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Exploring the Potential of Immersive Technologies to Enhance Online Learning Experiences and Engagement: A Systematic Literature Review

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Abstract:- The purpose of this research is to find out how immersive technology can improve online learning and student engagement. The study investigates how immersive technologies, for example augmented reality (AR) and virtual reality (VR) can be incorporated into online learning environment using a case study methodology. The paper explores how immersive technologies affect online course satisfaction among learners generally through learning results, and student involvement. By conducting a comprehensive literature review, the paper synthesizes existing knowledge and identifies gaps in the literature. In the systematic review in which exclusion and inclusion criteria was used to identify the suitable articles to be analyzed based on the study questions. The outcome of the study revealed that immersive technologies significantly boost learner engagement, improving the student learning outcomes thereby increasing their overall course satisfaction with online courses. However, it also identifies challenges and gaps in current research, emphasizing the need for further exploration. Recommendations for educators and policymakers include investing in immersive technologies learning tools, providing adequate training, fostering collaboration, and addressing issues of access and affordability. This paper sough to enhance the comprehension of how immersive technologies can be strategically leveraged to revolutionize online learning environments. By exploring the integration of advanced digital tools and techniques, the study uncovered various ways in which virtual and augmented reality can significantly improve the effectiveness and engagement of online learning. Ultimately, the findings provide valuable insights that can guide educators, institutions, and educational technology developers in optimizing online learning environments through the thoughtful application of immersive technology.

Keywords:- *Augmented Reality (AR), Virtual Reality (VR), Online Learning, E-Learning, Immersive Technologies.*

I. INTRODUCTION

The swift progress of digital technologies has revolutionized the field of education, presenting novel prospects for inventive pedagogical and educational approached (de Sousa Borges et al., 2014). augmented reality (AR) and Virtual reality (VR) together with other immersive technologies have the potential to completely transform online learning environments. These technologies have the ability to improve learning outcomes in online courses, encourage active learning, and increase student engagement by offering immersive and interactive settings (Mystakidis et al., 2022). The usage of educational technology in the 21st century has continuously changed due to rapid scientific and technological advancements. Besides, the development of AR, Computer generated Reality - virtual reality, and blended reality advancements are presumed to increase in the coming years. According to a recent study conducted by the International Data Corporation(Majid & Salam, 2021), approximately 25% of anticipated product deployments and 70% of businesses adopted the use of immersive technologies for both commercial and consumer use by end of 2023. In addition, the recent COVID-19 pandemic triggered the need of such technologies for self-entertainment and for collaborative learning.

Various areas have over and above been impacted by the dynamism in technological changes and education has not been left out. Contemporary learning approaches have been sought after with innovative technology to facilitate the onset of better learning processes and to improve learners' engagement. Numerous approaches have been used in training teachers in educational technology to help the process of teaching and learning. As a result, numerous educational technology-related studies have been conducted by educators and researchers to improve education in a variety of ways, including online learning (Majid & Salam, 2021), mobile learning (Mystakidis et al., 2021), digital games, social media (Dicheva et al., 2015), and virtual or augmented reality (Marougkas et al., 2023). As a result of the different advances accessible in education, this analysis focused on two prominent innovations which are AR and VR in enhancing learning online environment.

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This study aims to explore the ways in which immersive technology can enhance online learning and engagement. The study uses a methodical evaluation of the literature to examine how VR and AR may be included into online learning settings. It focuses on the ways in which these integrations impact learning results, student engagement, and general teacher and learner satisfaction. By combining prior research, the study seeks to increase our knowledge of the beneficial use of immersive technology in online learning.

II. LITERATURE REVIEW

Immersive technologies, including VR and AR, have garnered increasing attention in the field of education due to their ability to create interactive learning environments amongst students and teachers (Khan et al., 2021). The main role of VR is to immerses users in a computer-generated environment, while AR endeavors to overlay digitized literature based on the various demands of the users (Bal Ram & Pratima Verma, 2023). Both technologies offer unique opportunities for experiential learning, simulation-based training, and interactive storytelling in educational contexts.

- *The Augmented Reality (AR) Technologies and Online Learning*

AR is one of the cutting-edge technologies that is attracting attention in educational settings. To begin with, augmented reality is a technological advancement that allows tech consumers to observe digitized content overlaid with reality (Çetin, 2022) and furthermore allows digital information to be integrated live in a real-world setting. Due to AR's nature, users may interact with both virtual and actual items in the same area, which creates new learning opportunities for them (Omieno et. al., 2013; Kabudi et al., 2021).

Around the 1990s, big corporations such as A.L.I.C.E. AI Foundation and Deep Blue Corporation had access to AR systems for training and creative visualization (Khan et al., 2021). Furthermore, the instruments were computer-based and simplistic. However, a few augmented reality applications were offered to consumers in the market following the initial popularization of mobile applications around the year 2008 or so. This led to the increased demand for AR tools, which were mostly designed for marketing and entertainment purposes. Furthermore, Law & Heintz (2021) projected that as augmented reality (AR) matures and develops, it would eventually be adopted by other industries, like the education sector. However, it would take a number of years for learning and teaching, especially in higher institution of learning, to adopt and properly understand key elements of AR (Khan et al., 2021).

