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DESIGNING AI-ENHANCED IMMERSIVE LEARNING MATERIALS VIEWED FROM DISTANCE LEARNERS' PERSPECTIVES: FROM IMMERSION TO IMPLEMENTATION

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Abstract: The rapid advancement of artificial intelligence (AI) and immersive technologies is reshaping distance education by enabling more engaging and personalized learning experiences. However, a persistent gap remains between conceptual understanding and practical implementation for distance learners. This study addresses this gap by developing a learner-centered framework for designing AI-enhanced immersive learning materials in open and flexible distance learning (OFDL) contexts. Using a qualitative systematic literature review (SLR), the study synthesizes recent research on immersive learning, AI in education, and distance learning pedagogy. The findings identify key characteristics of immersive learning materials as perceived by learners: presence, experiential meaning-making, personalization, interaction, engagement, feedback, accessibility, and authenticity. Accordingly, the study proposes the AIDE framework (AI-Driven Immersive Design for Education), which organizes the design process into five phases: Analyze, Immerse, Differentiate, Engage, and Sustain. In addition, a conceptual model is introduced to explain how instructional design influences multidimensional learning outcomes through immersive learning experiences. The study highlights that effective immersion depends on technological sophistication and on the quality and contextual relevance of learner experiences. It contributes by bridging theory and practice, offering practical design guidance, and emphasizing inclusive and sustainable approaches. Future research is needed to empirically validate the proposed framework and model.

Keywords: Immersive Learning; AI in Education; OFDL; Student Experience; Technology-Enhanced Learning; AIDE Framework; Sustainable Education.

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INTRODUCTION

The rapid advancement of artificial intelligence (AI) and digital technologies has fundamentally reshaped the landscape of education, particularly within an open flexible distance learning (OFDL) setting. As learning increasingly transcends physical classrooms, the challenge facing educators is no longer limited to delivering content online, but extends to designing learning experiences that are engaging, meaningful, and responsive to diverse learner needs. In this evolving context, immersive learning has emerged as a powerful pedagogical approach, emphasizing experiential engagement, contextualized understanding, and active knowledge construction. However, while the concept of immersion has gained

considerable attention, its effective implementation in distance education remains a complex and underdeveloped area (Kamalov, Santandreu & Gurrib, 2023; Ruano-Borbalan, 2025; Singh, 2025; Wang, Wang, Zhu, Wang, Tran & Du, 2024).

The rationale of this inquiry lies in the need to bridge the persistent gap between *conceptual understanding* and *practical implementation* of immersive learning, particularly when enhanced by AI technologies (Rashevska & Semerikov, 2026). Existing research, including systematic reviews, has consistently highlighted the potential of immersive learning to improve engagement, deepen cognitive processing, and support knowledge retention. At the same time, AI offers unprecedented opportunities for personalization, adaptivity, and intelligent feedback. Yet, these advancements have not been sufficiently translated into *clear* and *actionable design strategies* that educators can adopt in real-world distance learning environments. More importantly, much of the current discourse remains technology-centered, often overlooking how learners themselves perceive experience and make meaning of immersive learning in distributed settings (Ursachi & Dascalu, 2025). This paper, therefore, seeks to reposition immersive learning design by foregrounding the *perspective of distance learners* as the central reference point (Lim, Cope & Kalantzis, 2022).

Despite growing scholarly interest, several critical research gaps remain. First, there is a lack of *integrative design frameworks* that systematically connect immersive pedagogy, AI capabilities, and the unique demands of distance learning (Ali, Ma, Muneeb & Wong, 2025). Existing studies often examine these elements in isolation, resulting in fragmented insights that are difficult to operate. Second, the *student perspective* is insufficiently represented in literature. While technological affordances are widely discussed, fewer studies investigate how learners experience immersion, engagement, personalization, and support in online environments (Schwartz & Blau, 2026). Third, there is limited conceptual and empirical work linking immersive learning design to *multidimensional learning outcomes*, including cognitive, affective, behavioral, and long-term sustainability outcomes (Sun, Chan & Wong, 2025). Fourth, issues related to *accessibility, inclusivity,* and *scalability* remain underexplored, particularly in contexts where learners face constraints (e.g., limited bandwidth, varying digital literacy, and diverse socio-economic conditions; Barikzai, Bharathi & Perdana, 2024). These gaps highlight the need for a more holistic and learner-centered approach to immersive learning design (Liu, Yue, Liu, Yang, Gao & Sha, 2025).

