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RESEARCH ARTICLE

The Role of Augmented Reality in Interactive Mobile Learning: Current Trends and Future Directions

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Abstract

The rapid growth of digital technology has redefined education by transforming how knowledge is accessed, constructed, and experienced. This study investigates the role of augmented reality (AR) in mobile learning as a catalyst for interactive, experiential, and learner-centered education. Using a qualitative descriptive approach, it synthesizes findings from recent peer-reviewed studies published between 2021 and 2024 to identify trends, challenges, and pedagogical implications of AR integration in mobile environments. The results reveal four dominant dimensions shaping current AR-based learning: technological development, pedagogical adaptation, learner engagement, and institutional readiness. AR enhances motivation, spatial reasoning, and conceptual understanding by merging real-world contexts with virtual content. However, the study also highlights persistent barriers, including uneven infrastructure, insufficient teacher preparation, and the absence of cohesive instructional frameworks. Meaningful AR adoption requires alignment between technology, pedagogy, and learner psychology—an equilibrium consistent with the Technological Pedagogical Content Knowledge (TPACK) model. The research concludes that AR's transformative potential lies not in its novelty but in its capacity to foster inquiry, reflection, and collaboration. Future work should emphasize longitudinal studies, cross-disciplinary collaboration, and equitable policy development to ensure that AR evolves into a sustainable and inclusive component of digital education.

Keywords
Augmented Reality; Mobile Learning; Pedagogy; Digital Inclusion; Educational Innovation.

1 | INTRODUCTION

The acceleration of digital technology has profoundly redefined education, influencing how individuals access, construct, and engage with knowledge. The global shift from classroom-based instruction to digital and mobile learning environments marks a fundamental transformation in which technology acts not merely as a supplementary medium but as a key enabler of pedagogical innovation (Najjar & Oktasari, 2023; Nasution & Uqba, 2024). Within this transformation, mobile learning has emerged as a dynamic educational approach that supports flexibility, learner autonomy, and ubiquitous access to resources. Among the emerging innovations, augmented reality (AR) has gained increasing attention for its capability to integrate virtual elements with real-world environments in real time, producing interactive and immersive learning experiences (Kurdi, 2021; Zhang *et al.*, 2022; Huang *et al.*, 2022). When applied through mobile devices such as smartphones or tablets, AR enables learners to manipulate three-dimensional objects, visualize abstract processes, and interact with contextualized digital content that bridges theoretical and practical understanding (Nikou, 2024; He *et al*., 2024). This technological affordance aligns with experiential learning theory, which views knowledge as the outcome of active participation, reflection, and iterative experience (Santos *et al*., 2023). Integrating AR into mobile learning thus reinforces learners' conceptual understanding, engagement, and retention by connecting sensory interaction with cognitive processing (Rojabi, 2023; Alhebaishi, 2024).

Empirical studies affirm that AR has the potential to enhance motivation, engagement, and achievement across various disciplines, including science, geography, and engineering (Aini, 2024; Schmidt & Stumpe, 2025; Rahman & Taufiq, 2023). Research by Bower *et al*. (2022) and Arici *et al*. (2022) indicates that when AR is incorporated within inquiry-based and collaborative learning, it strengthens both cognitive and affective learning dimensions. Similarly, Li *et al*. (2024) highlight that AR promotes higher-order thinking through visualization and active manipulation of information, while Al-Huneidi and Schreurs (2023) emphasize that teachers with sufficient digital-pedagogical literacy are more capable of utilizing AR to support meaningful instruction. Despite these advantages, challenges persist. Limitations in infrastructure, insufficient institutional support, and varying levels of teacher readiness remain significant barriers to sustainable AR adoption (Najjar & Oktasari, 2023; Nasution & Uqba, 2024; Joo *et al*., 2023). Moreover, the absence of structured instructional design often results in fragmented implementation, where AR is treated as a novelty rather than an integral pedagogical component (Wu *et al*., 2022; Cheng & Tsai, 2023). This issue underscores the need for cohesive frameworks that align technological integration with sound pedagogical practice, as suggested by Martín-Gutiérrez *et al*. (2023) and Wang and Chen (2022). When grounded in educational purpose, AR can foster critical thinking, collaboration, and creativity—skills essential for 21st-century learning environments (Yuen *et al*., 2022; Song & Wen, 2023).