Previous studies have identified various benefits of using immersive technologies in online learning, including increased enhanced retention of information, learner engagement, and improved critical thinking abilities (Bal Ram & Pratima Verma, 2023). VR and AR enable learners to experience advanced and complicated concepts through simulations and hands-on experiences that are not feasible in conservertive online courses. Moreover, immersive technologies can accommodate various different learning styles and approaches thereby, bringing together and solving the challenges surrounding individual differences among learners for exams visual, auditory, and kinesthetic learners. (Khan et al., 2021).

- *Virtual Reality (VR) Technologies in Online Learning*

Heo et al. (2021) examined factors affecting online learning success during the COVID-19 pandemic, emphasizing time management, self-efficacy, and the online learning environments. Their study highlighted how self-efficacy significantly influences learning engagement in online settings. In a related study, Domínguez et al. (2021) delved into the relationship between formative assessment and self-regulated learning, emphasizing the bidirectional nature of these interactions. Through analyzing students' activities within online learning platforms, they uncovered insights into how self-assessment strategies can enhance formative assessment practices in online learning activities. Their findings underscored the importance of promoting self-assessment to improve student engagement in formative assessment activities.

Overall, these studies demonstrate a growing interest in the use of technology to boost online learning experiences and promote self-regulated learning practices. By considering the temporal component of student behavior and interactions within online learning environments, researchers can gain valuable insights into the effectiveness of immersive technology in facilitating learning outcomes. As the field continues to evolve, future research should explore innovative approaches to integrating immersive technology into online learning environments to optimize student engagement and learning outcomes (Owidi, 2023).

Virtual reality has emerged as a transformative force with significant potential in the domain of online learning. The shift towards virtual environments, as evidenced by the rebranding of Facebook to Meta, signifies a turning point in how individuals engage with educational content. (Rospigliosi, 2022) highlights the importance of considering the implications of this shift, noting that VR presents new opportunities for interactive learning environments that mirror changes in socialization and work dynamics. However, there is also a risk of disconnection from reality, as described by Baudrillard (1981), which underscores the need to critically examine the role of such immersive technologies in education.

Sánchez-Cabrero et al. (2019) assessed the educational interest of early VR adopters and identified their current needs such as hardware needs, software requirements and development, and clearly articulated content to be used. The results indicated that with the growing need of using VR for educational purposes, a significant portion of users have yet to fully embrace its potential for learning. This highlights the importance of developing learning applications and education experiences that takes care of the needs and preferences of VR users, particularly in the education domain.

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Antonopoulos et al., (2024) compared learning outcomes in immersive VR environments with conventional web pages and desktop VR applications. The study found that learning in immersive VR outperformed web pages, suggesting that virtual reality and other immersive technologies has the potential to improve learning experiences. Furthermore, factors that contribute to the learning experiences were found to be more favorable in the immersive VR environment, indicating the transformative implications of VR for education. However, Majewska & Vereen (2023) emphasized that the growing interest in VR for pedagogy in higher education is due to its potential to engage students with materials and activities in novel ways that attract their interests in learning thereby improving their academic outcomes. Although initial results point to improvements in student's learning across subject areas, additional research inquiry is required to completely comprehend VR's effects on educational outcomes. The authors perceive the benefits and challenges of utilizing virtual reality (VR) in online courses, highlighting the fact that students view VR as a valuable learning tool

Akman & Çakır (2023) carried out an assessment of the educational uses of virtual reality (VR) and augmented reality (AR), with an emphasis on the effects these technologies on student engagement, motivation, and learning results. According to the study, by creating realistic and dynamic learning environments, AR and VR have the potential to enhance student learning, information retention, and skill acquisition. The results highlight how crucial it is to integrate AR and VR into teaching strategies in order to produce memorable and stimulating learning environments. Mergen et al. (2023) evaluated students' acceptance of virtual reality (VR) in medical education and its potential. The survey results indicated that most medical students approve of integrating VR into their curriculum, particularly for anatomy and surgery. The implementation of immersive VR technology in medical curricula has the potential to enhance students' clinical competencies and decision-making skills, ultimately benefiting public health.

Virtual reality has a wide range of applications in online education and has the potential to completely transform education field by providing immersive and dynamic learning environments. Although the use of virtual reality (VR) in education is becoming increasingly popular, more study is required to completely comprehend how technology affects student learning, results and engagement. Educators may build meaningful and powerful learning experiences that develop a generation of digitally literate and knowledge-driven learners by integrating virtual reality (VR) into their classroom and putting into considering the requirements and preferences of users.