The urgency of this study is amplified by several converging developments in global education. The widespread adoption of online and hybrid learning models, accelerated by recent global disruptions, has made distance education a central mode of learning rather than a supplementary option (Amiri, Goswami, Islam, Kabir & Hossen, 2026). At the same time, the rapid integration of AI into educational systems is reshaping expectations around personalized and adaptive learning experiences. Without robust pedagogical frameworks, there is a risk that technological innovation may outpace educational design, leading to fragmented, inequitable, or ineffective learning experiences (Merino-Campos, 2025). Furthermore, global educational priorities increasingly emphasize inclusive, equitable, and

lifelong learning opportunities, aligning with broader sustainability agendas. In this regard, designing immersive learning materials that are not only technologically advanced but also pedagogically sound and accessible is both a timely and necessary endeavor (Zhang, Wang, Jiang & Wu, 2025).

Guided by those considerations, this study addresses the following research questions: (i) What are the core characteristics of AI-enhanced immersive learning materials as perceived by distance learners? (ii) How can these learner-centered characteristics be translated into a practical and systematic instructional design framework for distance education? (iii) How does the proposed design (AIDE framework) conceptually relate to multidimensional learning outcomes in distance learning contexts? (Wang, Cheung & Chai, 2025; Mohebbi, 2025; Ahmed, Rahman, Hossain & Tambi, 2022; Ofem, Asuquo, Nwanunu, Madukwe, Nsan, Adie, Ukatu, Asukwo, Ebaye & Igwe, 2026).

In response to these questions, the *main objective* of this paper is to develop a comprehensive and practical framework for designing AI-enhanced immersive learning materials, explicitly grounded in the perspectives of distance learners (Abbasnejad, Soltani, Taghizadeh & Zare, 2026). This framework aims to bridge the gap between theoretical insights and instructional design practice by integrating principles of immersive learning, AI-enhanced personalization, and distance education (Verma & Dhaigude, 2026).

In addition, the study pursues several *supporting objectives*. First, it seeks to identify and synthesize the *core characteristics of immersive learning materials* from the viewpoint of students engaged in OFDL environments. Second, it aims to incorporate these characteristics into a structured design model; namely, the *AIDE framework (AI-Driven Immersive Design for Education)*, which provides step-by-step guidance for educators and instructional designers. Third, the paper proposes a *conceptual hypothesis model* that links the AIDE framework to learning outcomes through the mediating role of immersive learning experience, thereby establishing a foundation for future empirical validation. Fourth, the study aims to generate *practical implications* for the development of scalable, inclusive, and sustainable immersive learning environments in distance education.

Through this integrative and learner-centered approach, the paper advances the discourse from understanding immersion as a theoretical construct. Then it leads to recognizing immersion as a *designable and implementable pedagogical practice*, aligned with the evolving demands of AI-enhanced distance learning (Ghasem, 2025; Yan, Li, & Lowell, 2025; Ryan, Morel, Goodman, Hermes, Rehman, Louche, Keranen & Juntunen, 2025).

THEORETICAL FRAMEWORK

This study is grounded in an integrative theoretical foundation that connects immersive learning, AI in education, and distance learning pedagogy, while explicitly foregrounding the learner's perspective. In line with the rationale and research gaps identified earlier, this

section synthesizes key theoretical lenses that inform the design of AI-enhanced immersive learning materials and support the development of the proposed AIDE framework.

Immersive Learning as Experiential and Constructivist Practice

Immersive learning is most coherently understood through the lens of *constructivist* and *experiential learning* theories. Constructivism posits that learners actively construct knowledge through interaction with their environment, rather than passively receiving information. In this view, learning becomes meaningful when individuals engage with authentic contexts, manipulate ideas, and reflect on their experiences.

Closely aligned with this perspective, experiential learning emphasizes the cyclical process of concrete experience, reflective observation, abstract conceptualization, and active experimentation. Immersive learning environments, whether enabled through advanced technologies such as virtual reality or through carefully designed scenario-based activities, operationalize this cycle by situating learners in context-rich experiences that simulate real-world complexity.

