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Immersive Learning Factors Using Virtual Reality In Higher Education: A Systematic Literature Review(SLR)

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Abstract
This study aims to investigate the critical factors influencing the effectiveness of immersive learning through Virtual Reality (VR) in higher education. The effectiveness of immersive learning using VR is influenced by several key elements, such as 1) VR design, 2) teaching strategies, 3) cognitive load, and 4) student characteristics. Of the 35 articles reviewed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method between 2020 and 2024, 27 met the required standards and quality. The findings are organized into three themes: discipline-specific VR applications, the design of immersive learning experiences, and broader aspects, including engagement and inclusiveness. The study highlights that well-structured VR designs can significantly increase student engagement and improve learning outcomes in higher education.

Keywords: Immersive learning; virtual reality; higher education

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1.0 Introduction

Virtual Reality (VR) is transforming higher education by enhancing student engagement, motivation, and academic performance. Notably, this technology shifts traditional learning methods into interactive and immersive experiences, fostering real-world applications. The core immersive learning factors include 1) VR design, 2) Cognitive load, 3) Instructional methods, and 4) Learner attributes. However, it would benefit from more explicitly stating the central educational issue, particularly the inconsistent learning outcomes linked to inadequate instructional alignment in VR contexts. In particular, this study aims to identify critical factors influencing the effectiveness of immersive learning through VR in higher education. The objective of this study can be clarified as follows: (1) To explore the key factors that influence immersive learning in VR; (2) To evaluate recent studies on the effectiveness of VR in education; and (3) To identify how design elements and learner characteristics affect learning outcomes. Accordingly, research highlights that VR-based learning, including 360-degree videos, significantly boosts attention and knowledge retention compared to conventional 2D approaches (Kim, Kim, & Kim, 2022). However, the effectiveness of VR in education depends on both technological capabilities and content design, as well as student perceptions.

Learning styles and innovativeness, have some influence, their impact is comparatively minor. In line with this, managing cognitive load is crucial, as excessive immersion can distract rather than enhance learning (Makransky, Terkildsen, & Mayer, 2019). The research contributes to the development of a conceptual framework that optimizes engagement and cognitive processing, guiding educators in

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effectively integrating VR into higher education (Makransky & Petersen, 2021). Ultimately, VR has the potential to redefine higher education by enabling immersive and interactive learning experiences that deepen understanding and improve learning outcomes (Huang et al., 2022).

2.0 Literature Review

VR is revolutionizing higher education by providing immersive learning experiences that foster better student engagement, motivation, and a deeper understanding of concepts. The research highlights a lack of a unified framework addressing the effectiveness of VR in higher education. The justification lies in the fragmented nature of prior studies and the absence of comprehensive evaluations integrating user experience and cognitive learning principles. However, excessive cognitive load from VR systems can negatively affect learning outcomes, as highlighted by Solmaz et al. (2024). Although Fokides and Antonopoulos (2024) revealed that VR can enhance motivational presence, research on its effects on different cognitive types and intrinsic motivation remains limited, underscoring the need for further investigation into personalized VR learning methods. In addition, the effectiveness of VR in education relies on factors such as technological infrastructure, content quality, and interactive design. Thus, high-quality graphics and real-time feedback contribute to better student engagement and motivation (Fokides & Antonopoulos, 2024). Moreover, a student's digital skills, willingness to adopt new technology, and intrinsic motivation play a significant role in how they respond to VR content (Ye et al., 2022). While current research has focused on the technology itself, it has not sufficiently explored how these factors relate to individual learner characteristics such as adaptability and cognitive limits. Although the literature is recent and relevant, it lacks in-depth theoretical discussion. Accordingly, the inclusion of theories such as Constructivism and Cognitive Load Theory would strengthen the foundation of the review and better contextualize the findings.

3.0 Research Question

In a Systematic Literature Review (SLR), Research Questions (RQs) play a critical role in defining the study's scope, ensuring relevance, and minimizing bias. Clearly formulated RQs guide the literature search, helping to categorize and synthesize findings for meaningful insights. They enhance clarity, structure data analysis, and improve transparency, making replication and extension of the study possible. Additionally, RQs align the review with its objectives, whether identifying research gaps, evaluating interventions, or analyzing trends. According to Keele (2007), establishing RQs during the planning phase is essential as they shape the entire review methodology. For qualitative research, Lockwood et al. (2015) recommended the PICo framework, which structures RQs around three core elements: Population, Interest, and Context. Specifically, this approach simplifies the identification of literature and ensures a systematic analysis of the study subject. Notably, by breaking down key aspects, the framework facilitates the development of precise questions, streamlining the review process. Therefore, to maintain a structured and focused approach, this study is guided by three main RQs.

1. How do VR-based immersive learning models influence students' engagement and perceived effectiveness in higher education?
2. What are the effects of VR immersive learning on cognitive load and student motivation in higher education settings?
3, How can VR-based immersive learning environments be designed to promote inclusivity and accessibility for diverse student populations in higher education?

