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A Comprehensive Systematic Literature Review of Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) Technologies in Educational Environments

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1.0 Introduction

Artificial intelligence (AI) has evolved significantly over the past ten years, revolutionizing a wide range of industries through the automation of difficult tasks and the delivery of creative solutions (Kesavan & Marianand, 2022). Generative artificial intelligence (GAI) is one of the most notable developments in AI because of its amazing ability to create text, code, and other types of content that resemble human content on its own (Cummings et al., 2024). This branch of AI creates outputs that are remarkably similar to human creations by using advanced deep learning models that have been trained on large datasets. GitHub Copilot, Blackbox, and OpenAI's ChatGPT are noteworthy examples of GAI that have demonstrated significant potential in helping with software development and programming duties (Backström & Kihlert, 2023).

On the other hand, Virtual reality (VR) and augmented reality (AR) tools have emerged. The utilization of these tools revolutionized the field of education by providing immersive and interactive learning experiences (Shaukat, 2023). In the context of university level education, these tools are being used to enhance the ability of students to learn new concepts and solve problems. For example, VR/AR technologies have the ability to provide a bridge between theory and practice to students, as well as helping disabled students understand complicated topics (Ardiny & Khanmirza, 2018). These tools are intended to improve the learning process by enhancing teaching in various ways that cater to each student's needs.

However, incorporating those tools does not come without challenges, critics have raised concerns about the potential negative impacts of excessive reliance on GAI tools. Critics worry that this dependency could foster a culture that discourages students from using their own problem-solving abilities and instead leads them to rely on pre-existing answers from online tools (Biswas, 2023). Additionally, the integration of VR/AR tools in schools and universities can be costly. As it needs technical training, specialized hardware, as well as high computational power (Shaukat, 2023).

While AI, VR, and AR have expanded the possibilities in the technology sector, it is still vital to understand how it specifically affects students from different fields and levels. This study

concentrates on the impact of these three emerging technologies on higher education. The research aims to fully understand the advantages and potential disadvantages of incorporating these tools into university education and the students' academic performance.

2.0 Literature Review

This study talks about the emerging technologies being integrated into the educational systems and how students and lecturers can work with it successfully. Researchers have been working a lot on the integration of various technologies for years now and talked about the both shortcomings and the upbringings of the same technologies. This section provides the insights in immersive learning experiences with the used technologies, their challenges and contributions to the education along with the limitations they are facing.

Emerging technologies such as Artificial Intelligence (AI), Virtual Reality (VR) and Augmented Reality (AR) are revolutionizing on their own but they are also revolutionizing the educational system creating interactive, adaptive and immersive experiences. AI enhances personalized learning and provides the data-driven insights while VR is offering immersive simulations for the experimental learnings and AR blends both physical and virtual worlds into one to enhance interactivity and productivity.

2.1 Artificial Intelligence (AI) in Education

Artificial Intelligence is transforming education by allowing students to personalize their studies and make their learning experiences more efficient. It is shown in the simplest subjects where, for example, AI's applications in geography lecture in secondary schools aids in tailoring lessons to individual needs of each student which is also enhancing their own performance analysis making it easy for lecturers to focus on each student and understand their needs. (Matkovič, 2024). AI is also involved in the intelligent tutoring systems and automated grading systems which is reducing the workload for educators and allowing customized content delivery also ensuring students will learn and work at their own pace. (Holmes, 2019) However, AI-driven platforms such as adaptive learning for customized content delivery are allowing students to learn better and in their own way. (Smith & Roe, 2021)

In his paper, Sharki (2024) discussed how the integration of AI together with immersive technologies like VR and AR is used to create adaptive learning environments. By using real-time analytics and providing instant feedback, AI is enhancing the efficacy of the immersive tools and making learning more interactive and engaging. AI-powered chatbots and virtual assistants are also supporting students by providing them with all time assistance and answering all questions about the wanted topics. (Kesavan & Marianand, 2022)

Naturally, there are challenges in the adoption of AI in the educational sectors. One of those challenges are simply ethical issues for algorithm bias, data privacy and the misuse of AI where they must be fully addressed to build trust among stakeholders. (Cohen & Levine, 2020) Additional problem is the lack of teacher training in AI technologies where teachers often struggle to integrate the AI tools into the teaching practices due to the limited knowledge and resources available. (Holmes, 2019)

Study from Milani (2022) underlines AI's potential to bridge educational disparities, especially in the underfunded schools. By automating the routine tasks and personalizing the learning experience, AI can enhance the quality of education for all students of every background.