- *Gamification in Online Learning*

Gamification in online learning represents a significant shift in educational strategies, integrating game design elements and principles to enhance learner engagement, motivation, and educational outcomes (Marougkas et al., 2023). The application of gamification techniques in educational contexts has garnered considerable attention in recent literature, highlighting both its potential benefits and inherent challenges. One of the primary gamification elements identified in the literature is the use of points and scoring systems. According to Dicheva et al. (2015), points and scoring mechanisms serve as a tool for tracking progress and providing motivation through clear, quantifiable feedback. This system not only facilitates learner engagement by setting tangible goals but also enhances motivation as students accumulate points and strive to achieve higher scores.

Another prevalent component is the use of digital badges and certificates. Research by Cico et al. (2021) suggests that these visual representations of achievement can significantly impact learner motivation by recognizing and rewarding specific accomplishments. Badges function as a form of extrinsic motivation, offering learners tangible evidence of their progress and mastery of skills. Leaderboards are frequently employed to foster a sense of competition among learners (Lyanda et al., 2024). Studies such as those by (Irwanto et al., 2022) demonstrate that leaderboards can effectively drive engagement and performance by publicizing learners' rankings based on their achievements. This competitive element can encourage students to improve their performance and increase their participation in the learning process.

The structuring of educational content into levels and stages, akin to game levels, is another notable strategy. Research by Kapp (2012) indicates that this approach helps to break down complex material into manageable segments, allowing learners to progress incrementally. This progression system not only maintains engagement but also supports mastery learning by ensuring learners build on foundational knowledge before advancing. Incorporating challenges and quests into online learning environments can further enhance engagement. According to a study by Smiderle et al. (2020) challenges and quests align with learning objectives and introduce a gamified dimension that can make the learning experience more immersive. These elements encourage active participation and problem-solving, thereby increasing learner involvement and persistence (Alomari et al., 2019).

Storytelling and narrative frameworks are also employed to provide contextual relevance to the material being studied. Research by Sardi et al. (2017) emphasizes that narrative elements can make learning more engaging by embedding educational content within a compelling storyline, thus enhancing the perceived relevance and application of the knowledge. Interactive elements such as simulations, puzzles, and games are frequently highlighted in the literature as tools that facilitate active learning. As noted by Díaz-Ramírez (2020) these interactive features can support the development of practical skills and allow learners to apply knowledge in dynamic and engaging ways.

Despite the advantages, there are notable challenges associated with gamification. An overemphasis on extrinsic rewards, such as points and badges, can overshadow intrinsic motivation and the inherent value of learning (Abad-Segura et al., 2020). Balancing extrinsic incentives with intrinsic

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educational goals is crucial for maintaining the integrity of the learning experience. Additionally, the design of gamified elements must be carefully aligned with educational objectives to avoid potential distractions (Majid & Salam, 2021). Accessibility also remains a critical concern in the implementation of gamified learning environments. Ensuring that gamification strategies are inclusive and accommodate learners with diverse needs is essential for equitable educational opportunities (Burgstahler, 2015).

The integration of gamification into online learning has been shown to enhance engagement, motivation, and retention through various mechanisms such as points, badges, leaderboards, and interactive elements (Omieno et al., 2013). However, the effectiveness of these strategies depends on careful design and implementation to balance extrinsic and intrinsic motivators and ensure accessibility (Owidi et al., 2023). The current literature underscores the potential of gamification to transform educational experiences, provided that its application is thoughtfully managed.

➢ *Purpose and Objectives of the Study*

The purpose of this research paper is to investigate how immersive technology can improve online learning and engagement. The study looks at how VR and AR can be integrated into online learning environments through a systematic assessment of the literature. It focuses on how these integrations affect student engagement, learning outcomes, and overall satisfaction among teachers and learners. The goal of the study is to further our understanding of how immersive technology can be used effectively in online education by synthesizing previous literature.

The integration of Immersive technologies in online learning demands the presence of the technology and the skill requisite for using the technology. The systematic review was conducted in line with various questions that needs clarity for users to effectively adopt the use of such technologies specifically regarding VR and AR. The following research objectives guided the study:

- To analyze the distribution of scholarly articles on immersive technology in online learning over the past two decades, by conducting a bibliometric analysis to identify trends and patterns in publication frequency and subject focus.
- To categorize and summarize the demographic profiles of participants in studies involving immersive technology in online learning by reviewing and coding participant information from a sample of recent research articles.
- To identify and catalog the types of immersive technologies and gadgets used in virtual learning environments by conducting a systematic review of current literature and product specifications.
- To identify and describe the research methodologies employed in studies investigating immersive technology in online learning by reviewing and classifying the methods used in a representative sample of recent article
- To examine how various learning theories are applied in studies of immersive technology in online learning by analyzing the theoretical frameworks cited in a sample of research articles.