4.0 Materials and Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework is a widely recognized standard that ensures transparency, consistency, and thoroughness in SLRs (Page et al., 2021). The PRISMA was adopted to ensure methodological transparency, reproducibility, and comprehensive data synthesis. This approach was appropriate for identifying patterns across fragmented VR education research. Furthermore, it enhances the accuracy of reviews by systematically identifying, screening, and selecting studies while prioritizing randomized studies to minimize bias and strengthen the evidence. This study utilizes Web of Science (WoS) and Scopus, two extensive databases covering a diverse range of disciplines. Concurrently, PRISMA follows four key stages: identification, screening, qualification, and data abstraction. In the identification phase, relevant studies are gathered from databases. The flow of the process is visualized in Figure 1. The screening phase filters out studies that do not meet predefined criteria. During qualification, the remaining studies are assessed to ensure they meet the inclusion standards. Finally, in data abstraction, essential information is extracted and synthesized to support meaningful conclusions. This structured approach ensures a rigorous and reliable review process, providing valuable insights that contribute to research and practical applications.

4.1 Identification

This study relies on a crucial phase in the SLR process to collect a crucial amount of relevant literature. The initial step is to select words or keywords that will be used to generate related terms utilizing dictionaries, thesauri, encyclopedias, as well as previous research. As provided in Table 1, all pertinent phrases were identified for which search strings were developed for the WoS and Scopus databases. From these two databases, the first phase of this systematic review resulted in 35 publications relevant to the study topic.

Table 1. The search string

	TITLE-ABS-KEY (“immersive learning” AND “virtual reality” AND engagement) AND (LIMIT-TO (DOCTYPE, “ar”)) AND

Scopus	(LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2023) OR LIMIT-TO (PUBYEAR, 2024)) Date of Access: January 2025
WoS	"immersive learning" AND "virtual reality" AND engagement (Topic) and 2024 or 2023 or 2022 or 2021 or 2020 (Publication Years) and Article (Document Types) and English (Languages) Date of Access: January 2025

4.2 Screening

During the screening process, potentially relevant research articles are evaluated to ensure they support the defined research topic or question. During this phase, deep learning-based VR will be employed for research subject selection. Duplicate documents will be excluded at this stage. Following the initial rejection of 128 articles, 111 papers were retained for further screening by adhering to specific inclusion and exclusion criteria (see Table 2). As literature serves as the main source of practical guidance, it is considered the primary criterion. Book reviews, book series, meta-syntheses, meta-analyses, conference proceedings, and chapters omitted from recent studies will all fall into this category. The review is restricted to English-language sources published between 2020 and 2024. Ultimately, 30 publications were excluded due to duplication.

Table 2. The searching selection criterion

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2020 – 2024	< 2020
Literature type	Journal (Article)	Book, Conference, Review
Publication Stage	Final	In Press

4.3 Eligibility

In the third step, referred to as the eligibility phase, 81 articles were made available for evaluation. During this phase, the titles and main content of all articles were thoroughly assessed to verify they hold the inclusion criteria as well as meet the present research objectives. Subsequently, 46 articles were excluded due to reasons such as being out of scope, having irrelevant titles, containing abstracts that were not relevant to the study goals, or lacking full-text access, thereby relying on empirical evidence. This resulted in a total of 35 articles for further review.

4.4 Data Abstraction and Analysis

The evaluation strategy under this study employed an integrative analysis to examine and merge research designs that relied on quantitative methods. Data collection was asserted as an essential first step to develop themes during the identification of relevant topics and subtopics. Accordingly, the authors analyzed 35 selected publications, as presented in Table 3, for in-depth examination of all research-relevant statements and materials. The authors assessed notable studies on deep learning in Malaysia through a review of their methodologies, along with their research findings. The authors collaborated with their co-authors to develop a set of themes from the evidence they gathered within the study boundaries. During data interpretation, the team wrote entries into a log, which included notes about their analyses while also recording their views and overseeing challenges, in addition to raising reflections. Notably, a thorough comparison of the analysis determined any inconsistencies that might have occurred in the theme development method. At the same time, the authors resolved conceptual disagreements through collective discussions when they arose.

Table 3. Number and details of primary studies

No	Authors	Year	Journal	SCOPUS	WOS
1	Yong and Thi (2022)	2022	Malaysian Journal Of Learning And Instruction	/	
2	Hashim, Mohamed, Aziz, and Abd Patah (2022)	2022	Journal Of Technical Education And Training	/	/
3	Gunasekara, Turner, Fung, and Stough (2022)	2022	Australasian Journal Of Educational Technology	/	/
4	Keoy et al. 92024)	2024	Journal Of Information And Knowledge Management	/	/
5	Razak, Noordin, and Khanan (2022)	2022	Journal Of Technical Education And Training	/	/
6	Law (2024)	2024	Journal Of Applied Research In Higher Education	/	/
7	Ahmad, Ismail, and Husain (2022)	2022	International Journal Of Public Health Science	/	/
8	Yamin et al. (2023)	2023	Journal Of Advanced Research In Applied Sciences And Engineering Technology	/	/
9	Aziz (2023)	2023	Journal Of Logistics, Informatics And Service Science	/	
10	Swe and Bhardwaj (2023)	2023	Asia Pacific Scholar	/	/
11	Selvanathan, Velloo, Varughese, and Jeevanantham (2023)	2023	Teaching Public Administration	/	/
12	Wong et al. (2022)	2022	Knowledge Management And E-Learning	/	/
13	Abuhassna et al. (2022)	2022	Contemporary Educational Technology	/	/
14	Ramasamy, Shahzad, and Hassan (2023)	2023	Journal Of Education	/	
15	Mohamed Zabri, Mohammad Abakar, and Ahmad (2023)	2023	Cogent Education	/	/
16	Awee, Mohsin, and Yong (2022)	2022	Asia Pacific Journal Of Educators And Education	/	