2.2 Virtual Reality (VR) in Education

Virtual reality (VR) offers environments that enhance experiential learning making abstract concepts easier to engage with. Kaminska (2019) provides an extensive review of the applications of VR in education, highlighting the utility in creating the simulations for hands-on practice. One of the examples are medical students using VR to perform virtual surgeries and engineering students interacting with complex machinery in risk-free environments.(Fletcher & Tobias, 2020). VR is also highly used in the education of aviation where very realistic simulations are enabling pilots-in-training to develop critical skills without taking any risks yet in the real world scenarios. (Jevčak, 2024)

Alnagrat (2023) discusses the opportunities VR actually provides in virtual laboratories, where students can recreate and conduct experiments without requiring physical lab infrastructures. These approaches are very beneficial for unfunded institutions since it is reducing the cost of high quality equipment and experiences. VR also fosters student engagement by offering multisensory learning opportunities where lessons are more memorable and impactful. (Yang & Wang, 2020)

The whole process of adoption of VR is facing many challenges such as VR headsets that are limited in accessibility, especially in underfunded schools since the high implementation of VR is very expensive. Technical issues such as motion sickness and hardware compatibility are also under the challenges that might be faced with. (Kaminska, 2019). To address the barriers, Kamalov (2023) proposed the cost effective VR solutions made for educational institutions' needs.

2.3 Augmented Reality (AR) in Education

Augmented Reality (AR) blends the physical and virtual worlds into one while offering interactive learning experiences that enhance high engagements. Zheleva (2024) pointed out the

AR's applications in project based learning and where and how students use AR tools to visualize and interact with the complexities of models. For instance, AR enabled textbooks allow students to see 3D models of the historical artifacts or biological and chemistry structures enhancing the understanding of these subjects. (Patton & Takahashi, 2022)

AR is highly used in the STEM education as well where it facilitates the visualization of abstract concepts such as physical forces and chemical reactions. (Magomadov, 2020). AR also fosters collaborative learning by enabling students to work together on interactive projects. (Bacca, 2022). In addition, the gamification of AR applications increases students' motivation by incorporating elements of play into the learning process. (Kumar & Patel, 2023).

Despite the advantages, AR is facing several challenges where the content standardization is a significant barrier where the development of AR content requires specialized skills and resources. (Gupta & Sharma, 2021) The need for compatible devices, such as smartphones and tablets, can also be a constraint if the resources are limited. Developing user-friendly and cost-effective AR tools is important to overcome the barriers. By addressing all the issues, AR can become a more accessible and effective tool for enhancing the educational and learning outcomes. (Anderson & Dron, 2021)

2.4 Integration of AI, VR & AR in Education

The integration of AI with VR and AR creates powerful educational tools that adapt to individual learning styles and their needs. AI technologies provide real-time analytics and personalized feedback by enabling dynamic and interactive learning experiences. AI can highly analyze students' interactions within VR simulations and adjust the content to match their proficiency levels. (Backstrom & Kihlert, 2023)

The emphasis on combined impact of VR, AR and other learning analytics are improving the educational outcomes and experiences which is also said by many researchers. By integrating these technologies, educators can create comprehensive learning environments to provide diverse learning styles. (Greta & Celaj, 2023). Bermejo (2023) highlights the importance of aligning the technologies together with curriculum objectives to make sure it is pedagogically effective as well.

In addition, Adipat and Chotikapanich (2024) explored the role of the technologies in transitioning to smart universities where digital tools are modernizing higher education. With incorporation of AI, VR and AR, smart universities can provide personalization and immersive learning experiences way better to prepare students for the demands of the century we are living in.

