement.

1. INTRODUCTION

The rapid development of digital technology has initiated the period of Society 5.0, defined by the amalgamation of cyberspace and physical space to establish a human-centric, knowledge-oriented society. Notwithstanding this advancement, conventional educational systems mostly persist, depending on classic pedagogical approaches that frequently do not captivate learners or equip them for the requirements of a digitally interconnected environment.

Virtual Reality (VR) and Augmented Reality (AR) provide innovative solutions by facilitating immersive, interactive, and tailored educational experiences. Society 5.0 is a human-centred society that balances economic and technological advancements to solve society's problems with super-smart AI data systems. It represents a new vision for a smarter society where humans, nature and technology create a sustainable balance enhanced by data (Fukuyama, 2018).

Society 5.0 aims to balance economic development with social challenges, ensuring that technology serves humanity rather than the other way around. In the context of education, the Society 5.0 promotes a transformation whereby a digital invention plays a significant role in creating a learning experience that is more adaptive, personalised and immersive (Purnomo, 2021). Technologies such as Augmented and Virtual Reality enable students to engage with educational content in interactive ways, enhancing comprehension and retention (Beck, 2019).

Virtual reality (VR) and augmented reality (AR) are two distinct technologies with related uses in education. Virtual reality (VR) technology immerses the user in a digital environment, whereas augmented reality (AR) technology superimposes digital content on the real world. Academic attainment and student engagement have improved because of the use of these tools in the classroom (Elmqaddem, 2019). Additionally, these AI-driven learning platforms provide customised educational pathways, catering to individual learning styles and needs.

The transition moves away from traditional education models, which often rely on standardised curricula that may not effectively cater to diverse student needs. Instead, Society 5.0 embraces a more inclusive, technology-driven approach, ensuring that

students from different backgrounds access high-quality educational resources while fostering critical thinking skills essential for the future. In line with authors like Enaifoghe, Balogun and Afolabi (2021), this current study aims to investigate the revolutionising Education in Society 5.0, focusing on the Role of Virtual and Augmented Reality in Creating Immersive Learning.

2. RESEARCH METHODOLOGY

2.1. Research Design

This literature review adopted a systematic and thematic approach to explore how Virtual and Augmented Reality (VR/AR) contribute to immersive learning within the context of Society 5.0. The methodology outlines the strategies for identifying, selecting, analysing, and synthesising relevant literature. To investigate how virtual reality (VR) and augmented reality (AR) are changing education in the context of Society 5.0, this study uses a systematic literature review (SLR) design. Since the goal of the study is to synthesise existing theoretical, empirical, and technological information rather than gather primary data, a literature-based approach is appropriate. The review adheres to accepted procedures for systematic reviews in order to guarantee academic rigour, repeatability, and transparency.

2.2. Methodological Transparency

Through the use of a systematic and reproducible approach to the literature review procedure, our study guaranteed methodological transparency. Every step of the review process—search strategy, database selection, inclusion and exclusion criteria, screening methods, and theme analysis—was precisely outlined and applied methodically. While the PRISMA screening procedure improved the legitimacy and traceability of study selection, the utilisation of reputable academic resources and consistent keyword combinations reduced search bias. In order to preserve uniformity in recording authorship details, methodological characteristics, technical focus, and important discoveries across investigations, data extraction also adhered to a common template. Other researchers can replicate, validate, or expand the review in subsequent studies thanks to this open and well-documented approach, which strengthens the research's dependability and academic integrity.

The Process of Screening and Selection

The screening procedure was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) model:

- Identification: A wide range of research was produced by the initial database search.
- Screening: Relevance was assessed in abstracts and titles.
- Eligibility: The inclusion/exclusion criteria were used to evaluate full-text articles.
- Final selection: Research that satisfied every requirement was kept for examination.

This methodical procedure guaranteed methodological precision and reduced prejudice.

Table 1.1: Research Strategy

Research Methodology	Qualitative and integrative literature review
Search strategy	The literature was sourced from reputable academic databases including Scopus, Web of Science, ERIC, and Google Scholar. Keywords used in various combinations included: <ul style="list-style-type: none"> • "Society 5.0" • "Virtual Reality in Education" • "Augmented Reality Learning" • "Immersive Learning Environments" Boolean operators such as AND, OR, and NOT were used to refine search results.
Method of Search	To find pertinent literature, a methodical keyword search approach was employed. Included were Boolean operators and keywords: "Society 5.0," "education," "virtual reality" or "VR," "learning environments," "augmented reality" or "AR," "pedagogy," "immersive learning" or "experiential learning," "technology," "extended reality" or "XR," and "education transformation" Each database's search system was accommodated by customising the search strings.
Data Source	To guarantee thorough coverage, reliable and peer-reviewed academic databases were checked. Important databases consist of: <ul style="list-style-type: none"> • Web of Science (WoS) Scopus • IEEE Xplore • ScienceDirect ERIC (Education Resources Information Centre) and Google Scholar • The extensive coverage of technology, engineering, and educational research in these databases led to their selection.
Inclusion and Exclusion Criteria	<ul style="list-style-type: none"> • Inclusion: Peer-reviewed journal articles, conference papers, white papers, and book chapters focused on VR/AR in education and aligned with Society 5.0. Studies were included if they were they academic book chapters, conference papers, or peer-reviewed journal articles? <ul style="list-style-type: none"> • If they talked about XR, AR, or VR in educational settings. • If they presented intellectual assessments, theoretical frameworks, or empirical results <ul style="list-style-type: none"> • If they were released between 2015 and 2025. • If they were composed in English. • Exclusion: Non-English studies, articles with no educational focus, and studies concentrating solely on technical VR/AR development without educational application. • If they had nothing to do with immersive technologies or education; unrelated to pedagogy and only concerned with technical VR/AR engineering; Academic credibility was lacking (e.g., blogs, non-peer-reviewed reports); Were there any missing or duplicate texts?
Selection and Screening Process	Studies were assessed based on clarity of research objectives, methodology, and relevance to immersive learning and Society 5.0.
Data Analysis	A thematic synthesis approach was employed to identify recurring patterns and critical insights across studies. Key themes included pedagogical applications of VR/AR, learner engagement, cognitive load, accessibility, and ethical considerations. A comparative evaluation was also conducted to assess effectiveness and innovation across learning environments.