17	Ramdan et al. (2024)	2024	European Journal Of Educational Research	/	/
18	Jafar et al. (2023)	2023	International Journal Of Environmental Research And Public Health	/	
19	Radzuan, Fauzi, Zahari, and Ramli (2023)	2023	3l: Language, Linguistics, Literature	/	
20	Ali et al. (2024)	2024	International Review Of Education	/	
21	Ramis and Cheong (2024)	2024	International Journal Of Education And Practice	/	/
22	Selvakumar and Zhui (2023)	2023	Biomedicine (India)	/	/
23	Tee et al. (2022)	2022	Frontiers In Psychology	/	
24	Abdullah, Saw Fen, Samsudin, Tze Ying, and Chorng Yuan (2024)	2024	Sage Open	/	
25	Crosling, Lee, Passey, and Azizan (2023)	2023	Journal Of Educators Online	/	/
26	Yap and Tan (2022)	2022	Education For Chemical Engineers	/	/
27	Looi, Wye, and Abdul Bahri (2022)	2022	Sustainability (Switzerland)	/	/
28	Gao, Wong, Khambari, Noordin, and Geng (2022)	2022	Sustainability (Switzerland)	/	/
29	Hock and Ayub (2024)	2024	Asian Journal Of University Education	/	/
30	Muthuraman and Abdullah (2022)	2022	Journal Of Institutional Research South East Asia	/	
31	Tuameh and Johari (2023)	2023	Journal Of Commercial Biotechnology	/	
32	Looi (2022)	2022	International Journal Of Information And Learning Technology	/	/
33	Chan (2024)	2024	International Journal Of Mobile Learning And Organisation	/	
34	Sharma and Sharma (2021)	2021	Bulletin Of The Technical Committee On Learning Technology	/	
35	Artyukhov, Volk, Dluhopolskyi, Mieszajkina, and Myśliwiecka (2023)	2023	Sustainability	/	

database

5.0 Quality of Appraisal

Following Keele's (2007) guidelines, once primary studies are selected, referring to original research articles or documents included in a systematic review after initial screening, they undergo Quality Assessment (QA) to ensure their relevance and reliability. These primary studies serve as key sources of evidence and are analyzed using qualitative or quantitative methods to address the review's research objectives. In this study, the QA method proposed by Abouzahra, Sabraoui, and Afdel (2020) was applied, which encompasses six evaluation criteria for SLRs. The assessment process involved a scoring system with three possible ratings: "Yes" (Y) with a score of 1 for fully meeting the criterion, "Partially" (P) with a score of 0.5 if the criterion was somewhat met but had gaps, and "No" (N) with a score of 0 if the criterion was not met.

1. QA1: Is the study's objective explicitly defined?
2. QA2: Is the significance and relevance of the research clearly articulated?
3. QA3: Is the research methodology well-documented and transparent?
4. QA4: Are the key concepts and framework of the approach clearly explained?
5. QA5: Is the study evaluated in comparison to similar research?
6. QA6: Are the limitations of the study explicitly acknowledged?

The table presents a QA process used to evaluate a study according to specific criteria. Three experts review the study based on these criteria, scoring each one as "Yes" (Y), "Partly" (P), or "No" (N). The following is a detailed explanation:

1. Is the study's objective explicitly defined?
   This criterion assesses whether the objectives of the present study are clearly expressed and effectively communicated. A clearly stated purpose establishes the research direction as well as the research scope.
2. Is the significance and relevance of the research clearly articulated?
   This criterion assesses whether the significance and possible contributions are clearly articulated, emphasizing their relevance and impact.
3. Is the research methodology well-documented and transparent? This criterion assesses whether the research methodology is clearly articulated and suitable for achieving the objectives. A well-articulated methodology is essential for ensuring the study's validity as well as reproducibility.
4. Are the key concepts and framework of the approach clearly explained?
   This criterion evaluates whether the theoretical framework and main concepts are clearly defined and well-articulated, ensuring a comprehensive understanding of the approach.
5. Is the study evaluated in comparison to similar research? This criterion assesses whether the study has been compared to existing research. Benchmarking against prior studies situates the work in the wider academic context as well as focuses its contributions.
6. Are the limitations of the study explicitly acknowledged?
   The experts individually review the study while using these criteria, then combine their individual scores to generate the final evaluation. The study can advance to the following stage only when total scores from all three evaluators combine to exceed level 3.0. A specified threshold guarantees that studies with sufficient quality standards will proceed.