2.5 Comparative Insights

AI, VR and AR each on their own offer very unique benefits to education. AI is perfect in administrative tasks and personalization of the user experience where VR provides immersive environments that enhance the experimental learning while AR is the bridge between the theoretical and practical knowledge where digital content is overlaid in the real world. (Qureshi, 2023)

However, challenges such as high implementation cost, ethical concerns and limited teacher training remain to be one of the biggest barriers. By addressing these challenges, the collaborative effort from researchers, educators, policymakers and students is needed to focus on delivering the scalable, cost-effective and ethical solutions to successfully implement those technologies into everyday school education.

3.0 Methodology

This study investigates the adoption and impact of Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) in universities and schools. Researchers have employed a variety of methodologies to study their impact, effectiveness, and implementation challenges. This research will provide a review of different methodologies used in prominent studies in the field, focusing on the use of these technologies from two different views as well as understanding the strengths, weaknesses, and how these methodologies can be applied to a broader understanding of emerging technologies in universities and schools. The study follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure a systematic, transparent, and replicable review and PRISMA provides a visual summary of the screening Process . The following are the subsequent steps necessary to develop this methodology:

3.1 Search Strategies

To start our research, we used the key words related to our research topic such as ("Artificial Intelligence in Education" OR "Augmented Reality in Schools") AND ("Emerging Technology" OR "Virtual Reality in Higher Education") AND ("Higher Education" OR "University Education") AND ("Impact" OR "Effect") AND ("artificial intelligence" OR "AI"). Boolean operators (AND, OR) were applied to combine terms for logical relationships. The primary focus was to find researches that address the impact of AI, AR, and VR in education.

3.2 Eligibility Criteria

The studies were selected based on the relevance of the topic to our study objective, focusing on AI, VR, or AR technologies in educational contexts as well as studies that were published during 2020 and 2025. As exclusion criteria, we removed any duplicate research and studies that did not align with our research objectives. Documents that are older than five years and written in a different language than English.

Table1: SEARCH QUESTION

No	Search Questions	Search Objective
1	Emerging Technologies in Universities or Colleges? AI, VR, and AR in Universities or Colleges.	To identifying emerging technology in higher education (AI,VR, and AR)

Finding the right terms to employ when doing an information search is essential for applying the necessary filters; in this regard, the information search question should be approached from a variety of angles to produce pertinent results.

Table 2: SEARCH ALGORITHMS

Database	Search Algorithm
IEEE Xplore	("Artificial Intelligence in Education" OR "Augmented Reality in Schools") AND ("Emerging Technology" OR "Virtual Reality in Higher Education") AND ("Higher Education" OR "University Education") AND ("Impact" OR "Effect") AND ("artificial intelligence" OR "AI")
Semantic Scholar	("Artificial Intelligence in Education" OR "Augmented Reality in Schools") AND ("Emerging Technology" OR "Virtual Reality in Higher Education") AND ("Higher Education" OR "University Education") AND ("Impact" OR "Effect") AND ("artificial intelligence" OR "AI")
Google Scholar	("Artificial Intelligence in Education" OR "Augmented Reality in Schools") AND ("Emerging Technology" OR "Virtual Reality in Higher Education") AND ("Higher Education" OR "University Education") AND ("Impact" OR "Effect") AND ("artificial intelligence" OR "AI")

Table one shows the search question we used to find the research that related to our objective, where the search objective narrows the search for studies to the studies that satisfy our objective. However, figure one illustrates the methodology we used for this research paper and the criteria of selection of the data. We first filter according to the selected database, a total of 20 articles

were obtained in IEEE Xplore, 70 in Semantic Scholar, and 50 documents from Google Scholar, making the final obtained documents 140. The collected articles were subject to strict evaluation criteria to determine if they meet the eligibility criteria specified. Hence a total of 30 articles were identified that met these criteria.