III. METHODOLOGY

In order to comprehensively investigate a particular study topic, systematic reviews provided a rigorous scientific method that aids in the identification of patterns and gaps in the body of current body of knowledge. In a systematic review, relevant materials are grouped based on predefined criteria to address a particular research question.(Kamińska et al., 2023). In order to ensure clarity in the description of eligibility criteria, information sources, data collection procedures, data items, and result synthesis, the review process adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) declaration.

To give an overview of AR utilization in an online learning environment, this study reviewed papers from reputable journals. In particular, the study investigated the various kinds of learners and participants, the augmented reality technology used, research approaches, and theoretical foundations for AR applications in online learning that were being studied.

➢ *Criteria for Selecting Studies.*

For this review, the scientific papers on AR and VR utilization that were published in various journals listed in the SCOPUS and Social Sciences Citation Index (SSCI) repositories were gathered. The two databases serve as the primary source material for numerous review studies and are well-known in the academic community as respectable, highly cited publications(Liu et al., 2020). Furthermore, it was simple to access and modify the field tags of indexed papers to suit the demands of the researcher(Majid & Salam, 2021). The Web of Science (WOS) provided access to sophisticated search tools for SSCI-indexed publications. The search phrases "virtual reality", "mixed reality", and "augmented reality," were used as input. Additionally, the restrictions were established, stating that the time frame was from 2015 to 2023, the language could only be English, and the document kinds could only be articles and proceeding documents.

With the exception of a minor variation from WOS, the Scopus database included advanced search features and similar queries were used in WOS database. Although WOS did not have a "Topic" function, it was comparable to SCOPUS's "Title, Abstract, and Keyword" function. To increase the validity of the findings, "Keyword" was omitted from the query string in this review (Law & Heintz, 2021). Similar restrictions were in place, which stated that the time frame was from 2015 to 2023, the language could only be English, and the document kinds could only be proceeding papers and articles. The last search was done on August 25, 2024, and it produced 72 results. Figure 1 illustrates the methodology for the paper selection process.

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During the course of the systematic review, exclusion and inclusion approaches were decided upon (see Table 1). After applying the criteria, 31 papers were determined to be pertinent to the goal of the study.

Table 1 Exclusion and Inclusion Approaches

Inclusion Criteria	Exclusion Criteria
a) Empirical research is a requirement for research. b) Among the document types were English-language journal articles and conference proceedings. c) Immersed technology must be used as a main or supplemental teaching tool in the online platform. d) English or another language may be the target language. e) The articles outline the outcomes of using augmented reality (AR) or virtual reality to teach in the online platform.	a) The real use of immersive technologies in online learning is not discussed in articles. b) Articles that discuss virtual reality or other subjects but use the phrase "augmented reality". c) Excluded materials include biographical pieces, master's and PhD theses, book chapters, symposiums, editorial essays, meeting abstracts, and books. d) The study's results and the tools used to assess AR or Augmented reality are not presented in an understandable manner. e) Only an abstract in the paper research based on design.