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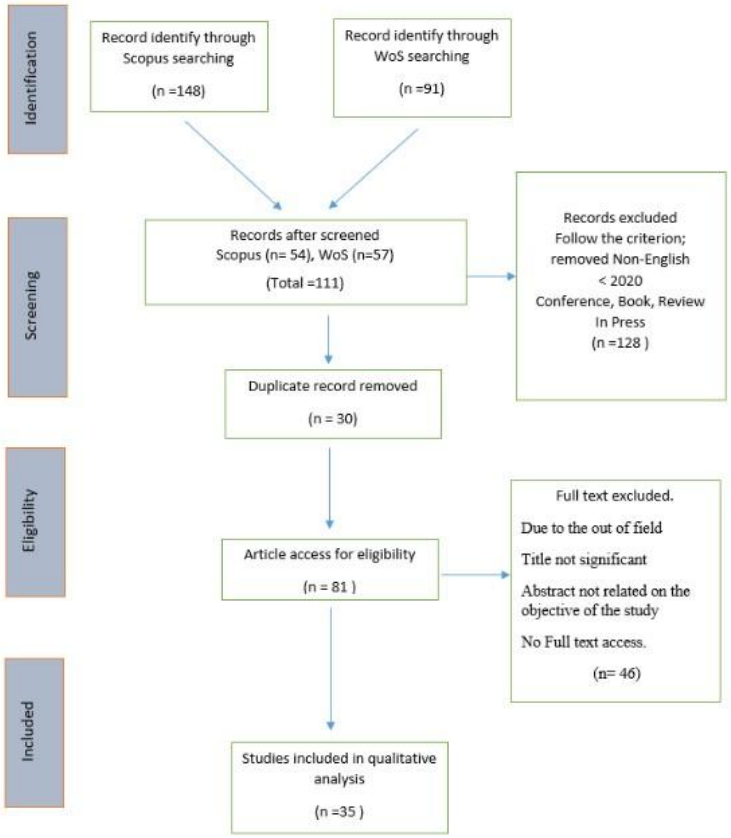

Fig. 1: Flow diagram of the proposed search study (Moher *et al.*, 2009)

6.0 Results

Background of the selected study: Table 4 outlines the QA results of the selected primary studies.

Based on the QA of 35 selected studies (PS1 to PS35), the integrity of VR research within immersive learning settings is evaluated. In particular, the research articles PS9, PS14, and PS16 received top scores under QA1 since they established their research goals effectively, though other studies received lower scores due to ambiguity. Meanwhile, PS8, together with PS19, presented efficient results in QA2 since they assessed how VR changes student motivation and engagement patterns. In addition, QA3 of PS3 and PS30 obtained high assessment scores since their systematic methodology enabled replication and reliability verification. Similarly, studies PS12 and PS21 achieved better QA4 results since they selected clear theoretical concepts, while research with weak conceptual definitions performed worse.

The assessment highlighted the critical significance of analyzing relative data while acknowledging research constraints. Notably, studies PS5 and PS29, which implemented structured research comparison, scored well in QA5, whereas various other cases failed to provide this benchmarking. At the same time, studies PS10 and PS27 demonstrated strong performance in QA6 by clearly stating their project boundaries, including issues with sample counts and technology limitations. Moreover, research that omitted information regarding study restrictions received lower grades. In essence, the development of high-quality research on immersive learning based on VR requires precise objectives and robust methodologies, alongside theoretical integrity and standardized comparisons between studies, as well as strict transparency measures.

A team of three independent experts applied six QA criteria to conduct consistent and objective assessments of the research. All discrepancies during assessment were addressed by expert consensus meetings until a third-party specialist delivered an impartial decision to finalize scores. The designated assessment system successfully reduced human error as well as personal judgment. The

methodology by Abouzahra et al. (2020) comprises three major weaknesses due to the exclusion of study sample sizes alongside ethical considerations through equal weighting of criteria across the board. Accordingly, the framework could be improved through additional quality indicators, together with weighted assessment for significant factors and standardized evaluation templates to make performance more effective.

Below is the quality evaluation table for the selected studies:

Table 4. Please refer to the list of primary studies in Table 3

Article	QA1 (1/0.5/0)	QA2 (1/0.5/0)	QA3 (1/0.5/0)	QA4 (1/0.5/0)	QA5 (1/0.5/0)	QA6 (1/0.5/0)	Total Mark	Percentage (%)
PS1	1	1	1	0.5	0	0.5	4.0	66.67%
PS2	1	1	1	0.5	0.5	0	3.5	58%
PS3	1	1	1	1	1	0.5	5	83%
PS4	1	1	1	1	0.5	0.5	4	67%
PS5	1	1	1	1	1	0.5	5	83%
PS6	1	0.5	1	1	0.5	1	5	83%
PS7	1	1	1	0.5	1	0.5	5.5	92%
PS8	1	1	1	0.5	1	1	6	100%
PS9	1	1	1	1	1	1	6	100%
PS10	1	0.5	1	1	1	1	5.5	92%
PS11	1	1	0.5	1	0.5	0.5	4.5	75%
PS12	1	1	1	1	0.5	0.5	5	83.33%
PS13	1	1	1	1	1	0.5	5.5	91.67%
PS14	1	1	1	1	1	1	6	100%
PS15	1	1	1	1	0.5	0.5	5	83.33%
PS16	1	1	1	1	1	1	6	100%
PS17	1	0.5	1	0.5	0.5	0.5	4.5	75%
PS18	1	1	1	1	1	0.5	6	100%
PS19	1	1	1	1	1	1	6	100%
PS20	1	0.5	1	0.5	0.5	0.5	4.5	75%
PS21	1	1	1	1	0.5	1	6	100%
PS22	1	1	1	1	1	1	6	100%
PS23	1	1	1	1	1	1	6	100%
PS24	1	1	1	1	1	1	6	100%
PS25	1	0.5	0.5	1	0.5	0.5	3.5	58%
PS26	1	1	1	1	1	1	6	100%
PS27	1	1	1	0.5	1	1	5.5	91.67%
PS28	1	1	0.5	0.5	0.5	1	4.5	75%
PS29	1	1	1	1	0.5	0.5	5.5	91.67%
PS30	1	1	1	1	1	1	6	100%
PS31	1	1	1	1	0.5	1	5.5	91.67
PS32	1	1	1	1	0.5	0	4.5	75%
PS33	1	1	1	1	1	0	5	83.33%
PS34	1	1	0.5	0.5	1	1	4	66.67%
PS35	1	1	1	1	1	0.5	4.5	75%

Note:
The scoring procedure is structured as follows:
- "Yes" (Y) = 1 point (if the criterion is fully met),
- "Partly" (P) = 0.5 points (if the criterion is somewhat met but with gaps),
- "No" (N) = 0 points (if the criterion is not met).