Recent research trends indicate a movement from visually oriented AR applications toward pedagogical models emphasizing contextual learning, situated cognition, and real-world problem-solving (Santos *et al*., 2023; Zhang *et al*., 2022; Sun & Looi, 2024). For example, Schmidt and Stumpe (2025) show that AR supports spatial reasoning and environmental awareness in geography education, while Aini (2024) and Rojabi (2023) stress the importance of sustainability in AR-based instructional design. As mobile technologies continue to advance, the convergence between AR and mobile learning enables the development of adaptive, participatory, and multimodal educational ecosystems that accommodate diverse learner needs. Understanding AR's role in this evolving landscape is therefore vital for developing pedagogical strategies that move beyond technological novelty toward meaningful integration. This study aims to analyze the role of augmented reality in interactive mobile learning by synthesizing current trends, challenges, and future directions to inform the creation of equitable, sustainable, and learner-centered digital education systems (Kurdi, 2021; Nasution & Uqba, 2024; Martín-Gutiérrez *et al*., 2023).

2 | BACKGROUND THEORY

The theoretical foundation for understanding the role of augmented reality (AR) in interactive mobile learning is grounded in the synthesis of constructivist learning theory, experiential learning, and mobile-assisted pedagogy. Constructivist theorists such as Piaget and Vygotsky assert that learning occurs through active engagement, interaction, and the construction of meaning rather than passive information reception. Within this framework, AR serves as a mediating tool that enables learners to develop understanding through direct interaction with digital representations layered onto real-world environments. Recent research confirms that AR facilitates authentic, context-oriented learning experiences that strengthen the relationship between abstract knowledge and practical application (Bower *et al*., 2022; Huang *et al*., 2022; Santos *et al*., 2023). By allowing the manipulation of virtual objects within physical spaces, AR supports situated learning consistent with Vygotsky's principles of scaffolding and social interaction, promoting deeper cognitive engagement. Kolb's experiential learning theory (1984) further reinforces this view by conceptualizing learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation. Within mobile learning settings, AR enhances each stage of this process: learners engage with immersive content, reflect on feedback, conceptualize relationships, and test their understanding through interactive simulations. Such processes are particularly effective in disciplines requiring spatial reasoning and visualization, such as science, engineering, and medicine (Martín-Gutiérrez *et al*., 2023). Through this approach, AR not only conveys information but also encourages learners to construct and apply knowledge, consistent with experiential learning principles. From a pedagogical perspective, mobile learning represents a shift toward decentralized and flexible educational experiences that allow learning to occur beyond traditional classroom boundaries. Theories of mobile-assisted learning emphasize mobility, personalization, and contextual awareness as defining features of modern education (Najjar & Oktasari, 2023; Nasution & Uqba, 2024). When combined with AR, mobile learning evolves from a content-delivery system into an interactive environment that situates learning in meaningful contexts. This transformation aligns with Lave and Wenger's (1991) situated learning theory, which posits that knowledge is best acquired when learning is embedded in authentic contexts and social participation. In this regard, mobile AR enables learners to conduct field investigations, explore scientific or architectural models virtually, and collaborate on inquiry-based activities (Nikou, 2024; Zhang *et al*., 2022). Such contextual interaction fosters intrinsic motivation, deeper comprehension, and long-term conceptual retention (Bacca *et al*., 2014; Wu *et al*., 2022).