3.3 PRISMA Flow Diagram

FIGURE 1 : PRISMA DIAGRAM FOR INFORMATION FILTERING
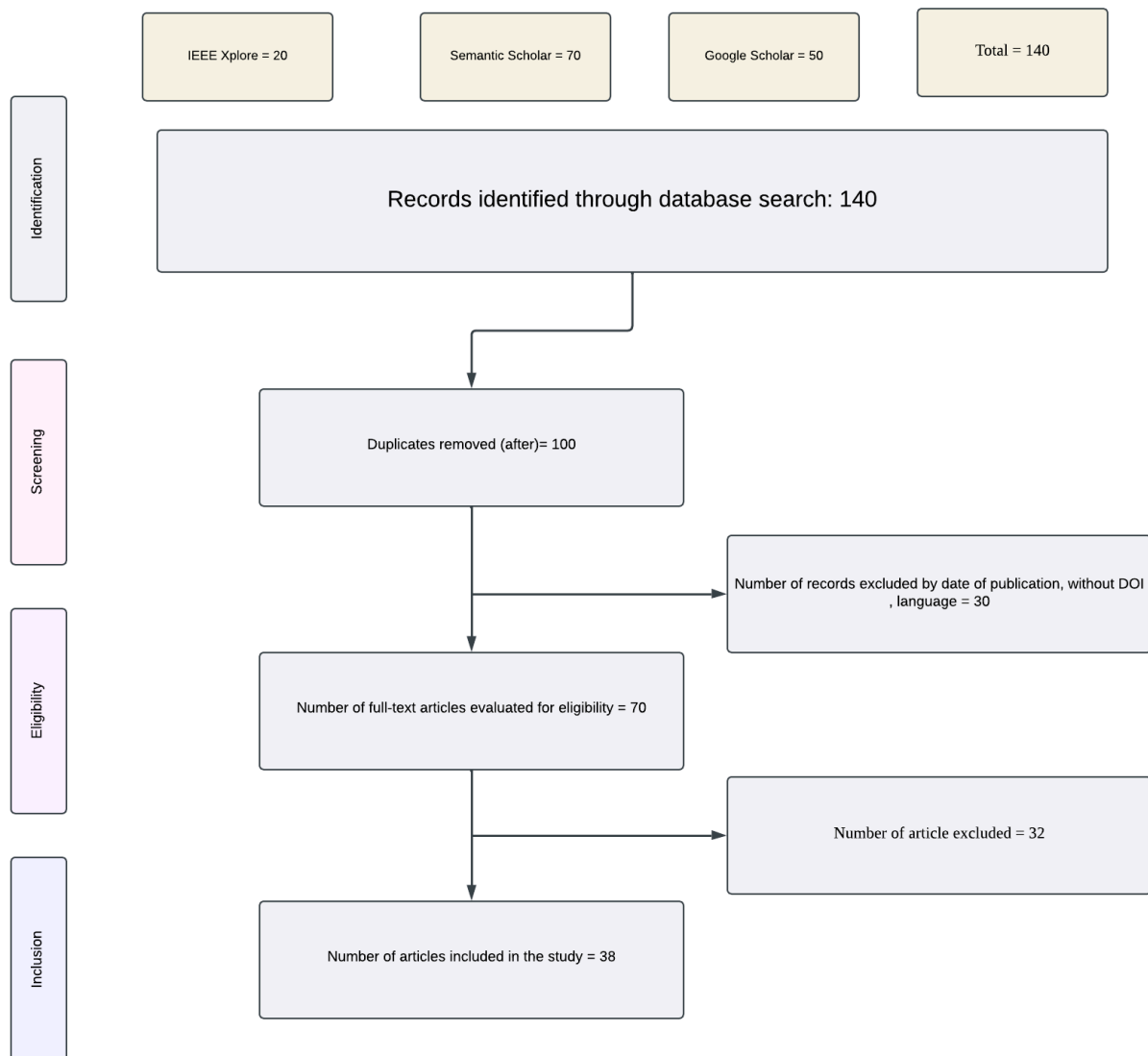
4. Contribution