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In particular, the improvement of engagement benefits the goal of determining the key factors that facilitate the success of immersive VR learning. Simultaneously, the focus on design also contributes to achieving the goal of understanding the influence of instructional and technological factors on the learning process. This clear linkage of these results to the objectives stated will allow the study to better demonstrate how each finding moves towards addressing the main RQs and towards the development of the overall research objective. Furthermore, the research collaborated to improve the themes in order to achieve thematic coherence. Notably, collaboration between the author and co-author established the selection and accuracy validation of themes for confirming the proper identification of issues. Each subtheme underwent the expert review process to verify its clear relevance and applicability before domain appropriateness was confirmed for the study. Subsequently, the authors examined their findings through mutual discussion to ensure they could address variations in theme interpretations. Any inconsistencies led the participants to have direct discussions until they reached an agreement. In addition, ending procedures were applied to each theme to maximize consistency across all aspects. Both oncologists and biomedical science experts performed additional examinations to validate the recognized issues. Each subtheme received expert confirmation of domain validity through their review, which confirmed their focus and applicability as well as their complete coverage. Consistent with this, the author also modified certain aspects of the design after consulting experts who provided their input.

6.1 Immersive Learning for Discipline-Specific Education

Immersive Virtual Reality (IVR) is gaining recognition as an effective educational tool in higher education, significantly enhancing student engagement, comprehension, and motivation across multiple disciplines. Studies have demonstrated its impact in medical education, where tools such as the Immersive Virtual Anatomy Laboratory (IVAL) enable students to explore 3D anatomical structures, improving retention and participation (Kadri et al., 2024). Likewise, VR-based streaming of surgical procedures provides a more profound

understanding of workflows, addressing the limitations of traditional instructional methods. Furthermore, IVR has proven beneficial in fostering creative and linguistic skills. For instance, spherical video-based VR has been reported to boost engagement, creativity, and writing performance in Chinese composition (Chen et al., 2022), while it has also been proven to enhance intrinsic motivation in teaching design history (Gill et al., 2024). Collectively, these studies highlight IVR's versatility and its capacity to support active learning, sustained engagement, and improved academic performance across various educational settings.

6.2 Design and Development of Immersive Learning Experiences

Immersive learning experiences, particularly those involving VR, highlight essential themes of engagement, motivation, and the creation of effective learning environments. Research demonstrates VR's ability to deepen engagement through interactive features and realistic simulations. For instance, Rogers and Alexander (2022) explained their study on the implementation of Experience Application Programming Interface (xAPI) to reflect engagement metrics to justify the use of VR-based learning. By enabling teamwork in shared VR spaces, these platforms facilitate collective problem-solving and experiential learning. Furthermore, the integration of presence and multimedia allows VR to blend real and virtual contexts, enhancing the application of knowledge in practical settings (Liu et al., 2024). Together, these findings highlight the significance of creating VR experiences that prioritize user diversity, collaboration, and engagement to fully harness the potential of immersive learning environments.

6.3 Engagement, Inclusivity, and Broader Applications in Immersive Learning

Virtual Reality (VR) as a method of immersive learning has demonstrated a great possibility in terms of engagement, inclusion, and overall learning outcomes of students. It is spatially aware and active, and this feature enhances the learning process in a great way (Figueroa Jr., 2023). VR is also helpful in fostering the culture across different cultures through diminishing the stereotypes and increasing thinking or cognitive abilities of the different learners (Shadiev et al., 2024). VR has the benefit of providing a personalized and strengths-based learning environment of a marginalized population, such as autistic students. Altogether, these results emphasize the evident potential of VR in reducing education gaps and offering captivating, inclusive education. Nevertheless, a more philosophical interconnection of the study, especially with Constructivist Learning Theory, and Cognitive Load Theory, could use additional reinforcement of its academic soundness. Additionally, it would be interesting to speculate on the wider implications, e.g. guiding policy, curriculum development, and teacher training to give a more detailed picture of the place of VR in education.