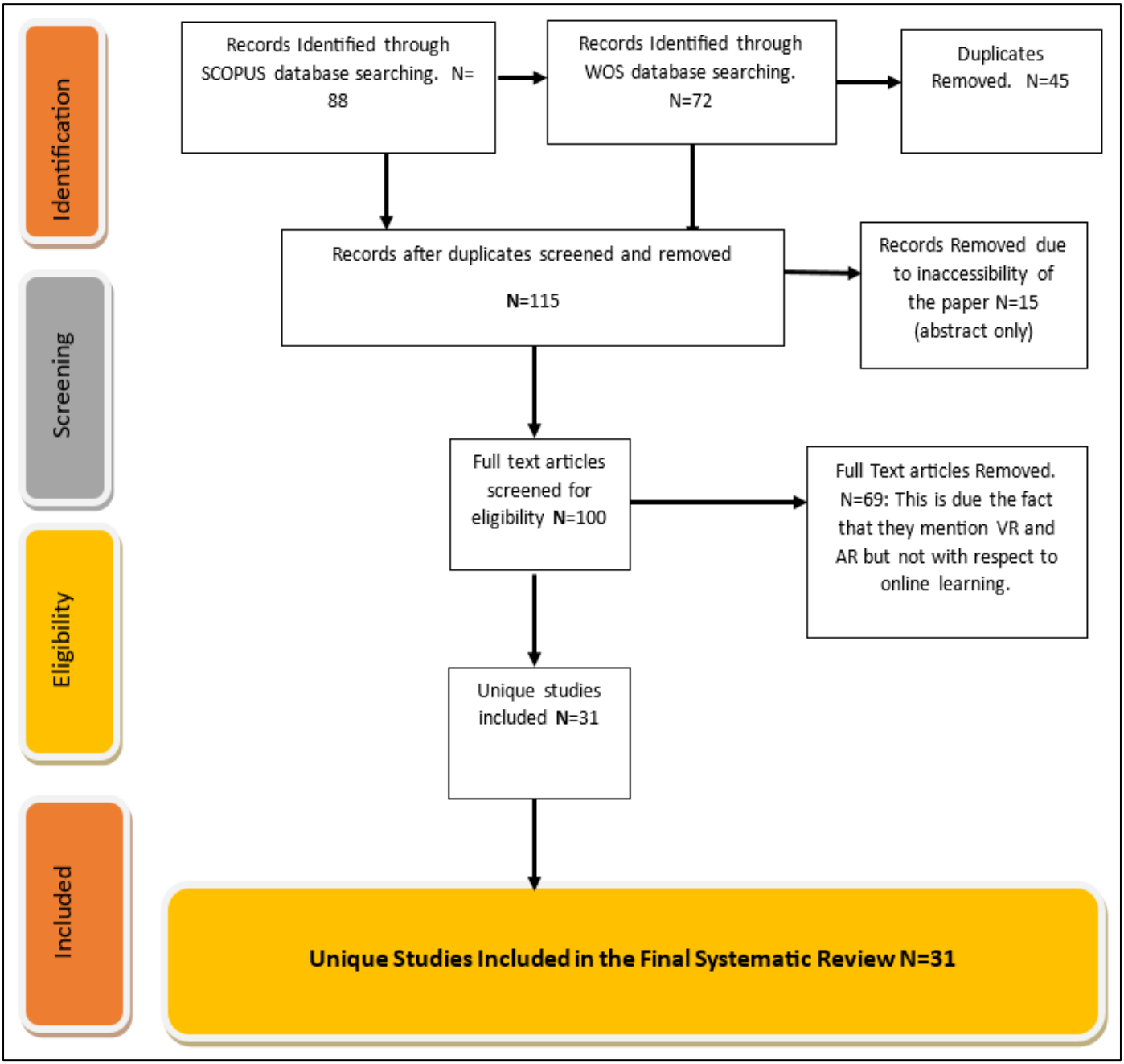

Fig 1 The Systematic Review Process

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IV. FINDINGS

➢ *Distribution of Articles on Use of Immersive Technologies in Online Learning*

The data shows that, although there were no articles published in 2016, 2017 and 2018 (see Figure 2), the number of articles published on the use of virtual and augmented reality technologies for e-learning rose steadily in 2019 and peaked in 2020. In contrast to the prior concentration on entertainment and marketing, (Irwanto et al., 2022) stated in 2022 that the next years (2023–2025) focused great potential in AR applications for educational purposes. However, as Covid 19 pandemic was being managed, the number of articles on immersive technologies tremendously reduced. This is a sign that concentration shifted to other forms of research in educational technologies since physical learning had been resumed by most academic institutions. Therefore, our evaluation corroborated the earlier investigation regarding the paucity of studies on application of similar technologies in online pedagogical infrastructures until 2019.