Table 3: CONTRIBUTION AND RESULT

No	Study Authors	Methodology	Purpose	Outcome	Technology Gap
1.	(Kamińska et al., 2019)	1.Comprehensive survey of existing literature. 2.Synthesis of the latest developments in Virtual Reality (VR) applications within education.	The aim of this study is to explore how VR technology addresses the challenges students face in understanding complex, abstract concepts.	present a detailed overview of VR applications within educational settings,	There is a gap in research related to the long-term impact of VR on student retention, mastery of complex concepts, and its cost-effectiveness for educational institutions.
2.	(Matkovič, 2024)	Exploratory qualitative study .	The purpose of this study is to examine emerging technologies like AI, VR, and AR that are being used to enhance geography teaching and learning in secondary schools.	The study highlights the potential of AI, VR, and AR technologies in transforming education, specifically in teaching geography in primary schools.	One of the primary gaps is the lack of standardized guidelines and recommendations for the safe and effective use of these technologies in classrooms.
3.	(Bermejo et al., 2023)	A Systematic Literature Review	The purpose of this study is to review and analyze the use of AR/VR technologies in higher education institutions (HEIs) over the past decade.	The study provides a comprehensive review of the integration of AR/VR technologies in HEIs, focusing on the experiences of both students and teachers.	There is also a gap in research on the hardware used in AR/VR teaching-learning experiences, with future studies needing to examine the role of hardware in enhancing these experiences.
4.	(Garlińska et al., 2023)	Systematic review based on the PRISMA framework and the authors' personal experience	The primary goal of integrating emerging technologies in distance education is to enhance the learning experience by breaking down geographical barriers and providing access to quality education globally.	The outcome of these technologies in education is transformative, offering opportunities for more engaging, interactive, and personalized learning experiences.	The digital divide is a significant challenge, as access to technology (like Internet connectivity and hardware) is not uniform globally.
5.	(Sakr & Abdullah, 2024)	1.Systematic review 2.examination of the use of learning analytics	The purpose of this study is to address research gaps identified in existing systematic reviews about the impact of Virtual Reality (VR), Augmented Reality (AR), and	The study reveals that the most significant impacts of VR and AR technologies on learners include improved motivation, attention, understanding, performance, and knowledge retention	The study highlights a gap in research related to the exploration of VR, AR, and Learning Analytics integration across different educational systems and learner types.

			Learning Analytics on various types of learners and educators across diverse educational systems.		
6.	(Magomadov, 2020)	Literature Review	Explore the impact and potential of AR and VR technologies in education, specifically addressing how these technologies can resolve current issues in traditional education systems.	The paper aims to highlight the benefits of VR and AR, such as increased engagement, retention, and practical application, as well as the challenges of adopting AR and VR in traditional learning systems.	Despite the advancements in AR and VR, there is a technology gap in terms of accessibility, affordability, and teacher readiness for integrating these tools into educational practices.
7.	(Adipat & Chotikapanich, 2024)	Literature Review	The purpose of this study is to explore the transition of higher education institutions to smart universities by incorporating cutting-edge technologies like AR, VR, AI, and biometric systems.	The study outcome is to provide insights into how higher education institutions can harness advanced technologies to foster innovation, inclusivity, and sustainability in education.	The technology gap identified in the study revolves around the need to overcome the challenges of adopting smart university technologies. Such as high cost of implementation, the digital divide that limits access to advanced technologies for some students and educators, and the challenges of maintaining privacy and security in a highly digitalized learning environment.
8.	(Dimitriadou & Lanitis, 2023)	1.literature review 2.SWOT analysis	The aim of this paper is to explore the role of Artificial Intelligence in smart classrooms, offering a comprehensive understanding of its applications and potential in education.	This study is to offer a clear understanding of how AI can be effectively integrated into smart classrooms. Through a SWOT analysis, the paper aims to provide insights into the strengths, weaknesses, opportunities, and threats of adopting AI technologies in education.	The technology gap in AI smart classrooms includes integration challenges, high costs, privacy concerns, and limited teacher training.
9.	(Abrar et al., 2022)	Literature Review	The purpose of the study is to explore how AR, VR, and the Metaverse can revolutionize education in Jammu & Kashmir by improving the quality of education,	The study aims to demonstrate that the implementation of these technologies can enhance educational standards in J&K, particularly in rural areas. The anticipated outcomes include better student engagement, personalized learning experiences, improved assessment methods, and the potential for greater	The gap in utilizing AR, VR, and the Metaverse for education in Jammu & Kashmir (J&K) lies in limited infrastructure, lack of widespread access to emerging technologies, insufficient teacher training,