7.0 Discussion

IVR has emerged as a valuable tool in education, offering improved engagement, understanding, and hands-on learning across various disciplines. In medical education, tools such as IVAL and live-streamed surgeries enable students to interact with 3D anatomical structures and observe real-time procedures, enhancing knowledge retention and comprehension. Similar applications in biochemistry and fire safety training have demonstrated effectiveness in developing procedural skills and boosting motivation. However, these benefits are less evident when it comes to teaching abstract or theoretical concepts, highlighting the need for better instructional design that considers cognitive load. Beyond science-based fields, IVR also supports creativity and language development. Notably, studies in primary education report improved student engagement, creative thinking, and writing skills, while its use in subjects like design history and biology further demonstrates its flexibility in promoting active learning. These findings suggest that IVR can serve a wide range of educational goals when thoughtfully integrated into teaching practices. Despite its strengths, this study has limitations. It is based on a systematic review of literature published between 2020 and 2024, written in English, which may have excluded other relevant research. The findings rely solely on secondary data, without any empirical testing or primary research. Additionally, while the study identifies key factors that support immersive learning, it does not examine how these factors perform across different learning environments, which limits the ability to generalize its conclusions. These limitations suggest that future research should include real-world testing, broader language inclusion, and comparisons across multiple fields to better understand the full potential of IVR in education. Overall, IVR presents strong potential to transform learning by offering immersive, engaging, and effective experiences, but its success depends on thoughtful design and ongoing research.

8.0 Conclusion

In conclusion, this paper can play a role in supporting the emerging body of literature on immersive learning as it focuses on the effectiveness of VR in education at the higher-education level by considering its major determinants. It employs the PRISMA approach to conduct a systematic review of 27 studies published between 2020 and 2024, identifying aspects such as the design of VR, models of teaching, learner traits, and cognitive load management as critical to the effectiveness of VR learning. In addition, one of the main contributions is placing importance on the idea of designing VR with a focus on cognitive load to ensure that immersive experiences promote rather than inhibit learning. With the use of Cognitive Load Theory, the paper can provide practical information on how to design VR environments that minimize mental effort, facilitating better understanding and memorization. The study also underscores the issue of appropriate educator preparation that should guarantee that the teachers will be able to use immersive tools without hesitation. Most teachers might struggle to operate VR without proper assistance. Another issue in the research is the consideration of aligning the implementation of VR with curriculum objectives, since students may utilize VR due to its appeal, rather than as a step to achieve some purposeful goals of learning. Overall, the study fills the gap between the theoretical knowledge and the applied experience, and provides

guidance to teachers, curriculum designers, and policymakers in the meaningful implementation of VR in the context of higher education to achieve better results in teaching and learning. Correspondingly, future research should validate the findings in applied educational settings, explore adaptive and personalized VR learning, and assess the long-term impact of immersive technologies on student performance.

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Paper Contribution to Related Field of Study
The study has useful recommendations that can be used by educators, program developers, and policymakers to enhance the design, applicability, and success of VR-based education in higher learning institutions.

References

Abdullah, M. N. L. Y., Saw Fen, T., Samsudin, M. A., Tze Ying, S., & Chorng Yuan, F. (2024). Factors Influencing Undergraduate Students' Online Learning Outcomes: A Structural Equation Modeling. *Sage Open*, *14*(2), 1–14.

Abouzahra, A., Sabraoui, A., & Afdel, K. (2020). Model composition in Model Driven Engineering: A systematic literature review. *Information and Software Technology*, *125*, 1–18.

Abuhassna, H., Busalim, A. H., Mamman, B., Yahaya, N., Zakaria, M. A. Z. M., Al-Maatouk, Q., & Awae, F. (2022). From Student's Experience: Does E-learning Course Structure Influenced by learner's Prior Experience, Background Knowledge, Autonomy, and Dialogue. *Contemporary Educational Technology*, *14*(1), 1–23.

Ahmad, N. S., Ismail, A., & Husain, Z. (2022). Psychological well-being impacts among university students on online learning during the COVID-19 pandemic. *International Journal of Public Health Science*, *11*(3), 1037–1045.

AlGerafi, M. A. M., Zhou, Y., Oubibi, M., & Wijaya, T. T. (2023). Unlocking the potential: A comprehensive evaluation of augmented reality and virtual reality in education. *Electronics*, *12*(18), 1–29.

Ali, N. S. M., Fauzi, M. A., Saidin, N., Nor, N. R. M., Ismail, N. F. S., & Aling, N. A. (2024). Adoption of e-learning by pre-university students following the COVID-19 pandemic: An analysis based on the unified theory of acceptance and use of technology (UTAUT). *International Review of Education*, *70*(3), 453–475.

Artyukhov, A., Volk, I., Dluhopolskyi, O., Mieszajkina, E., & Myśliwiecka, A. (2023). Immersive University Model: A Tool to Increase Higher Education Competitiveness. *Sustainability*, *15*(10), 1–16.

Awee, A., Mohsin, F. H., & Yong, K. T. (2022). Students' adaptability on unexpected transition to online learning during COVID-19 pandemic: The role of self regulation learning and self efficacy. *Asia Pacific Journal of Educators and Education*, *37*(1), 19–45.

Aziz, K. A. (2023). Social Media Natives and Online Learning: A Longitudinal Study across the COVID-19 Lockdowns in Malaysia. *Journal of Logistics, Informatics and Service Science*, *10*(1), 141–168.

Chan, V. (2024). Investigating students' perceptions of the use of a multifunctional mobile-based virtual reality application for English/Chinese interpreting learning. *International Journal of Mobile Learning and Organisation*, *18*(3), 304–322.

Chen, Y., Li, M., Huang, C., Han, Z., Hwang, G., & Yang, G. (2022). Promoting deep writing with immersive technologies: An SVVR-supported Chinese composition writing approach for primary schools. *British Journal of Educational Technology*, *53*(6), 2071–2091.