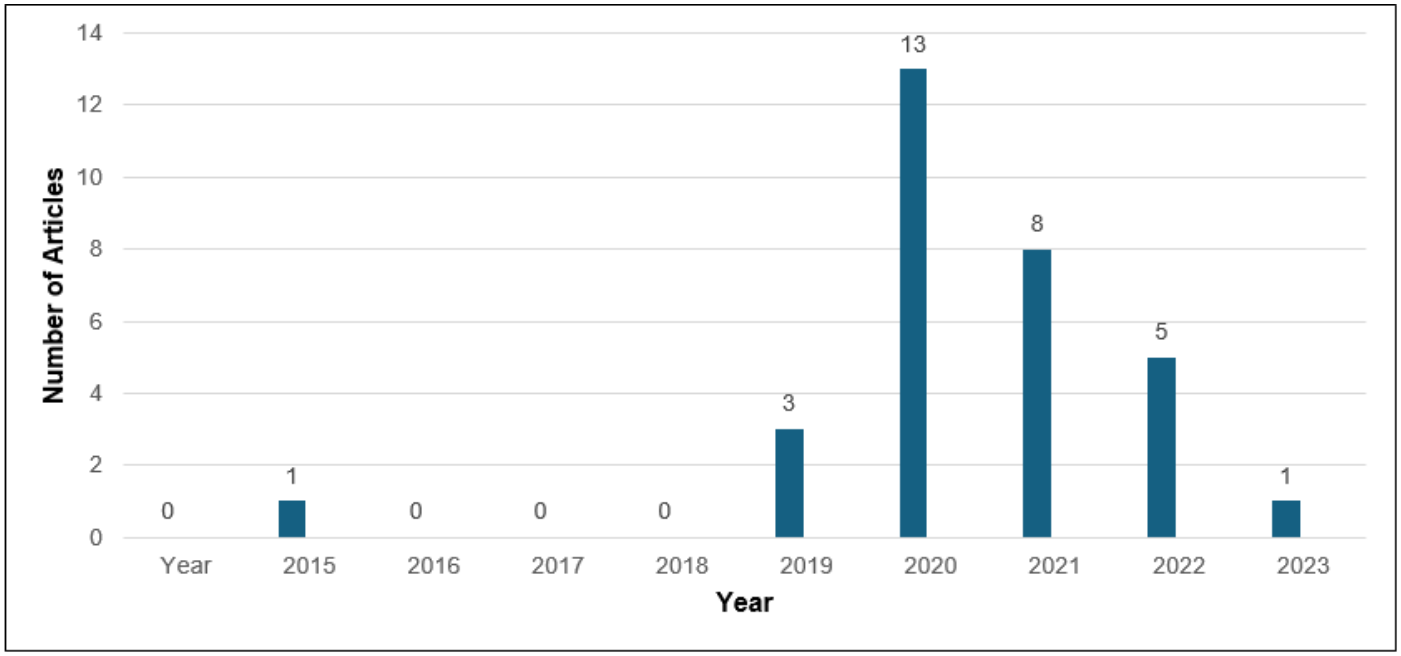

Fig 2 Distribution of Articles Published per year

Nonetheless, businesses like Google were forerunners in 2017 when AR and VR emerged as popular technologies, with Snapchat being the first social media network to effectively include AR user features in the same year (Majewska & Vereen, 2023). The platforms might also be a factor in the growing interest in augmented reality (AR) as it relates to online learning, which would boost the number of papers published starting in 2019. The presence of the Covid-19 Pandemic also triggered the use of Immersive technologies like VR since there was need for specialized learning in isolation as a result of the Pandemic. High AR availability, affordability, and simpler operability are further factors contributing to the rise (Conde et al., 2021). As a result, future online learning research using AR was probably going to increase.

➢ *Categories of Respondents in past studies*

Fifteen research articles (48%) used university and college students as the key respondents from among the 29 study samples. Secondary school children accounted for the second-highest percentage (38.2%), while kindergarteners (10.2%) and Primary school students (3.6%) were the subjects of the remaining research. The high percentage of college and university students who took part in the study was consistent with earlier research (Dicheva et al., 2015) and (Kovacs, 2023). This could be because mobile devices are more accessible (Avila-Garzon et al., 2021) samples are more easily accessible, (Seprum & Wongwatkit, 2022) and participants can provide thoughtful and constructive feedback on how Immersive technology applications are used. Since most of the AR and VR applications in the study were prototypes, adult participants were needed to provide input on the application's usefulness and efficacy.

➢ *Immersive Technologies and Interactive Gadgets in Virtual Learning Environments*

Three forms of AR were identified by this review: marker less, marker-based, and location-based (Antonopoulos et al., 2024). According to the current research, 20 of the 31 publications used AR that is marker based, making it the most popular type used in online learning. Furthermore, location-based augmented reality (AR) was employed in nine of the investigations. In these studies, real-time GPS positioning was used to explore and understand geographically based content. Most of the published research on location-based augmented reality (AR) incorporated gamification, or game-based concepts, in Online Learning. A marker-less kind was utilized in just one investigation. Additionally, 23 of the studies made use of the researchers' own AR application prototypes, and three other studies made use of commercially available AR applications. To view augmented reality content, various display types are employed. Table 2 illustrates the range of these display types, which are not restricted to a single device per study. For

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instance, one study combined computer desktops with HoloLens, while three studies utilized computers and projectors, often using two devices simultaneously. Consequently, the number of devices reported surpasses the number of individual studies. Additionally, in two surveys, only general terms such as electronic devices and devices with applications were mentioned.

Table 2 Types of Augmented Reality Display Gadgets

Augmented Reality Gadget	Total
Tablet	7
Projector	4
Mobile Devices (iPod/Smartphone)	16
Desktops and with Devices with Webcam	9
Holo Lens	2
Unspecified	1

- *Study Methodologies used for Investigating Immersive Technology in Online Learning*

Similar to the findings of (Kamińska et al., 2023), the analysis showed that mixed-method research designs were the most often utilized, with 20 studies; they were followed by quantitative research designs (eight studies) and qualitative research designs (three studies). Because the mixed-method approach involved starting with a quantitative method and moving on to a qualitative one, the investigations were typically explanatory and sequential. Despite the fact that many studies did not specifically state that they used a mixed-method approach, the analysis showed that different types of data were collected. Consequently, even though the word "mixed-method" was not used, this review classified the research as having a mixed-method design.

Additionally, the data collection techniques employed were categorized in parallel with a research project carried out by (Wang et al., 2024), wherein a range of data gathering techniques were employed from the 31 chosen papers included in this evaluation. According to Figure 3, the most common way of gathering data for 20 research was the use of questionnaires. Observations (16), field notes (11), documents (11), pre-and post-tests (13), interviews (18), and focus group talks (13). Regarding this, two researchers used gameplay data, evaluation forms, and other reflection reports, whereas one study used audio, documents, and pre-tests.