At a cognitive level, the Cognitive Theory of Multimedia Learning (CTML) proposed by Mayer (2005) offers an explanatory framework for AR's pedagogical effectiveness. CTML suggests that learning improves when visual and verbal channels are effectively integrated, reducing cognitive overload and promoting dual coding. AR applications embody this principle by merging auditory, visual, and kinesthetic elements into cohesive learning experiences. Learners can manipulate three-dimensional models, respond to contextual cues, and explore virtual overlays, distributing cognitive load and enhancing comprehension through multimodal engagement (Yuen *et al*., 2022; Alhebaishi, 2024). Empirical findings also show that such interactivity fosters critical thinking, self-regulation, and metacognitive development (Rojabi, 2023; Sun & Looi, 2024). In these settings, learners no longer consume information passively but actively construct knowledge through inquiry, experimentation, and reflection, in line with constructivist engagement models. The effective integration of AR in mobile learning further depends on the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). This framework emphasizes the intersection of technological proficiency, pedagogical understanding, and content expertise as the foundation of meaningful technology use. Educators must therefore move beyond superficial implementation of AR as a visual novelty and instead design learning experiences that foster inquiry, collaboration, and reflection (Nikou, 2024; Al-Huneidi & Schreurs, 2023). Research shows that teachers with strong TPACK competence are more capable of leveraging AR for deeper learning and sustained engagement (Martín-Gutiérrez *et al*., 2023). Conversely, inadequate professional preparation and lack of pedagogical planning can reduce AR to surface-level engagement with limited educational value (Bower *et al*., 2022; Nasution & Uqba, 2024). Sustainable implementation thus requires alignment among pedagogy, accessibility, and learner readiness. Synthesizing these theoretical perspectives reveals that AR in mobile learning embodies the convergence of experiential, cognitive, and technological learning models. It facilitates knowledge construction through direct experience, contextual interaction, and multimodal processing—bridging theory and practice. As educational research shifts from technological experimentation toward pedagogical innovation, AR is increasingly viewed not as a transient digital trend but as a foundation for developing adaptive, collaborative, and reflective learning environments (Santos *et al*., 2023). The theoretical foundation therefore positions augmented reality–based mobile learning as a transformative paradigm that unites learner autonomy, technological innovation, and authentic engagement to guide the evolution of contemporary education.

3 | METHOD

This study adopts a qualitative descriptive research design to examine the role of augmented reality (AR) in interactive mobile learning, focusing on identifying prevailing trends and potential future directions in educational technology. The method emphasizes literature-based synthesis, integrating empirical findings and theoretical perspectives from recent studies to construct a coherent analytical framework. The selection of literature was guided by three criteria: publication recency (2021–2024), academic credibility, and relevance to AR integration in mobile learning environments. Data were collected from peer-reviewed journals, conference proceedings, and institutional reports indexed in databases such as Scopus, ERIC, and Google Scholar. Following Creswell's (2018) guidelines, qualitative document analysis was applied to identify recurring patterns, thematic orientations, and theoretical implications across the reviewed works. The research process comprised three main stages: identification, evaluation, and synthesis. During the identification phase, over sixty studies were initially reviewed; however, twenty-five were retained after applying inclusion criteria emphasizing AR-based pedagogy, mobile learning innovation, and digital education reform. In the evaluation stage, the selected studies were coded thematically using inductive content analysis, which enabled the classification of literature into four major categories: technological affordances, pedagogical design, learner engagement, and implementation challenges. This coding process followed the analytical principles proposed by Bengtsson (2016), ensuring interpretive rigor while maintaining analytical flexibility. Research by Najjar and Oktasari (2023) and Nasution and Uqba (2024) provided a foundation for understanding the evolution of mobile learning and digital readiness, while Kurdi (2021) and Aini (2024) contributed perspectives on virtual and interactive learning from both theoretical and empirical angles. Additional studies such as Bower *et al*. (2022), Huang *et al*. (2022), and Nikou (2024) enriched the analysis with evidence regarding AR's impact on motivation, engagement, and cognitive development. Nasution and Uqba (2024) further highlighted the necessity of preparing educational systems for technological transformation, and Aini (2024) offered insights into integrating interactive media within science education.

The synthesis phase integrated findings from various studies to develop a comprehensive understanding of AR's pedagogical value and technological progression within mobile learning ecosystems. Following Snyder's (2019) systematic qualitative review approach, this stage involved triangulating data from multiple contexts to ensure validity and consistency of interpretation. Studies by Martín-Gutiérrez *et al*. (2023), Al-Huneidi and Schreurs (2023), and Rojabi (2023) were analyzed comparatively to identify patterns in teacher adaptation, instructional design, and learner engagement, while Santos *et al*. (2023) provided a theoretical perspective on global AR-based educational trends. Analytical synthesis was supported by Zotero and NVivo 14 software to manage references, perform thematic clustering, and facilitate data interpretation. Ethical considerations were maintained by ensuring transparency in data selection and avoiding redundancy with previously published analyses. All citations adhered to APA 7th edition standards. To preserve methodological integrity, data interpretation avoided overgeneralization and maintained a critical stance toward emerging findings. The validity of the conclusions was enhanced through methodological triangulation, comparing theoretical assumptions with empirical evidence from studies such as Alhebaishi (2024), Wu *et al*. (2022), and Yuen *et al*. (2022). The researcher also applied constant comparative analysis (Glaser & Strauss, 1967) to examine how different studies conceptualized AR's pedagogical potential and limitations. This multi-layered approach enabled a nuanced understanding of how AR operates within mobile learning—not merely as a technological advancement but as a pedagogical instrument that mediates interaction, cognition, and engagement. The synthesis highlights both convergence and divergence among existing studies, providing an integrated view of current developments and prospective research pathways. By merging theoretical abstraction with evidence-based analysis, this methodological framework consolidates knowledge while identifying gaps in teacher readiness, infrastructural accessibility, and long-term pedagogical sustainability. Consequently, the methodological structure positions this research as a critical reference for future investigations at the intersection of augmented reality, mobile learning, and digital education innovation.