From the perspective of distance learners, immersion is not solely a function of technological sophistication, but of *perceived presence, contextual relevance,* and *active engagement.* This understanding shifts the focus from "technology-driven immersion" to "experience-driven immersion," where the quality of instructional design determines the depth of learner involvement. Consequently, immersive learning materials must be intentionally designed to foster experiential meaning-making, enabling learners to "learn by doing" even in distributed environments (Radianti, Majchrzak, Fromm & Wohlgenannt, 2020; Petersen, Petkakis & Makransky, 2022; Mystakidis, 2022; Petersen, Stenbergt, Mayer & Makransky, 2023; Huang & Liaw, 2018).

AI in Education and Adaptive Learning

The integration of AI into education introduces new possibilities for personalization, adaptivity, *and* intelligent support. All of which are critical in distance learning contexts characterized by learner diversity. Theoretical perspectives on AI in education are often linked to adaptive learning systems, which dynamically adjust instructional content, pacing, and feedback based on learner data.

From a pedagogical standpoint, AI can be viewed as an enabler of *learner-centered design*, supporting differentiated instruction at scale. This aligns with the principle that effective learning occurs when instructional experiences are responsive to individual needs, prior knowledge, and learning trajectories. AI-driven recommendation systems, intelligent tutoring systems, and learning analytics provide mechanisms for continuous adjustment, thereby enhancing relevance and engagement.

Importantly, the role of AI extends beyond efficiency toward *augmenting the quality of the learning experience*. When integrated into immersive environments, AI can facilitate real-time interaction, provide contextualized feedback, and simulate complex scenarios that respond to learner actions. From the student perspective, this translates into a sense of being guided, supported, and understood within the learning process. Thus, AI becomes a critical component in transforming immersion from a static experience into a dynamic, responsive learning journey (Zawacki-Richter, Marín, Bond & Gouverneur, 2019; Holmes, Bialik & Fadel, 2021; Luckin, Holmes, Griffiths, & Forcier, 2016; Chen, Chen & Lin, 2020; Lourenço & Valente, 2026).

Distance Learning and Transactional Distance

Distance education theory provides an essential lens for understanding the unique challenges and opportunities associated with learning in non-physical environments. A central concept in this domain is *transactional distance*, which refers to the psychological and communicative space between learners and instructors in distance settings.

Transactional distance is influenced by three key variables: structure, dialogue, and learner autonomy. High levels of structure with limited interaction may increase feelings of isolation, whereas increased dialogue and flexibility can reduce perceived distance. In immersive learning design, these elements must be carefully balanced to create environments that are both structured enough to guide learning and flexible enough to support autonomy.

From the learner's perspective, immersive learning materials have the potential to *reduce transactional distance* by: (i) Enhancing presence through contextualized experiences, (ii) Increasing interaction through AI-mediated dialogue and collaboration, and (iii) Supporting autonomy through flexible and self-paced pathways.

Thus, immersive learning, when thoughtfully designed, can address one of the most persistent challenges in distance education: the sense of disconnection (Moore, 1993; Anderson, 2008; Garrison, Anderson & Archer, 2000; Bozkurt & Sharma, 2020; Martin & Bolliger, 2018).

Learner Engagement and Self-Determination

Engagement is a central construct in understanding how learners interact with educational experiences, particularly in distance learning, where external structures are less immediate. Theoretical models of engagement typically distinguish between *cognitive, emotional,* and *behavioral dimensions,* all of which are essential for meaningful learning.

Self-Determination Theory further enriches this perspective by identifying three fundamental psychological needs: autonomy, competence, and relatedness. Learning environments that support these needs are more likely to foster intrinsic motivation and sustained engagement.

Immersive learning environments, especially those enhanced by AI, are well-positioned to address these dimensions: (i) **Autonomy** is supported through learner control and adaptive pathways, (ii) **Competence** is reinforced through timely feedback and achievable challenges, and (iii) **Relatedness** is facilitated through social interaction and AI-mediated communication.

From the student perspective, immersion is experienced not only cognitively but also emotionally and socially. Therefore, effective immersive learning materials must be designed to sustain engagement across all three dimensions, ensuring that learners remain motivated and actively involved (Zawacki-Richter, Marín, Bond & Gouverneur, 2019; Holmes, Bialik & Fadel, 2021; Luckin, Holmes, Griffiths, & Forcier, 2016; Chen, Chen & Lin, 2020; Panja, 2025).