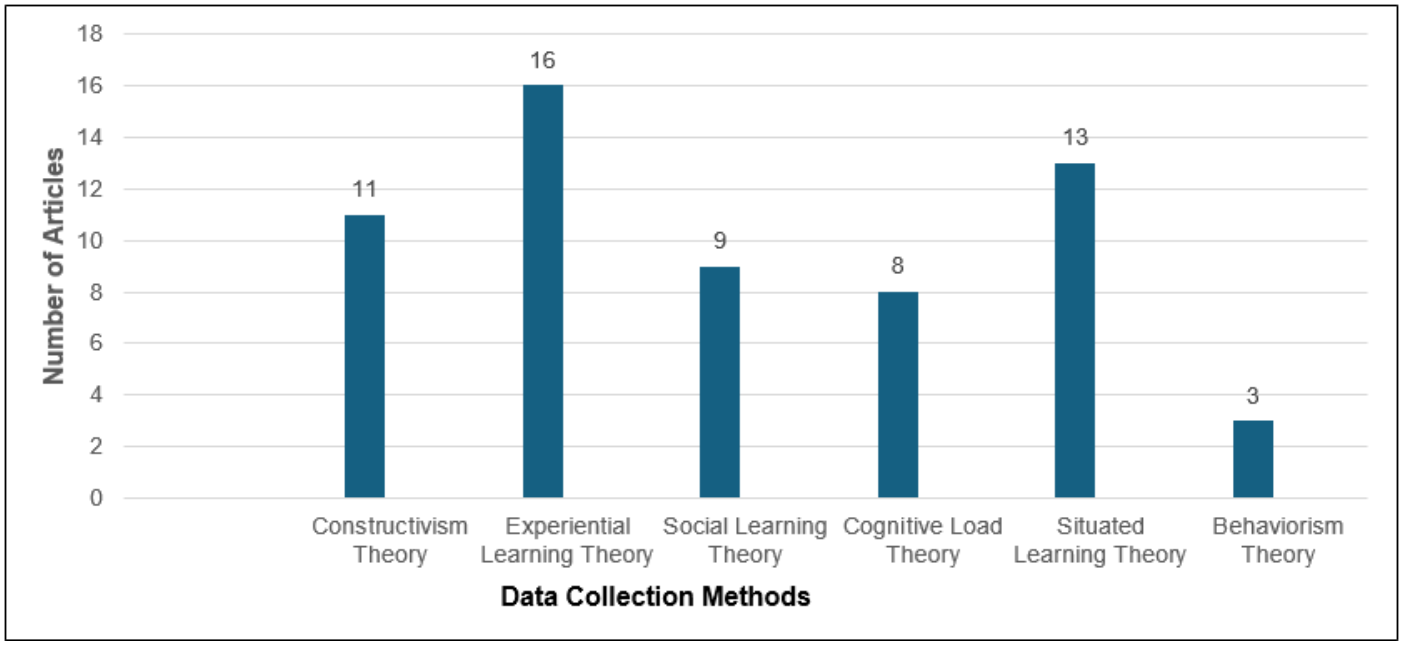

Fig 3 Study Methodologies used for Investigating Immersive Technology in Online Learning

- *Learning Theories and Immersive Technologies in Online Learning Spaces*

The result of the review reveals a range of benefits associated with the integration of immersive technologies into online learning environments. Participants report increased engagement, motivation, and sense of presence in virtual environments, leading to improved learning outcomes and retention of information. VR and AR simulations enable students to visualize abstract concepts, examine actual situations and use theoretical information in real-world settings.

Moreover, participants highlight the role of immersive technologies in fostering collaboration, communication, and social interaction among learners in online courses. VR environments facilitate peer-to-peer interaction, group projects, and collaborative problem-solving activities, enhancing the sense of community and belonging in online

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learning communities. Additionally, participants express positive attitudes towards using similar technologies in online learning, citing their potential to transform the way students learn and engage with course content.

In order to characterize, explain, and forecast the phenomena under investigation, theory has a significant role in empirical research (Cico et al., 2021). Theoretical framework-based study findings make it easier to "*make sense*" of the data (Liu et al., 2020). Therefore, this paper identified the learning or educational theories that underpin online learning with immersive technologies. The hypothesis mentioned in the publication was first found using the keyword "theory." Each work was carefully analyzed and scrutinized for theories or concepts linked to AR and VR in online learning when no hits were found. Key theories found to form part of most studies included Constructivism theory by Jean Piaget and Lev Vygotsky, Behaviorism Theory by B.F. Skinner, Experiential Learning by David Kolb, Social Learning Theory by Albert Bandura, Situated Learning Theory by Jean Lave and Cognitive Load Theory by John Sweller and Etienne Wenger, the Situated Learning Theory by Jean Lave. Figure 3 shows the identified theories.