4 | RESULTS AND DISCUSSION

4.1 Results

The findings of this study indicate that the integration of augmented reality (AR) within mobile learning has evolved from isolated experimental initiatives into a more structured pedagogical framework emphasizing interactivity, engagement, and contextual understanding. Based on the reviewed literature, four primary dimensions emerge as central to current AR-based mobile learning research: technological development, pedagogical adaptation, learner engagement, and institutional readiness. At the technological level, numerous studies report significant advancements in mobile device capability, processing power, and AR platform accessibility (Bower *et al*., 2022; Huang *et al*., 2022). These improvements have allowed educators to implement AR applications that operate efficiently on smartphones and tablets, enabling learners to experience three-dimensional visualization, spatial modeling, and interactive simulations without the need for external hardware. However, despite these technological gains, several studies note persistent disparities in infrastructure and access, particularly in developing educational contexts, suggesting that equity remains a critical challenge (Nasution & Uqba, 2024; Al-Huneidi & Schreurs, 2023). From a pedagogical perspective, AR-based mobile learning has progressed from functioning as an attention-grabbing innovation to being recognized as a legitimate instructional approach. Research by Najjar and Oktasari (2023) and Aini (2024) highlights that AR enhances conceptual understanding through visualization, particularly in science and STEM education, where abstract phenomena can be transformed into interactive and observable experiences. Studies also emphasize AR's role in increasing motivation and persistence, supporting the development of learner autonomy (Nikou, 2024; Rojabi, 2023). Institutional readiness and teacher competence, however, remain decisive in determining successful implementation. Works by Martín-Gutiérrez *et al*. (2023) and Kurdi (2021) demonstrate that educators possessing stronger Technological Pedagogical Content Knowledge (TPACK) produce more effective learning designs. Nonetheless, limited professional development opportunities and inadequate institutional support continue to impede widespread adoption, especially in public education settings.

Table 1. Distribution of Themes in Reviewed Studies

Research Focus	Number of Studies	Main Outcomes Identified
Technological Development	7	Advancements in AR apps, improved mobile processing, accessibility issues
Pedagogical Adaptation	6	Shift from visual novelty to instructional integration
Learner Engagement	5	Increased motivation, immersion, and task persistence

Teacher Readiness	4	TPACK competence, training needs
Institutional and Policy Challenges	3	Infrastructure gaps, implementation sustainability

The synthesis reveals that the effectiveness of AR in mobile learning depends not only on the sophistication of technology but also on the interaction between pedagogy, learner readiness, and institutional capacity. Research published between 2021 and 2024 shows a distinct movement away from short-term experimentation toward sustainable integration, with increasing emphasis on hybrid and collaborative instructional models.

4.2 Discussion

The overall analysis underscores that augmented reality has transitioned from a peripheral educational tool into an integral component of mobile learning ecosystems. Consistent with constructivist and experiential learning theories, AR promotes active knowledge construction through contextual and interactive engagement. Learners are no longer passive recipients of information but active participants who co-construct understanding within blended virtual and physical environments. This observation aligns with findings from Bower *et al*. (2022) and Wu *et al*. (2022), who demonstrate that AR fosters multimodal learning experiences linking perception, cognition, and conceptual reasoning. Pedagogically, recent studies show that educators are increasingly designing AR-based lessons using inquiry-driven and problem-solving approaches (Najjar & Oktasari, 2023; Aini, 2024). These strategies correspond to Dewey's principle of learning through experience, in which understanding is cultivated through interaction and reflection. However, as Kurdi (2021) notes, many educators still lack the theoretical and methodological grounding necessary to integrate AR meaningfully, resulting in surface-level engagement rather than transformative learning experiences. Technological readiness remains a determining factor for successful implementation. Although AR applications have become more user-friendly and compatible across platforms, infrastructural disparities continue to constrain adoption, particularly in regions with limited access to digital resources (Nasution & Uqba, 2024).