2.3. Extraction And Analysis of Data

The final collection of chosen studies' data was taken out and arranged thematically. Important details included. Recurring patterns, concepts, and gaps were found using a thematic analysis approach. Themes were analysed considering Society 5.0's overarching objectives, specifically those related to digital transformation, personalised learning, and human-centered innovation (Enaifoghe, 2021).

2.4. Methods For Gathering and Analysing Data

A methodical and planned strategy was taken in the data collection process for this literature review. Relevant scholarly materials were obtained from reputable academic databases, including Scopus, Web of Science, IEEE Xplore, ScienceDirect, ERIC, and Google Scholar. Predefined keywords and Boolean combinations, such as "Society 5.0," "virtual reality," "augmented reality," "immersive learning,"

and "education technology," were employed in the search approach. By using these keywords, the review was able to include research that specifically addressed the function of VR and AR in education in the framework of Society 5.0.

The selection procedure was guided by a set of inclusion and exclusion criteria. Only scholarly book chapters, conference papers, and peer-reviewed articles authored in English and published between 2015 and 2025 were considered. Studies not directly relevant to immersive technology in education or lacking scholarly repute were rejected. Titles and abstracts were reviewed first, followed by full-text examination to establish their appropriateness for the review. The PRISMA workflow model served as a guide for this approach to guarantee transparency and rigour.

Following the identification of pertinent studies, data extraction entailed methodically documenting important details including authors, year of publication, research objective, methodologies employed, educational setting, types of VR/AR technology evaluated, and key findings. To make comparison and synthesis easier, this data was arranged into a structured matrix.

The analytical phase included thematic analysis, allowing the researcher to uncover repeating patterns, concepts, and themes across investigations. The conversation was organised around the emerging themes, which included the advantages of immersive learning, pedagogical efficacy, student participation, technology obstacles, and future potential. This method highlighted gaps and patterns in the literature while enabling a cogent synthesis of findings.

2.5. Ethical Considerations

This study presents little ethical risk because it only uses existing academic material and does not include human subjects. To preserve academic integrity and prevent plagiarism, all sources were appropriately cited.

2.6. The Methodology's Limitations

Only English-language papers are included in the review, which may leave out pertinent findings.

VR/AR literature frequently gets out of date due to rapid technology improvements.

Direct comparability may be hampered by differences in study quality and methodology.

Notwithstanding these drawbacks, the methodology offers a clear and reliable way to combine the most recent research.

3. LITERATURE REVIEW

This section of the study reviews relevant literature within the topic under study. Virtual Reality (VR) and Augmented Reality (AR) provide innovative solutions by facilitating immersive, interactive, and tailored educational experiences. Society 5.0 is a human-centred society that balances economic and technological advancements to solve society's problems with super-smart AI data systems (Ahmad et al, 2023). As indicated by Akcayir et al (2022), incorporating these technologies into conventional education is nascent, characterized by few empirical data and inconsistent use across educational settings.

It is essential to comprehend how VR and AR might be effectively utilized to revolutionize learning settings in accordance with the objectives of Society 5.0. This literature review aims to bridge the gap by summarizing current research on the educational uses of VR and AR, delineating their advantages, constraints, and the prerequisites for their effective implementation in developing immersive learning environments. There is a great technological improvement in the era of Society 5.0. However, educational systems are still using the outdated pedagogical models that fail to meet the information needs of digitally native learners (Ahmad et al, 2023).

The virtual and augmented reality technologies have shown great potential to transform learning into more immersive, interactive experiences (Fitria, 2023) but their incorporation in the educational system remains limited, fragmented and uneven across contexts (Faiqotuzzulfa & Putra, 2022). There is a gap in understanding how these technologies can be effectively leveraged to align with the human-centered innovation goals of Society 5.0 specifically in promoting inclusive, equitable, and lifelong learning (Ahmad et al., 2023).

This literature review seeks to critically explore the role of VR and AR in revolutionising education within Society 5.0, highlighting their pedagogical value, implementation challenges, and the pathways they offer toward more responsive and transformative learning environments. Research indicates that the integration of VR and AR significantly influences education for both learners and instructors. In K-12 education, virtual reality (VR) and augmented reality (AR) provide several benefits for the instruction of STEM (Science, Technology, Engineering, and Mathematics) disciplines (Leighton & Crompton, 2017; Zawadzki et al., 2020). It serves as a conduit that aids instructors in imparting the educational content (Sharma et al., 2021; Zikky et al., 2018).

Virtual reality (VR) and augmented reality (AR)

enhance engagement in higher education by transforming academic concepts into practical applications. Consequently, it enhances self-confidence, thereby reinforcing educational gains (Divekar et al., 2021). Additionally, it offers a significant advantage to instructors by enabling them to develop the course without expensive laboratory enhancements (Enaifoghe, 2026, Syed et al., 2019). In vocational education, virtual reality (VR) and augmented reality (AR) enhance the dissemination and acquisition of practical information, improve knowledge retention, and enable learners to master intricate processes. Consequently, the quality of learning enhances for students (Fehling et al., 2016; Kamińska et al., 2017a, b).

It also reduces the instructional burden for instructors. Virtual Reality and Augmented Reality applications serve as navigational tools in the educational process (Bacca et al., 2015; Wei et al., 2020). In the field of IT, these technologies enhance the training process and provide students with unlimited training sessions as needed (Carruth, 2017), without the continuous presence of trainers during the training (Bosch et al., 2020). Moreover, it heightens awareness of perilous circumstances. Ultimately, it enhances the safety of trainees (Eiris et al., 2020; Ting et al., 2021).