Crosling, G., Lee, A. S. H., Passey, D., & Azizan, S. N. (2023). A Study of the Use of Blended Learning/Online Learning Tools in a Higher Education Institution in an ASEAN Country. *Journal of Educators Online*, *20*(3), 1–17.

Dengel, A., & Mazdefrau, J. (2018). Immersive learning explored: Subjective and objective factors influencing learning outcomes in immersive educational virtual environments. *Proceedings of 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering, TALE 2018*, 608–615. IEEE.

Dengel, A., & Mazdefrau, J. (2019). Presence Is the Key to Understanding Immersive Learning. *Communications in Computer and Information Science*, *1044*, 185–198. Springer.

Figueroa Jr, R. B. (2023). Immersive capability and spatial presence in virtual reality photo-based tours: implications for distance education. *Asian Association of Open Universities Journal*, *18*(3), 201–217

Huang, W., Roscoe, R., Craig, S., & Johnson-Glenberg, M. (2021). Extending the Cognitive-Affective Theory of Learning with Media in Virtual Reality Learning: A Structural Equation Modeling Approach. *Journal of Educational Computing Research*, 60, 807 - 842. https://doi.org/10.1177/07356331211053630

Jafar, A., Dollah, R., Mittal, P., Idris, A., Kim, J. E., Abdullah, M. S., … Zakaria, N. S. (2023). Readiness and challenges of e-learning during the COVID-19 pandemic era: A space analysis in Peninsular Malaysia. *International Journal of Environmental Research and Public Health*,*20*(2), 1–15.

Kadri, M., Boubakri, F.-E., Kaghat, F.-Z., Azough, A., & Zidani, K. A. (2024). IVAL: Immersive Virtual Anatomy Laboratory for enhancing medical education based on virtual reality and serious games, design, implementation, and evaluation. *Entertainment Computing*, *49*, 1–12.

Keele, S. (2007). *Guidelines for performing systematic literature reviews in software engineering*. Kitchenham.

Keoy, K. H., Koh, Y. J., Iqbal, J., Anjum, S. S., Yeo, S. F., Cherukuri, A. K., … Piut, D. A. A. (2024). Streamlining micro-credentials implementation in higher education institutions: Considerations for effective implementation and policy development. *Journal of Information & Knowledge Management*, *23*(1), 1–30.

Kersting, M., Steier, R., & Venville, G. (2021). Exploring participant engagement during an astrophysics virtual reality experience at a science festival. *International Journal of Science Education, Part B*, *11*(1), 17–34.

Kim, J., Kim, K., & Kim, W. (2022). Impact of immersive virtual reality content using 360-degree videos in undergraduate education. *IEEE Transactions on Learning Technologies*, *15*(1), 137–149.

Law, M. Y. (2024). Leadership and change management in the transition to online curriculum delivery in Malaysia: a comparative case study. *Journal of Applied Research in Higher Education*, *16*(4), 1146–1159.

Liu, J., Liu, Q., Yu, S., Ma, J., Liu, M., & Wu, L. (2024). How do autonomy and learner characteristics combine to influence learners' learning outcomes and cognitive load in virtual reality learning environments? A fuzzy-set qualitative comparative analysis approach. *Education and Information Technologies*, *29*(1), 77–101.

Looi, K. H. (2022). Overcoming challenges to make e-learning a panacea for present and future crises. *The International Journal of Information and Learning Technology*, *39*(3), 227–239.

Looi, K. H., Wye, C.-K., & Abdul Bahri, E. N. (2022). Achieving learning outcomes of emergency remote learning to sustain higher education during crises: an empirical study of Malaysian undergraduates. *Sustainability*, *14*(3), 1–13.

Lockwood. C, Z. Munn, and K. Porritt, "Qualitative research synthesis: Methodological guidance for systematic reviewers utilizing meta-aggregation," *Int. J. Evid. Based. Healthc*., vol. 13, no. 3, pp. 179–187, 2015, doi: 10.1097/XEB.0000000000000062.

Makransky, G., Terkildsen, T. S., & Mayer, R. E. (2019). Adding immersive virtual reality to a science lab simulation causes more presence but less learning. *Learning and Instruction*, *60*, 225–236.

Makransky, G., & Petersen, G. (2021). The Cognitive Affective Model of Immersive Learning (CAMIL): a Theoretical Research-Based Model of Learning in Immersive Virtual Reality. *Educational Psychology Review*, 33, 937-958. https://doi.org/10.1007/s10648-020-09586-2

Mohamed Zabri, S., Mohammad Abakar, Y., & Ahmad, K. (2023). Exploring the acceptance of online learning among students in technical and non-technical programmes at a higher education institution. *Cogent Education*, *10*(2), 1–17.
Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*, *6*(7), 1–6.

Muthuraman, A. A., & Abdullah, S. (2022). Perceived satisfaction towards emergency remote teaching amidst Covid-19 crisis: a case among undergraduate students in Penang, Malaysia. *Journal of Institutional Research South East Asia*, *20*(1), 76–103.

Page, M. J., McKenzie, J. E., Bossuyt, P., Boutron, I., Hoffmann, T. C., Mulrow, C. D., … Moher, D. (2021). The prisma 2020 statement: An updated guideline for reporting systematic reviews. *Medicina Fluminensis*, *57*(4), 444–465.