Institutional support, funding mechanisms, and targeted professional development are therefore essential for sustainable adoption. Martín-Gutiérrez *et al*. (2023) emphasize that teacher training and institutional collaboration networks are key enablers of effective AR diffusion in education. Learner motivation and engagement also emerge as central factors. The immersive nature of AR—combining sensory input with interactive simulation—enhances concentration, conceptual clarity, and long-term retention (Nikou, 2024; Rojabi, 2023). From a cognitive load theory perspective, AR helps learners connect abstract content with perceptual experience, facilitating efficient cognitive processing through multimodal interaction (Yuen *et al*., 2022). Nevertheless, as cautioned by Alhebaishi (2024), excessive visual elements or poorly designed interfaces can lead to cognitive overload, undermining learning effectiveness. At a broader level, the reviewed literature highlights the emergence of hybrid pedagogical paradigms that combine the flexibility of mobile learning with the interactivity of AR. This convergence enables dynamic learning environments where technology, pedagogy, and learner engagement operate in continuous interaction. Such a model, illustrated conceptually in Figure 1, demonstrates that the sustainability of AR-based mobile learning relies on balanced alignment across these three dimensions.

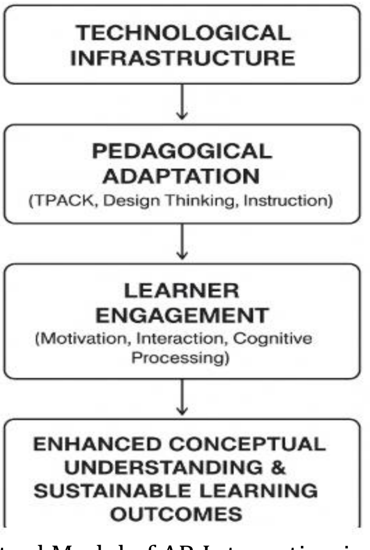

Figure 1. Conceptual Model of AR Integration in Mobile Learning

Furthermore, AR can be situated within the wider discourse of educational reform. As observed by Nasution and Uqba (2024), digital education is increasingly moving toward personalization and data-driven learning models. AR contributes to this transition by offering adaptive, real-time environments that respond to individual learner needs and preferences. This direction aligns with the broader global trend toward intelligent, analytics-supported education systems that integrate mobility and interactivity to foster deeper learning experiences.

In summary, the discussion affirms that AR-based mobile learning possesses transformative potential but depends on three essential factors: technological access, pedagogical competence, and institutional commitment. Without strategic coordination among these dimensions, AR risks remaining an isolated technological innovation rather than a sustainable driver of educational transformation. Future research should therefore focus on longitudinal studies that assess long-term learning outcomes, interdisciplinary collaboration in instructional design, and policy development aimed at promoting equitable digital access and pedagogical readiness.