Research indicates that VR and AR technologies yield greater learning gains compared to traditional educational resources (Garzón & Acevedo, 2019). In K-12 education, virtual reality (VR) and augmented reality (AR) have effectively enhanced the learning and teaching processes across several disciplines, including programming (Segura et al., 2020), science (Nasharuddin et al., 2021), and foreign languages (Alfadil, 2020). Virtual Reality and Augmented Reality technology have significantly advanced the higher education sectors. Examples include computer science (Srimadhaven et al., 2020), medical education (Kleinert et al., 2015), and engineering (Allcoat et al., 2021; Molnár et al., 2018).

The integration of these technologies has also favorably influenced VE and IT educational programs. It facilitated the elucidation of plastic surgery training (Mughal et al., 2020), automobile maintenance and assembly (Gavish et al., 2015; Santamaría-Bonfil et al., 2020), and manufacturing (Pilati et al., 2020; Yildiz et al., 2019). The construction (Shi et al., 2020), mining (Liang et al., 2019), and nursing (Chang & Lai, 2021) sectors have substantially gained from the incorporation of these technologies into both virtual education and information technology educational frameworks.

Numerous studies have utilized questionnaires

and surveys as the only data collecting instrument for their research (Eder et al., 2020; Kowalski et al., 2020; Scaravetti & Doroszewski, 2019). Bacca-Acosta et al. (2021) employed a mix of data gathering instruments, including eye-tracking, a questionnaire, and a semi-structured interview. Various data gathering instruments have been utilized in virtual reality and augmented reality research. Consequently, it is essential to examine these tools to inform future study on contemporary methodologies and instruments to provide precise outcomes.

The objective of employing any innovative educational intervention tool is to improve the learning and teaching process. This upgrade necessitates the analysis of the ensuing data from VR and AR applications, highlighting the significance of Learning Analytics (LA). LA (Abdullah & Sakr, 2021) aggregates and examines learner data to improve the educational experience and learner outcomes. Birt et al. (2019) utilized Learning Analytics in their study by employing an analytical dashboard to assess clinical anatomy. This technology has assisted instructors in monitoring pupils' activities during examinations. It also furnishes them with a comprehensive summary of the summative evaluation.

3.1. Current Research

Analyzing prior and contemporary literature in the discipline is essential, as it assesses the field's present condition and directs other scholars in identifying suitable issues for exploration. Furthermore, to ascertain the topics that have enduring relevance (Akçayır & Akçayır, 2017; Davies et al., 2010; Höffler & Leutner, 2007). Numerous systematic review studies examined the integration of VR and AR in the educational sector. In these studies, academics have focused their investigations on a certain technology inside a particular field throughout one or more educational systems. The systematic review by McCloskey et al. (2023) synthesizes the application of VR and AR technology in surgical education through an analysis of 48 research related to spine surgery.

Other reviews, such as Babalola et al. (2023), have concentrated their analysis on the application of immersive technologies (VR, AR, and MR) for occupational safety and health training in the industrial sector, examining 67 research. A systematic analysis by Baysan et al. (2023) evaluated 12 papers to demonstrate the effects of 360-degree VR apps in nursing education. Marougkas et al. (2023) have conducted a thorough review of the integration of virtual reality in education. The study primarily

examined personalization strategies employed in immersive VR for educational purposes within the classroom, as well as the limitations and advantages of utilizing VR in education.

Additionally, the findings highlighted the subjects most frequently incorporating VR technology, including Chemistry, Engineering, and Biology. The review by Juliana et al. (2022) examines the use of VR in business education, while the research by Rahman et al. (2022) explores the effects of VR integration in laboratory instruction. The study by Alvarez-Marin and Velazquez-Iturbide (2022) examines the incorporation of augmented reality (AR) in engineering education, focusing on its effects as seen by both students and teachers within the field. The study by Huang et al. (2018) examined the application of VR and AR technology in dental education for students. Mazzuco et al. (2022) examined the application of AR technology in higher education within the Chemistry field.

In contrast, Choi et al. (2022), Moussa et al. (2022), and Radianti et al. (2020) explored the integration of VR technology in higher education. The study by Zweifach and Triola (2019) has proven the acceptance of VR and AR in medical teaching inside higher education. Conversely, the research of Akçayır and Akçayır (2017) has examined the educational effects of augmented reality across many educational tiers, encompassing K-12, higher education, and vocational training. Nonetheless, it was challenging to locate a thorough assessment that examined and synthesized the impact of VR and AR technologies from student and educator perspectives across many fields and all existing educational institutions to ascertain the most often observed impacts.

Moreover, it proved difficult to locate a study that examined the influence of Learning Analytics integration within VR and AR learning environments, as well as the research trends in educational systems and their adoption of these technologies among existing systematic reviews in the domain (Enaifoghe & Ndebele, 2023). Consequently, it is essential to evaluate the advantages of integrating these technologies into diverse educational systems from several viewpoints and to examine the data collecting instruments utilized, the research inclinations of educational systems, and their adoption of VR and AR technologies.

Furthermore, to explore the benefits of integrating Learning Analytics with Virtual Reality (VR) and Augmented Reality (AR) to optimize the utilization of these technologies while guiding future research,

educational institutions, and industrial organizations in their application for educational and training objectives. This study selected and evaluated 150 research publications published between 2015 and 2021 that examine the impact of integrating VR and AR technology in various educational institutions.

3.2. Recent Developments in Virtual and Augmented Reality for Educational Purposes

Recent studies highlight the increasing incorporation of VR/AR in education. Ahmad et al. (2023) emphasize virtual reality (VR) and augmented reality (AR) as pivotal enabling technologies for Education 5.0, which may augment customization, engagement, and accessibility in learning. These technologies facilitate learner-centered models by replicating real-world events, promoting experiential learning, and cultivating essential 21st-century abilities.