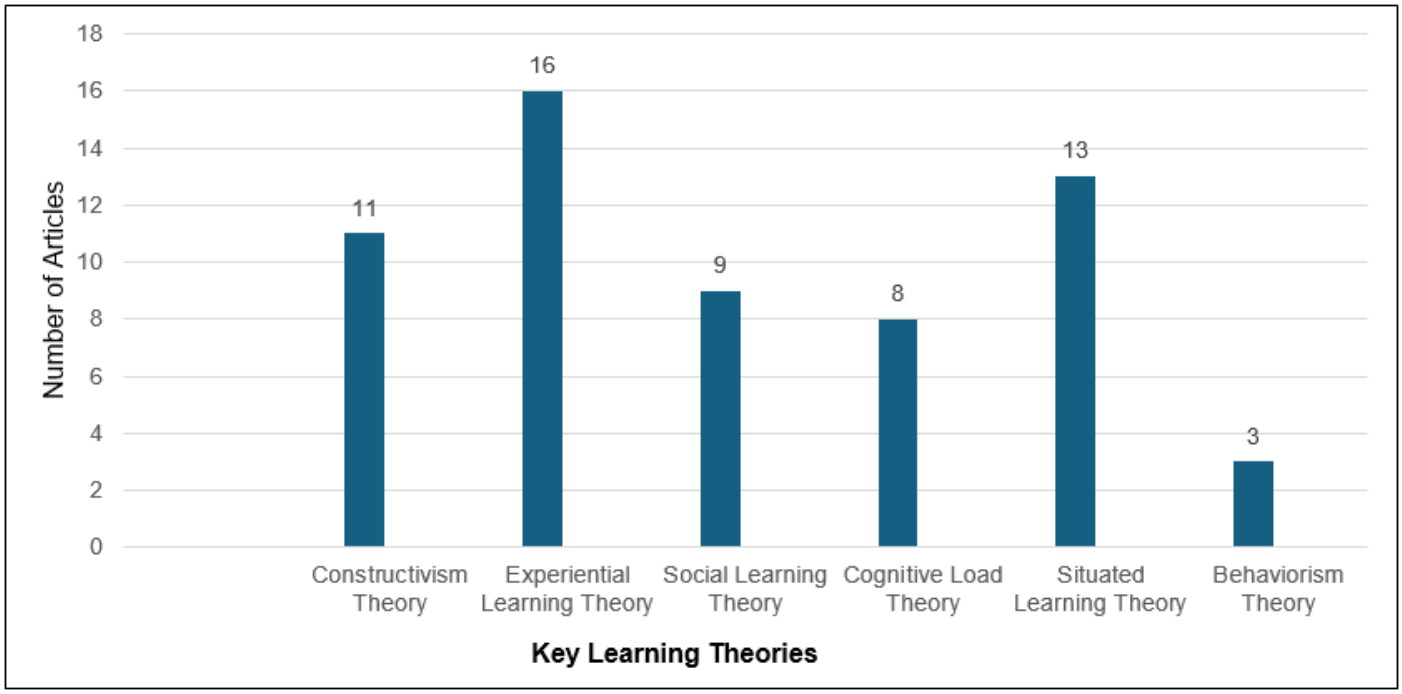

Fig 4 Learning Theories in Various Articles

V. CONCLUSIONS AND RECOMMENDATION

➢ *Conclusions*

This study reveals that immersive technologies, specifically Augmented Reality (AR) and Virtual Reality (VR), significantly enhance online learning environments. The integration of AR and VR into online education platforms has been shown to improve learner engagement, satisfaction, and educational outcomes. AR technologies, particularly marker-based and location-based AR, are prominently utilized in online learning, offering interactive and contextually rich experiences. VR, with its ability to create fully immersive environments, has demonstrated substantial potential to transform conventional learning approaches and foster deeper understanding through simulated experiences. Despite these advancements, challenges such as accessibility, cost, and the need for effective training remain. The research underscores the importance of incorporating these technologies to provide dynamic and engaging learning experiences but also highlights the need for further exploration into optimizing their use in educational settings.

➢ *Recommendations*

Based on the findings of the study, several recommendations are offered for educators, developers, instructional designers, and policymakers seeking to leverage immersive technologies in online learning:

- Invest in Technology: Educational institutions and policymakers should invest in AR and VR technologies to enhance online learning environments. Prioritize the development and acquisition of immersive tools that align with educational goals and curricula.
- Training and Support: Provide comprehensive training for educators on the effective use of AR and VR technologies. Ensure that instructors are well-equipped to integrate these tools into their teaching practices and can leverage their full potential.
- Enhance Accessibility: Address barriers to access by exploring affordable solutions and ensuring that immersive technologies are accessible to diverse student populations. Consider strategies for making these technologies more widely available and affordable.

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- Promote Collaboration: Encourage collaboration between educators, technologists, and researchers to develop and refine AR and VR applications that meet educational needs. Foster partnerships to share best practices and innovative approaches.
- Address Research Gaps: Further research is needed to explore the long-term effects of immersive technologies on various learning outcomes and to address existing gaps in literature. Focus on evaluating the impact of these technologies across different educational contexts and learning styles.

By implementing these recommendations, educators and policymakers can harness the potential of immersive technologies to create engaging and effective online learning experiences for students.

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