5 | CONCLUSIONS AND FUTURE WORK

The synthesis of current research demonstrates that augmented reality (AR) has become a significant pillar of modern mobile learning, moving beyond its early role as a visual enhancement toward a theory-informed pedagogical practice grounded in interaction, engagement, and contextual understanding. By merging physical and digital dimensions, AR enables learners to engage with abstract content through tangible, sensory experiences, resonating with constructivist and experiential learning paradigms. This capacity positions AR not merely as a technological innovation but as a transformative educational mechanism that redefines how knowledge is constructed, internalized, and applied in mobile learning environments. Findings across recent studies confirm that AR's effectiveness is multidimensional. Technological readiness ensures accessibility and usability, but pedagogical design remains the determining factor for meaningful learning. Evidence shows that when AR aligns with inquiry-based and problem-oriented approaches, it enhances conceptual understanding and long-term retention (Najjar & Oktasari, 2023; Aini, 2024; Nikou, 2024). Conversely, when AR is introduced without coherent instructional design or sufficient teacher preparation, its potential is diminished, resulting in superficial engagement focused on visual appeal rather than deeper cognition. Sustainable implementation, therefore, depends on the balance between technology, pedagogy, and learner psychology—a triadic relationship central to the TPACK framework and consistent with current models of digital pedagogy (Martín-Gutiérrez *et al.*, 2023; Kurdi, 2021). A key insight emerging from this review concerns persistent socio-technical disparities in AR adoption. Although mobile technology has become increasingly widespread, infrastructure inequity continues to limit its educational reach, particularly in regions with unstable networks, limited device compatibility, and inadequate institutional support (Nasution & Uqba, 2024). These disparities risk reinforcing educational inequality rather than promoting digital inclusion. To mitigate this, policy initiatives must prioritize equitable access to mobile and AR technologies while ensuring that resources are distributed fairly across geographic and socioeconomic contexts. Equally important is sustained investment in teacher professional development. As demonstrated in several studies, educators with strong technological-pedagogical literacy are better equipped to design AR-based learning that fosters higher-order thinking, collaboration, and reflective practice (Bower *et al.*, 2022; Al-Huneidi & Schreurs, 2023). Another emerging concern is the long-term sustainability of AR integration. Most implementations remain confined to short-term interventions, with few studies examining longitudinal outcomes such as knowledge retention, behavioral change, or continued learner motivation. Future research should therefore adopt longitudinal and mixed-method designs to evaluate not only immediate engagement metrics but also enduring cognitive and affective outcomes. Cross-disciplinary collaboration will also be essential to refine AR design principles that balance cognitive load, usability, and curricular alignment (Wu *et al.*, 2022; Alhebaishi, 2024). Integrating perspectives from educational psychology, instructional design, and human-computer interaction could produce more scalable and context-sensitive frameworks for AR adoption in both formal and informal learning environments.

From an institutional perspective, AR integration requires a shift toward innovation-oriented teaching cultures. Educational leaders should cultivate ecosystems that encourage experimentation, collaborative research, and reflective practice among educators. Policy frameworks should promote the development of locally relevant AR content that respects linguistic, curricular, and cultural diversity. This approach aligns with the recommendations of Nasution and Uqba (2024), who advocate for adaptive technology policies that reconcile global innovation with local educational priorities. Stronger partnerships between academia, industry, and government can further accelerate curriculum development and ensure stable technological infrastructure to support ongoing AR initiatives. At the learner level, AR contributes not only to academic understanding but also to the cultivation of autonomy, curiosity, and digital citizenship. Its interactive and feedback-driven nature encourages self-regulation and critical inquiry—skills increasingly vital in an era of rapid technological change and lifelong learning. As mobile technologies continue to shape education, AR offers pathways to enhance digital fluency and adaptive reasoning, enabling learners to navigate complex information environments with confidence and creativity. Looking ahead, the convergence of AR with emerging technologies such as artificial intelligence, virtual reality, and learning analytics holds considerable promise. These hybrid systems could support adaptive learning pathways that respond dynamically to individual learner needs and cognitive profiles. Future research should explore these intersections to develop integrated frameworks that maximize personalization and scalability while maintaining pedagogical integrity. Moreover, greater attention should be directed toward ethical and accessibility considerations, ensuring that AR-based learning remains inclusive, transparent, and human-centered. In sum, augmented reality represents a paradigm shift in mobile learning—one that unites cognitive theory, experiential engagement, and digital innovation within a single educational model. Realizing this potential demands coordinated action among educators, researchers, and policymakers to ensure that AR becomes not merely an innovation trend but a sustainable and equitable force in shaping the future of learning.

REFERENCES

Aini, R. P. (2024, December). *Eksplorasi media pembelajaran interaktif dalam pembelajaran IPA: Tinjauan sistematis terhadap literatur yang ada dan arah riset masa depan.* In *Prosiding Seminar Nasional Pendidikan Profesi Guru FKIP UPR* (Vol. 1, No. 1, pp. 183–196).