A 2023 systematic review by van der Meer et al. examines the role of virtual reality in collaborative learning, highlighting five principal affordances, findings show that it enhanced learner motivation, facilitation of remote collaboration, interdisciplinary learning environments and cultivation of social skills. And it is congruence with collaborative learning frameworks (Sakr & Abdullah, 2024). These findings are especially pertinent when digital cooperation is crucial in post-pandemic education.

3.3. Pertinent Literature

This research aims to review the existing literature on virtual reality (VR) and augmented reality (AR) in education over the past decade, summarizing related works that encompass various objectives and examining specific applications of VR and AR in learning, as presented in Table 1. Keywords employed in the search for pertinent literature encompassed factors from this title, concentrating on the most extensive research in education. Recently, during the Covid-19 epidemic, several studies, including literature reviews and surveys (Enaifoghe, 2021), have been published about VR and AR in education.

The study by Enaifoghe (2021), shows how South Africa government responded to the global outbreak of the COVID-19 pandemic through a multimodal approach to shift from in-person learning to online learning system in education sector while living in an era of emerging pandemics.

Scavarelli et al. (2021) investigated the integration of virtual reality and augmented reality in social learning environments, including schools and museums, grounded in learning theories. Patel et al.

(2020) and Boyles (2017) examined the attributes of virtual, augmented, and mixed reality, along with their benefits and drawbacks in education and individuals' experiences with these technologies in real life. Moreover, several studies used virtual reality or augmented reality only within the educational context.

Additional studies have examined the advancements of VR and AR throughout several domains, including education. Sirohi et al. (2020) examined the novel incorporation of virtual reality and augmented reality across many sectors, including education. Furthermore, several research undertaken during the Covid-19 outbreak provided useful insights and demonstrated the importance of VR and AR in addressing external challenges in education.

3.4. Discussion Of Findings

Educational impact of virtual reality (VR) and augmented reality (AR) on learner engagement, motivation, and academic achievement.

Augmented Reality (AR) and Virtual Reality (VR) technology have transformed educational methodologies by providing immersive digital experiences, interactive environments, simulations, and enhanced participation. However, these technologies are in the developmental phase and need substantial investment and extensive customisation to satisfy the significant demand in education. This thorough assessment seeks to contextualize the evolution of AR and VR in education over the past twelve years.

Augmented and virtual reality (AR & VR) represent significant technological developments with substantial promise to enhance the education system. The implementation of Augmented Reality (AR) and Virtual Reality (VR) in education has increased significantly in recent years, offering several prospects for technology-enhanced learning (Tan et al., 2022). Augmented Reality (AR) and Virtual Reality (VR) provide students with immersive digital experiences unattainable through conventional teaching methods (Phakamach et al., 2022), facilitating deeper engagement with intricate material beyond mere lectures and textbooks (Sun et al., 2022), while allowing educators to tailor content to diverse learning styles (Childs et al., 2021).

These technologies not only enhance immersive experiences but also enable educators to conduct simulations and engage in virtual field excursions without the need for physical travel (Seidametova et al., 2021). Moreover, the use of emerging

technologies like AR and VR may connect traditional classroom training with real-world experience, offering substantial advantages for learners' professional growth.

Augmented Reality (AR) is a technology that enriches the real-world environment by superimposing computer-generated content onto it (Hantono, Nugroho, & Santosa, 2018), with professional applications spanning various sectors, including healthcare, manufacturing, education, and retail (Antonioli et al., 2014). Organizations now using augmented reality to enhance employee safety by offering virtual training simulations and visualizing equipment functionality prior to manufacturing. Conversely, Virtual Reality (VR) is a sophisticated technical advancement that has transformed our engagement with digital surroundings (Velev & Zlateva, 2017).

Utilizing advanced computer graphics, motion sensors, and display technologies, virtual reality allows users to immerse themselves in very realistic representations of actual or fictional environments. Virtual reality has demonstrated its immense value across several sectors, including gaming, education, healthcare, and real estate (Kamińska et al., 2019). Although AR and VR may appear analogous, they are two distinct technologies serving different objectives. Virtual reality immerses viewers in an entirely novel digital environment, offering an interactive experience via headsets or goggles. Augmented reality enhances the physical environment by superimposing digital items, either providing additional information or improving its usefulness.

Moreover, AR and VR technologies have several advantages for online, mobile, and blended learning by delivering immersive educational experiences and fostering a more captivating learning atmosphere. Augmented Reality (AR) and Virtual Reality (VR) facilitate the creation of virtual environments and simulations, enabling students to investigate and engage with real-world settings without exiting the classroom (Young et al., 2020). Moreover, augmented reality (AR) and virtual reality (VR) can facilitate the development of dynamic and captivating material, including three-dimensional graphics and videos, which can enhance student engagement (Gargrish et al., 2020).

This research examines contemporary literature on the progress of augmented reality (AR) and virtual reality (VR) in education during the past twelve years, highlighting research patterns, gaps, advantages, problems, and recent advancements. Research hypotheses corroborated by previous

studies on augmented reality (AR) and its use in education have been proposed and substantiated by a significant increase in educational research in recent years. This research contributes by elucidating the existing literature and offering further paths for the advancement of AR and VR in education.

3.5. Integration Of AR And VR Technology in Education

The integration of AR and VR technology in education is increasingly prevalent. Students can connect with their surroundings more immersively, enhancing involvement and facilitating a deeper comprehension of subjects (Zhang et al., 2022). As the expense of AR and VR gear diminishes, the technology is expected to become increasingly accessible in the future. Augmented Reality (AR) and Virtual Reality (VR) technologies are transforming educational methodologies and enhancing student engagement with their environment (Du et al., 2020). Augmented Reality (AR) and Virtual Reality (VR) provide novel avenues for students to engage with three-dimensional objects, investigate their surroundings, and enhance their comprehension of subjects.