Prakash, A., Haque, A., Islam, F., & Sonal, D. (2023). Exploring the potential of metaverse for higher education: Opportunities, challenges, and implications. *Metaverse Basic and Applied Research*, *2*(40), 1–11. https://doi.org/10.56294/mr202340

Radzuan, N. R. M., Fauzi, W. J., Zahari, H., & Ramli, M. (2023). Tertiary students perceptions of learning oral presentation skills in in-class and online learning environment: A case study. *3L: Language, Linguistics, Literature*, *29*(1), 169–183.

Ramasamy, S. P., Shahzad, A., & Hassan, R. (2023). COVID-19 Pandemic Impact on Students Intention to Use E-Learning Among Malaysian Higher Education Institutions. *Journal of Education*, *203*(3), 596–604.

Ramdan, M. R., Abdullah, N. L., Ngah, N. S., Yin, K. Y., Fuad, D. R. S. M., Yonus, A., & Shokory, S. M. (2024). An Integrated Framework of Online Learning Effectiveness in Institutions of Higher Learning. *European Journal of Educational Research*, *13*(3), 1321–1333.

Ramis, T., & Cheong, L. S. (2024). Mediating effect of psychological needs satisfaction on the relationship between presence and academic motivation during online learning. *International Journal of Education and Practice*, *12*(1), 66–81.

Razak, A. N. A., Noordin, M. K., & Khanan, M. F. A. (2022). Digital learning in technical and vocational education and training (TVET) in public university, Malaysia. *Journal of Technical Education and Training*, *14*(3), 49–59.

Rogers, J. W., & Alexander, K. (2022). Standards and affordances of 21st-century digital learning: Using the Experience Application Programming Interface and the Augmented Reality Learning Experience Model to track engagement in extended reality. *Acta IMEKO*, *11*(3), 1–6.

Selvakumar, K., & Zhui, M. W. P. (2023). Prevalence of tension-type headache and its correlation with sleep quality among physiotherapy and nursing students from higher education institutions in Klang valley, Malaysia, during the COVID-19 pandemic. *Biomedicine*, *43*(2), 638–643. https://doi.org/10.51248/.v43i02.2440

Selvanathan, M., Velloo, P., Varughese, S., & Jeevanantham, M. (2023). Student satisfaction on lecturers' effectiveness, efficiency and productivity: Malaysian education landscape during the COVID-19 pandemic. *Teaching Public Administration*, *41*(1), 108–121.

Shadiev, R., Chen, X., Reynolds, B. L., Song, Y., & Altinay, F. (2024). Facilitating cognitive development and addressing stereotypes with a cross-cultural learning activity supported by interactive 360-degree video technology. *British Journal of Educational Technology*, *55*(6), 2668–2696.

Sharma, R. C., & Sharma, Y. P. (2021). Designing virtual reality experiences in education. *Article in Bulletin of the Technical Committee on Learning Technology*, *21*(1), 2306–0212.

Sunardi, Meyliana, Ramadhan, A., & Rosmansyah, Y. (2023). Critical Factors of Immersive Learning in Higher Education: A Systematic Literature Review. *2023 10th International Conference on ICT for Smart Society*, 1–8. IEEE.

Swe, K. M. M., & Bhardwaj, A. (2023). Perceptions of clinical year medical students on online learning environments during the COVID-19 pandemic. *Asia Pacific Scholar*, *8*(1), 47–50.

Tee, M., Rasli, A., Toh, J. S. S. K., Abas, I. H., Zhou, F., & Liew, C. S. (2022). A Delphi method on the positive impact of COVID-19 on higher education institutions: Perceptions of academics from Malaysia. *Frontiers in Psychology*, *13*, 1–10.

Tuameh, A., & Johari, J. (2023). Does the Adoption of Innovative Teaching Approaches Improve the Performance of Biotechnology Educators? Evidence from Malaysian Higher Educational Institutes. *Journal of Commercial Biotechnology*, *28*(1), 164–176.

Wang, H., & Sun, J. (2021). Real-time virtual reality co-creation: collective intelligence and consciousness for student engagement and focused attention within online communities. *Interactive Learning Environments*, 31, 3422 - 3435. https://doi.org/10.1080/10494820.2021.1928711

Wong, P. P. Y., Wong, G. W. C., Techanamurthy, U., Mohamad, W. S. B., Febriana, A., & Chong, J. C. M. (2022). Using social mobile learning to stimulate idea generation for collective intelligence among higher education students. *Knowledge Management and E-Learning*, *14*(2), 150–169.

Yamin, F. M., Mustafar, M., Mohamad, M., David, J., Ramli, M. F., Saad, S., & Nawaz, S. S. (2023). Students' Acceptance of Technological Devices for E-Learning During Covid-19 Pandemic in Malaysian Higher Education. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *33*(1), 1–9.

Yap, J. S., & Tan, J. (2022). Lifelong learning competencies among chemical engineering students at Monash University Malaysia during the COVID-19 pandemic. *Education for Chemical Engineers*, *38*, 60–69.

Ye, Q., Zhou, R., Anwar, M. A., Siddiquei, A. N., Hussain, S., & Asmi, F. (2022). Virtual reality-based learning through the lens of eudaemonic factors: Reflective thinking as a game changer. *Thinking Skills and Creativity*, *45*, 1–16.

Yong, S. M., & Thi, L. S. (2022). Online learning motivation during Covid-19 pandemic: The role of learning environment, student self-efficacy and learner-instructor interaction. *Malaysian Journal of Learning and Instruction*, *19*(2), 213–249.