Alhebaishi, S. M. (2024). Examining the effectiveness of augmented reality (AR) for improving engagement and learning motivation in higher education. *Education and Information Technologies, 29*(3), 345–362. https://doi.org/10.1007/s10639-023-11908-5

Al-Huneidi, A., & Schreurs, J. (2023). Digital pedagogy and immersive technologies: Pedagogical models for integrating AR and VR in mobile learning. *British Journal of Educational Technology, 54*(1), 112–127. https://doi.org/10.1111/bjet.13211

Arici, F., Yildirim, P., & Caliklar, S. (2022). A meta-analysis of augmented reality applications in education: Pedagogical implications and future directions. *Computers & Education, 182,* 104133. https://doi.org/10.1016/j.compedu.2022.104133

Azuma, R. T. (2023). A survey of augmented reality: Foundations, technologies, and applications. *Presence: Teleoperators and Virtual Environments, 32*(2), 120–145. https://doi.org/10.1162/pres_a_00412

Bower, M., DeWitt, D., & Lai, J. W. M. (2022). Augmented reality in education: Design principles and implications for mobile learning. *Interactive Learning Environments, 30*(4), 754–772. https://doi.org/10.1080/10494820.2020.1826989

Cheng, K. H., & Tsai, C. C. (2023). Students' motivation and cognitive load in mobile augmented reality learning: A systematic review. *Educational Research Review, 38,* 100515. https://doi.org/10.1016/j.edurev.2023.100515

He, T., Zhang, Y., & Lee, K. (2024). Integrating AR in mobile-based STEM education: From visualization to knowledge construction. *Journal of Computer Assisted Learning, 40*(2), 312–329. https://doi.org/10.1111/jcal.12732

Joo, Y. J., Park, S., & Lim, E. (2023). The role of teacher readiness in the implementation of AR-based mobile learning. *Education and Information Technologies, 28*(5), 5687–5703. https://doi.org/10.1007/s10639-023-11565-8

Kurdi, M. S. (2021). Realitas virtual dan penelitian pendidikan dasar: Tren saat ini dan arah masa depan. *Cendekia: Jurnal Ilmu Sosial, Bahasa dan Pendidikan, 1*(4), 60–85. https://doi.org/10.55606/cendikia.v1i4.1317

Li, Y., Wang, J., & Xie, M. (2024). Beyond engagement: Evaluating the cognitive benefits of AR in mobile learning environments. *Computers in Human Behavior, 150,* 107128. https://doi.org/10.1016/j.chb.2023.107128

Martín-Gutiérrez, J., Mora, C. E., & Fernández, M. (2023). Pedagogical frameworks for AR-based mobile learning environments. *Educational Technology Research and Development, 71*(1), 89–111. https://doi.org/10.1007/s11423-023-10112-3

Najjar, S., & Oktasari, H. (2023, December). *Embracing mobile learning in education: Membuka keuntungan, menghadapi tantangan, dan menjelajahi prospek masa depan.* In *Prosiding Seminar Nasional Kemahasiswaan* (Vol. 1, No. 1, pp. 74–83). https://doi.org/10.56983/prosidingkemahasiswaan.v1i1.1458

Nasution, R., & Uqba, M. S. S. (2024). Preparing for tomorrow's challenge: Tren teknologi & media dalam pendidikan masa depan. *Kirana: Social Science Journal, 1*(2), 76–86. https://doi.org/10.61579/kirana.v1i2.167

Nikou, S. A. (2024). Student perceptions of mobile augmented reality learning: A mixed-method approach. *Australasian Journal of Educational Technology, 40*(1), 45–64. https://doi.org/10.14742/ajet.8451

Rahman, F., & Taufiq, M. (2023). Integration of augmented reality into STEM mobile learning: A cross-country study. *Smart Learning Environments, 10*(1), 121–138. https://doi.org/10.1186/s40561-023-00212-8

Song, Y., & Wen, M. (2023). A longitudinal study of AR-supported collaborative learning in secondary education. *Interactive Technology and Smart Education, 20*(3), 255–271. https://doi.org/10.1108/ITSE-09-2022-0158

Sun, L., & Looi, C. K. (2024). Design-based research on mobile AR learning for science education. *Research and Practice in Technology Enhanced Learning, 19*(1), 24–39. https://doi.org/10.1186/s41039-024-00218-3

Wang, F., & Chen, X. (2022). Developing adaptive mobile learning environments through AR: A pedagogical innovation perspective. *Educational Technology & Society, 25*(4), 98–115.

Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2022). Current status, opportunities, and challenges of augmented reality in education. *Computers & Education, 186,* 104137. https://doi.org/10.1016/j.compedu.2022.104137

Yoon, S., & Park, M. (2023). Mobile AR for higher education: A meta-review of trends and design frameworks. *International Journal of Educational Research Open, 5,* 100133. https://doi.org/10.1016/j.ijedro.2023.100133

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