Augmented Reality (AR) and Virtual Reality (VR) can provide interactive simulations, enabling students to investigate intricate subjects inside a secure and stimulating setting. Moreover, the incorporation of AR and VR in educational settings has demonstrated a beneficial impact on student engagement and learning outcomes (Sun et al., 2022). Students utilizing AR and VR technology exhibit increased motivation, engagement, and improved academic achievement (Alizadehsalehi et al., 2021). This is largely attributable to the immersive learning experience offered by AR and VR, enabling students to explore, discover, and engage with their surroundings.

The implementation of augmented reality (AR) and virtual reality (VR) in educational settings has been increasingly adopted, as educational institutions commence investments in this technology. The price of AR and VR devices has consistently diminished, enhancing accessibility for individuals with limited financial resources. Augmented reality and virtual reality technology have been employed in several educational environments, including museums, libraries, and scientific centers. Utilizing AR and VR, students may examine and engage with items in a manner unattainable in the actual realm. This form of learning can be especially advantageous for younger pupils, who may struggle to comprehend intricate

topics without visual support.

Current integration of Virtual and Augmented technologies to enhance teaching and learning in educational environments.

In primary education, virtual reality allows for the virtual field trips and storytelling improving engagement and comprehension among the learners and it also enable learners to explore distant ecosystem, historical landmark or even the solar system enhancing curiosity and spatial understanding (Grossert, 2023). The study by Akcayir et al (2022) found that the virtual reality and augmented reality technologies increase the learner involvement and motivation by making content more accessible and engaging through 3D visualisation. In addition, the study revealed that these technologies have improved learners liking for subjects like science by over 30% compared to the traditional method.

The study by Huang et al (2022) found that the virtual and augmented reality technologies help learners to better understand the topics that they are struggling in such as plant life cycle or anatomy. The study by Bacca et al (2021) also revealed that these technologies make learning to be easy including those learning with disabilities. The study conducted by Yilmaz and Bayraktar in 2022 revealed that there is 25 % increase in vocabulary among Grade 3 learners using AR apps in comparison with paper-based materials. Additionally, the study by Chen et al (2020) reported these technologies enhance / improve active and experiential learning by allowing learners to learn by doing.

The findings from the study by Chaudhari et al (2025) stated that virtual reality facilitate interactive labs and historical reenactments enhancing conceptual understanding and retention in subject like science and history. Virtual and augmented reality enhance students to conduct experiments in simulated environments reducing safety risks and resources limitations. The study by Balalle (2025) stated that virtual and augmented reality technologies in higher education institutions enhance the skill of problem solving and critical thinking. They also support immersive learning environments that are particularly important in disciplines such as medicine, engineering and hospitality (Enaifoghe, 2021).

The study by Bermejo et al (2023) indicated that these technologies also improve learning involvement and teaching effectiveness, but the study also mentioned that these technologies imply

drawbacks like visual fatigue and mental exhaustion when overused. The study by Chaudhari et al. (2025) mentioned that these technologies are mostly used in technical training such as automotive repairs, welding and customer service offering safe, repeatable practice environment.

3.6. Challenges And Limitations of Integrating VR And AR Technologies Into Immersive Learning Environments.

A significant problem of augmented reality (AR) and virtual reality (VR) in education is the expense (Nguyen et al., 2019). The gear and software necessary for these technologies can be costly, and educational institutions may lack the financial resources to acquire them. Furthermore, the software employed to provide the immersive experiences need regular updates, potentially incurring further expenses. A further problem pertains to accessibility (Biswas et al., 2021). Not all students possess the requisite hardware and software; therefore, educational institutions must devise methods to ensure availability for all learners.

The research conducted by Perifanou, Economides, and Nikou (2023) indicated that educators lack adequate expertise with these technologies and possess insufficient technological and pedagogical competencies, including programming abilities and proficiency in 3D design software. The study by Crogman et al. (2020) indicated that the utilization of these technologies raises privacy problems owing to data tracking in immersive environments.

Research conducted by Huang et al. (2020) and Jensen and Konradsen (2018) indicates that the integration of virtual and augmented reality technologies in education faces challenges due to a disparity between technological capabilities and curriculum alignment, resulting in these technologies being employed as supplementary tools rather than being thoroughly integrated into instructional design. The study by Ndjama and Westhuizen (2025) revealed that instructors and learners are reluctant to adopt new technology, which impedes their use. Immersive environments can induce cognitive overload from overwhelming sensory input, especially in inexperienced learners (Makransky & Lilleholt, 2018).

Extended usage of virtual reality may lead to symptoms such as motion sickness and ocular strain (Rebenitsch & Owen, 2016). Access to immersive technology is inconsistent across areas and populations, thus exacerbating the digital divide (Zhao et al., 2020). Moreover, inadequate accessibility

features in certain virtual and augmented reality technologies might impede participation for students with impairments (Al-Azawei et al., 2020). Augmented and virtual reality systems accumulate extensive user data, prompting issues regarding privacy, consent, and data security (Slater & Sanchez-Vives, 2016).

3.7. Investigative Trends and Deficiencies: Obstacles and Constraints

Despite its potential, the incorporation of VR and AR in education encounters several obstacles. Exorbitant hardware expenses, insufficient technological proficiency among instructors, and restricted curricular integration constitute substantial obstacles. Moreover, there are apprehensions over screen time, cognitive overload, and the necessity for pedagogically effective content design.

Recent bibliometric analyses indicate a burgeoning corpus of research on augmented reality (AR) and virtual reality (VR) in education, with a significant rise in publications following 2020. Nonetheless, a significant portion of the research is disjointed, characterized by a scarcity of longitudinal studies and uneven assessment methods (Nguyen et al., 2019). There is a want for more empirical study on long-term learning results, cross-cultural applications, and ethical considerations.