4.1 Discussion

This paper has explored the use of three important emerging technologies trends that are used in higher education, concentrating on their applications and opportunities. The research listed in our article highlights the relationship between technology and higher education and what impact and challenges these technologies force.

Artificial intelligence (AI) is rapidly transforming various sectors, including healthcare, education, and finance, by enabling personalized solutions and enhancing service access (Soni, 2024). According to the latest study done by UNESCO, 60% of University students say that incorporating technology in the classroom increases their motivation and level of engagement (Cueva et al., 2024). Moreover, Association of American Universities (AAU) report that the use of the online learning modality increased in the last years, and that 30% of college students in the United States participated in at least one online course during the year 2020 (Irwanto et al., 2023). The presence of AI tools and technologies have significantly impacted the modern educational system. A clear example of this is the emergence of generative artificial intelligence (GAI) (Milani et al., 2022). This branch of AI creates outputs that are remarkably similar to human creations by using advanced deep learning models that have been trained on large datasets. GitHub Copilot, Blackbox, and OpenAI's ChatGPT are noteworthy examples of GAI that have demonstrated significant potential in helping students and teachers (O. Backström,2023). However, there is debate regarding the impact of GAI tools on students' learning capacities and acquired skills as a result of their use in educational institutions. Proponents of these tools claim that they make it much easier to improve students' experience with assignment solving and boost their completion rates for increasingly challenging projects. In addition to reducing inconvenience and raising user engagement, this kind of assistance can

also improve student retention rates in computer science curricula (B. Qureshi, 2023) (B. Qureshi,2023). However, AI has always raised questions for its challenges such as the digital divide, privacy concerns,model bias and ethical implications must be addressed to ensure responsible and inclusive technological advancements (Soni, 2024).

Virtual reality (VR) and augmented reality (AR) are emerging technologies with significant potential in higher education. These technologies offer immersive learning experiences, enhancing student engagement, motivation, and retention compared to traditional methods (Gawed & Al-Fuhaidi, 2024). AR and VR applications can be used to teach academic, social, and vocational skills to students with disabilities (Kellems et al., 2021). Universities worldwide are integrating VR/AR into their curricula, with some institutions establishing dedicated VR laboratories to facilitate active learning (Denni et al., 2024).Technology can help bridge educational resource gaps and provide practical experience, particularly beneficial for experiential learning in higher education (Ali, 2023). While VR/AR implementation in some regions, like Yemen, is still in its early stages, there is growing recognition of its potential to transform educational practices and improve learning outcomes across diverse disciplines (Gawed & Al-Fuhaidi, 2024). Enentually, resources and experience are needed to create content for AR and VR applications, and the calibre of instructional materials that are already accessible can differ. To provide fair access to new technologies, ethical factors like privacy and accessibility must also be carefully taken into account. Emerging technology can be costly and hard to access for some, and it requires investment in hardware, software, and maintenance. Hence, educational institutions that have limited resources and budget may not be able to afford these technologies. Technical constraints can be a challenge for schools that don't have the necessary infrastructure and reliable internet connections, which is critical for accessing and downloading AR and VR content.

5.0 Conclusion

The methodology followed in this article highlights the adoption of PRISMA methodology, which ensures a clear understanding of the gathered literature review, as well as the identification of trends for the comparison of different studies. This study can make a contribution to knowledge in the field of emerging technology in higher education for Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR), providing valuable guidance for educators, researchers and decision makers. To ensure a quality education in the education environment it proves that adapting these technologies can boost students' performance in many fields of education.

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