A 2023 bibliometric analysis of augmented reality in education indicates a significant increase in research interest, especially in STEM and vocational training. The study indicates that augmented reality improves spatial comprehension, provides real-time feedback, and facilitates contextual learning; nonetheless, obstacles persist in content creation and curriculum integration (Huang et al., 2020).

Notwithstanding the potential, obstacles including elevated implementation expenses, insufficient educator training, and restricted educational frameworks endure. Ethical considerations, such as data privacy and screen time, necessitate scrutiny (Akcaayir et al., 2022). Furthermore, longterm studies are necessary to evaluate the enduring effects of VR/AR on educational results.

3.8. The Role of Virtual and Augmented Reality

Findings shows that virtual and augmented reality create immersive learning Environments. The shift to Society 5.0—a human-centric, highly intelligent society—requires a reconfiguration of educational frameworks. Education 5.0 prioritizes individualized, inclusive, and technology-driven

learning experiences. Virtual Reality (VR) and Augmented Reality (AR) are among the most promising instruments in this shift, providing immersive, interactive, and experiential learning environments. The advent of Society 5.0—a concept proposed by Japan to establish a super-smart society—highlights incorporating digital technology into every facet of life, including education. In this setting, known as Education 5.0, the objective is to cultivate individualized, inclusive, and technology-enhanced learning environments. Virtual Reality (VR) and Augmented Reality (AR) are among the most transformational technologies in this field, increasingly acknowledged for their potential to alter education.

3.9. Virtual And Augmented Reality in Education

Virtual Reality (VR) and Augmented Reality (AR) technologies provide immersive, interactive experiences that can markedly improve student engagement and information retention. Virtual reality generates entirely simulated settings, whilst augmented reality superimposes digital material over the physical world, both facilitating immersive learning that surpasses traditional approaches. These technologies have been utilized across several fields—from medical simulations and engineering design to language acquisition and historical education—exhibiting enhanced student enthusiasm, spatial comprehension, and critical thinking abilities.

3.10. Conformity With Society 5.0 Objectives

Education 5.0 prioritizes human-centric innovation, with VR/AR effectively supporting this goal through the facilitation of flexible learning trajectories, immediate feedback, and collaborative virtual environments (Bermejo et al., 2023). These technologies facilitate the cultivation of 21st-century competencies, including creativity, problem-solving, and digital literacy. Furthermore, they facilitate the closure of educational disparities by granting access to superior resources irrespective of geographic or financial obstacles.

4. CONCLUSION

The use of Virtual and Augmented Reality in education signifies a crucial advancement toward achieving the concept of Society 5.0—a society in which technology amplifies human capability and welfare. This research study has shown that VR and AR technologies provide transformational opportunities for developing immersive, interactive,

and learner-centered educational experiences. These technologies not only augment engagement and information retention but also facilitate the cultivation of essential 21st-century competencies, including collaboration, creativity, and digital literacy.

The successful application of these technologies depends on overcoming various enduring problems, such as infrastructure expenses, instructor readiness, and the creation of pedagogically effective material. Furthermore, ethical issues and fair access must be stressed to guarantee that the advantages of immersive learning are inclusive and sustainable.

As research in this domain expands, there is a distinct necessity for longitudinal studies, multidisciplinary cooperation, and policy frameworks that facilitate innovation in education. By integrating VR and AR into the overarching objectives of Society 5.0, educators and policymakers may cultivate a more adaptable, inclusive, and future-oriented educational framework.

5. RECOMMENDATIONS

The recommendations will be following the objectives of the study, and they are as follows:

5.1. Future Research Directions

The results of this analysis point to a number of gaps in the body of knowledge about the integration of VR and AR in Society 5.0 learning environments. **Future studies in this field should focus on filling in these particular deficiencies in order to progress scholarship:**

Empirical Validation of Immersive Learning Outcomes: Large-scale empirical data on learning performance, retention, and long-term skill development are scarce, despite the fact that several studies emphasise the promise of VR and AR. To remedy this lack of strong empirical evidence, longitudinal and experimental studies should be conducted in the future.

Context-Specific Studies in Under-Researched locations: The review found that there was a dearth of research from developing settings and a concentration of studies in technologically advanced locations. In order to comprehend contextual limitations, cultural factors, and infrastructure limits, future research should concentrate on rising economies.

Pedagogical Frameworks Adapted to Society 5.0: There is a lack of pedagogical models that specifically connect immersive technologies to Society 5.0 capabilities, like collaboration between humans and technology, personalisation, and human-centered

learning. New instructional frameworks that are in line with these competencies should be created and tested in future studies.

Cost, Scalability, and Accessibility Issues: Despite the fact that issues like cost and scalability are often brought up, not many research offer concrete, empirically supported solutions. Low-cost VR/AR technologies, equitable access tactics, and sustainable implementation models should all be investigated further.

Teacher Readiness and Professional Development: The review found that teachers' training needs and digital competency were not given enough consideration. Targeted professional development methods that facilitate successful VR/AR integration in a variety of educational

contexts should be the focus of future research.

Implications of Immersion Technologies for Ethics and Psychology: Only a small amount of study has been done on the possible problems associated with VR/AR use, such as cognitive overload, student safety, data privacy, and ethical issues. Future studies should thoroughly investigate these topics and provide standards for deployment that are both morally and safely acceptable.

Future research can significantly advance our understanding of how VR and AR can serve the human-centered, technologically integrated learning vision of Society 5.0 by basing these recommendations on the research gaps that were clearly revealed in the review.

REFERENCES

- Ahmad, S., Umirzakova, S., Mujtaba, G., Amin, M. S., & Whangbo, T. (2023). Education 5.0: Requirements, Enabling Technologies, and Future Directions. arXiv
- Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review. *Educational Research Review*, 20, 1-11.
- Akçayır, M., Akçayır, G., & Arslan, O. (2022). *Exploring the effect of augmented reality in elementary science education. Educational Technology & Society*.
- Al-Ansi, A.M., Jaboob, M., Garad, A. and Al-Ansi, A., 2023. Analysing augmented reality (AR) and virtual reality (VR) recent development in education. *Social Sciences & Humanities Open*, 8(1), p.100532.
- Alizadehsalehi, S. Hadavi, A. & Huang, J.C. (2021). Assessment of AEC students' performance using BIM-into-VR *Applied Sciences*, 11 (7) (2021), p. 3225
- Antasari, A., Juniarti, Y. and Lestari, Z., 2025. EDUCATIONAL TRANSFORMATION IN THE ERA OF SOCIETY 5.0: CHALLENGES AND OPPORTUNITIES FOR EDUCATORS. *International Journal of Teaching and Learning*, 3(6), pp.971-985.
- Bacca, J., Baldiris, S., & Fabregat, R. (2021). *Augmented reality trends in education: A systematic review. Computers & Education*.
- Bacca, J., Baldiris, S., Fabregat, R., Graf, S., & Kinshuk. (2014). Augmented reality trends in education: A systematic review of research and applications. *Educational Technology & Society*, 17(4), 133-149.
- Balalle, H., 2025. Learning beyond realities: exploring virtual reality, augmented reality, and mixed reality in higher education – a systematic literature review. *Discover Education*, 4(1), pp.1-19.
- Beck, D., 2019. Augmented and virtual reality in education: Immersive learning research. *Journal of Educational Computing Research*, 57(7), pp.1619-1625.
- Bermejo, B., Juiz, C., Cortes, D., Oskam, J., Moilanen, T., Loijas, J., Govender, P., Hussey, J., Schmidt, A.L., Burbach, R. and King, D., 2023, May. AR/VR teaching-learning experiences in higher education institutions (HEI): A systematic literature review. In *Informatics* (Vol. 10, No. 2, p. 45). MDPI.
- Blackburn, J. (2023). *The cost of immersive learning: Barriers to VR and AR adoption in schools. Journal of Educational Technology*, 18(2), 45-59.
- Boyles, B. (2017). *Virtual reality and augmented reality in education Center For Teaching Excellence, United States Military Academy, West Point, Ny* (2017)
- Built In. (2023). *How virtual reality is changing education*. Available at: <https://builtin.com/virtual-reality/vr-education> (Accessed: 19 June 2025).
- Carayannis, E.G. and Morawska, J., 2023. University and education 5.0 for emerging trends, policies and practices in the concept of industry 5.0 and society 5.0. In *Industry 5.0: Creative and Innovative Organisations* (pp. 1-25). Cham: Springer International Publishing.
- Chaudhari, P., Patel, R. and Shah, M. (2025). *Applications of AR and VR in modern education. International Journal of Educational Technology*, 12(1), pp. 45-59.
- Chen, C. M., Lin, Y. L., & Lee, H. M. (2017). Learning effects of an interactive augmented reality system for

- enhancing arithmetic performance of students with learning disabilities. *Interactive Learning Environments*, 25(4), 423–437.
- Chen, C.-C., Chen, M.-P., & Tsai, C.-C. (2023). *Collaborative AR learning environments in primary education: A meta-analysis*. *British Journal of Educational Technology*.
- Childs, E., Mohammad, F., Stevens, L., Burbelo, H., Awoke, A., Rewkowski, N. & Manocha, D. (2021). An overview of enhancing distance learning through augmented and virtual reality technologies (2021) *arXiv preprint arXiv:2101.11000*
- ClassPoint. (2025). *10 ways to use AR and VR in the classroom*. Available at: <https://www.classpoint.io/blog/ar-vr-in-classroom> (Accessed: 19 June 2025).
- Crogman, H., Patel, R., & Lin, S. (2025). *Technical challenges in immersive learning environments: A review of VR/AR integration*. *International Journal of Emerging Educational Technologies*, 12(1), 22–38.
- Di Serio, Á., Ibáñez, M. B., & Kloos, C. D. (2013). Impact of an augmented reality system on students' motivation for a visual art course. *Computers & Education*, 68, 586–596.
- Du, R., Turner, E., Dzitsiuk, M., Prasso, L., Duarte, I., Dourgarian, J., Kim, D. (2020). DepthLab: Real-time 3D interaction with depth maps for mobile augmented reality *In Proceedings of the 33rd annual ACM Symposium on user interface Software and technology* (2020), pp. 829-843
- Elmqaddem, N., 2019. Augmented reality and virtual reality in education. Myth or reality. *International journal of emerging technologies in learning*, 14(3).
- Enaifoghe, A. & Ndebele, N.C. (2023). Examining the barriers to the adoption and integration of information communication technologies as e-Government in Africa. *International Journal of Research in Business and Social Science* 12 (7), 383-393
- Enaifoghe, A. (2021). Digitalisation of African Economies in the Fourth Industrial Revolution: Opportunities for Growth and Industrialisation. *African Journal of Development Studies* 11 (2), 31
- Enaifoghe, A. (2021). South Africa's Response to COVID-19 Pandemic through a Multimodal Approach. In *The Zambakari Advisory, Living in an Era of Emerging Pandemics*, 162. Special Issue: Fall 2021
- Enaifoghe, A. (2021). The influence of globalization in positioning African indigenous knowledge and learning system. *The Palgrave Handbook of Africa and the Changing Global Order*, 239-256.
- Enaifoghe, A. (2026). The Governance of Artificial Intelligence Application As Adaptive Learning in the Institution of Higher Education. *Scientific Culture*, Vol. 12, No. 2.1, (2026), pp. 3419-3438.
- Enaifoghe, A.O., Balogun, T. & Afolabi, O.S. (2021). The fourth industrial revolution: Integrating ICT in the South African education system. *ResearchersWorld-International Refereed Social Sciences Journal* 12 (2), 33
- Faiqotuzzulfa, F., & Putra, S. A. (2022). Virtual Reality's Impacts on Learning Results in 5.0 Education: A Meta-Analysis. *International Transactions on Education Technology*, 1(1), 10-18.
- Fitria, T. N. (2023). Augmented Reality (AR) and Virtual Reality (VR) Technology in Education: Media of Teaching and Learning: A Review. *IJCIS*
- Fukuyama, M., 2018. Society 5.0: Aiming for a new human-centered society. *Japan spotlight*, 27(5), pp.47-50.
- Gargrish, S., Mantri, A. & Kaur, D.P. (2020). Augmented reality-based learning environment to enhance teaching-learning experience in geometry education, *Procedia Computer Science*, 172 (2020), pp. 1039-1046
- Gossett, K. (2023). *Virtual reality in primary education: A new frontier*. *Journal of Early Childhood Learning*, 8(2), pp. 112–124.
- Hantono, B.S., Nugroho, L.E. & Santosa, P.I. (2018). Meta-review of augmented reality in education In *2018 10th international conference on information technology and electrical engineering (ICITEE)*, IEEE (2018), pp. 312–315
- Huang, Y.-M., Liu, M.-C., & Wu, T.-T. (2021). *Using VR to enhance elementary school students' science learning performance*. *Interactive Learning Environments*.
- Ibáñez, M. B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. *Computers & Education*, 123, 109–123.
- Kamińska, D. Sapiński, T., Wiak, S., Tikik, T., Haamer, R.E., Avots, E. ..., Anbarjafari, G. (2019). Virtual reality and its applications in education: *Survey Information*, 10 (10) (2019), p. 318
- Kormakova, V., Satler, O. and Chernyavskikh, S., 2021. Application of VR/AR technologies in secondary general education. Problems and prospects.
- Makransky, G., & Lilleholt, L. (2018). A structural equation modeling investigation of the emotional value of immersive virtual reality in education. *Educational Technology Research and Development*, 66(5),

1141-1164.

- Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education*, 70, 29-40.
- Ndjama, J. D. & Van Der Westhuizen, J. (2025). *A Systematic Review of the Challenges and Limitations of VR in Education*. In S. Mazhar Hussain & A. Nawaz Hakro (Eds.), *Creating Immersive Learning Experiences Through Virtual Reality (VR)* (pp. 1-32). IGI Global
- Parong, J., & Mayer, R. E. (2018). Learning science in immersive virtual reality. *Journal of Educational Psychology*, 110(6), 785-797.
- Patel, S., Panchotiya, B. & Ribadiya, S.A (2020). Survey: Virtual, augmented and mixed reality in education *IJERT*, 9 (2020), pp. 1067-1072
- Perifanou, M., Economides, A.A. and Nikou, S.A., *Teachers' views on integrating augmented reality in education: needs, opportunities Challenges and Recommendations. Future Internet*. 15, 20 (2023) [online]
- Phakamach, P., Senarith, P. & Wachirawongpaisarn, S. (2022). The Metaverse in education: The future of immersive teaching & learning *RICE Journal of Creative Entrepreneurship and Management*, 3 (2) (2022), pp. 75-88
- Proven Reality. (2023). *How AR and VR are transforming education*. Available at: <https://provenreality.com/ar-vr-in-education> (Accessed: 19 June 2025).
- Purnomo, Y. ed., 2021. Educational Innovation in Society 5.0 Era: Challenges and Opportunities: Proceedings of the 4th International Conference on Current Issues in Education (ICCIE 2020), Yogyakarta, Indonesia, 3-4 October 2020.
- Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, 147, 103778.
- Sakr, A., Abdullah, T. (2024). Virtual, augmented reality and learning analytics impact on learners, and educators: A systematic review. *Educ Inf Technol* 29, 19913-19962 (2024). <https://doi.org/10.1007/s10639-024-12602-5>
- Sayed, Y., De Jager, N., & Van der Berg, S. (2021). Digital learning challenges and the digital divide in South African education. *South African Journal of Education*, 41(Supplement 2), S1-S11.
- Scavarelli, A. Arya, A. & Teather, R.J. (2021). Virtual reality and augmented reality in social learning spaces: A literature review, *Virtual Reality*, 25 (1) (2021), pp. 257-277
- Seidametova, Z.S. Abduramanov, Z.S. & Seydametov, G.S. (2021). Using augmented reality for architecture artifacts visualizations, *CEUR Workshop Proceedings* (2021)
- Sirohi, P., Agarwal, A. & Maheshwari, P. (2020). A survey on augmented virtual reality: Applications and future directions in 2020 *seventh international conference on information technology trends (ITT)*, IEEE (2020), pp. 99-106
- SpringerLink. (2025). *Virtual and augmented reality in higher education: A systematic review. Educational Technology Research and Development*, 73(4), pp. 987-1005.
- Sun, J.C.Y., Ye, S.L., Yu, S.J & Chiu, T.K. (2022). Effects of wearable hybrid AR/VR learning material on high school students' situational interest, engagement, and learning performance: The case of a physics laboratory learning environment, *Journal of Science Education and Technology* (2022), pp. 1-12
- Tan, Y., Xu, W., Li, S. & Chen, K. 2022). Augmented and virtual reality (AR/VR) for education and training in the AEC industry: A systematic review of research and applications *Buildings*, 12 (10) (2022), p. 1529
- Velev, D. & Zlateva, P. (2017). Virtual reality challenges in education and training *International Journal of Learning and Teaching*, 3 (1) (2017), pp. 33-37
- Young, G.W., Stehle, S., Walsh, B.Y. & Tiri, E. (2020). Exploring virtual reality in the higher education classroom: Using VR to build knowledge and understanding, *Journal of Universal Computer Science* (8) (2020), pp. 904-928
- Zhang, Y., Liang, B. Chen, B., Torrens, P.M., Atashzar, S.F., Lin, D. & Sun, Q. (2022). Force-aware interface via electromyography for natural VR/AR interaction *ACM Transactions on Graphics*, 41 (6) (2022), pp. 1-18