Authentic Learning and Real-World Relevance

Authenticity is a defining characteristic of immersive learning. Theoretical perspectives on authentic learning emphasize the importance of situating knowledge within real-world contexts, enabling learners to engage with problems that mirror professional or societal challenges. In distance learning environments, authenticity plays a crucial role in enhancing relevance and transferability. When learners perceive tasks as meaningful and applicable beyond the course, they are more likely to invest effort and retain knowledge over time. Immersive learning materials can support authenticity through: (i) Scenario-based learning, (ii) Problem-based tasks, and (iii) Simulations of real-life situations.

From the learner's viewpoint, authenticity bridges the gap between theory and practice, transforming learning into a purposeful activity rather than an abstract exercise (Moore, 1993; Anderson, 2008; Garrison, Anderson & Archer, 2000; Bozkurt & Sharma, 2020; Martin & Bolliger, 2018).

Inclusive and Sustainable Learning Design

A critical dimension of contemporary educational theory is the emphasis on *inclusivity* and *sustainability*, particularly in alignment with global educational priorities. In the context of OFDL, inclusivity involves ensuring that learning materials are accessible to diverse learners, regardless of technological, socio-economic, or geographical constraints.

Sustainable learning, in turn, refers to the development of competencies that extend beyond immediate academic outcomes, including lifelong learning skills, adaptability, and the ability to apply knowledge in changing contexts. Immersive learning design must therefore consider: (i) Accessibility (device compatibility, low-bandwidth options), (ii) Flexibility (time, pace, learning pathways), and (iii) Equity (inclusive content and representation)

From the student perspective, immersion is meaningful only when it is *accessible and relevant to their lived realities.* This reinforces the need for design frameworks that integrate

technological innovation with pedagogical responsibility (Kolb, 1984; Piaget, 1972; Vygotsky, 1978; Deci & Ryan, 2000; Bandura, 1986).

Synthesis and Theoretical Positioning

Taking together, these theoretical perspectives provide a coherent foundation for this study. Immersive learning is conceptualized as an experiential, constructivist process enhanced by AI-driven personalization and situated within the unique dynamics of distance education (Dai & Ke, 2022). Learner engagement, authenticity, and inclusivity serve as critical mediating principles that shape how immersion is perceived and experienced (Lee, Chang & Suh, 2025).

This integrated foundation directly informs the development of the AIDE framework, which operationalizes these theoretical insights into a practical design model. By linking instructional design elements with learner experience and learning outcomes, the framework responds to the identified research gaps and aligns with the study's objective of advancing immersive learning from conceptual understanding to practical implementation (Wolf, Herstätter, Rantschl, Ramsauer & Magana, 2025).

In this way, the theoretical foundation not only supports the proposed model but also positions the study within a broader effort to design *AI-enhanced, learner-centered,* and *sustainable learning environments* for the future of distance education (Jallali, Hafdhi, Aloufi, Masoudi & Alshmrani, 2026; Roa González, Sánchez Sánchez, Seoane Pujol, & Díaz Palencia, 2025).

METHOD

This study adopts a qualitative systematic literature review (SLR) to synthesize existing scholarship and translate it into a practical, learner-centered design framework for AI-enhanced immersive learning in distance education (Atkinson & Cipriani, 2018; Dickinson, 1995; Gupta et al., 2024; Randles & Finnegan, 2023; Siddaway et al., 2019; Zawacki-Richter, Marín, Bond & Gouverneur, 2019; Radianti, Majchrzak, Fromm & Wohlgenannt, 2020; Page, McKenzie, Bossuyt et al., 2021; Kitchenham, 2004).

Research Design

The choice of an SLR is aligned with the study's objectives: (1) to consolidate fragmented knowledge across immersive learning, AI in education, and distance learning, (2) to identify core characteristics of immersive learning from the distance learner perspective, and (3) to develop a design-oriented framework (AIDE) grounded in evidence.

Methodologically, the review combines systematic search and selection procedures with interpretive synthesis, drawing on principles from evidence-based review protocols and qualitative synthesis approaches. Rather than merely aggregating findings, this study emphasizes *conceptual integration* and *model development*, making it suitable for advancing both theory and practice.

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Review Protocol and Procedure

The review follows a structured, multi-stage protocol to ensure transparency, rigor, and replicability. The process consists of four main phases: *identification, screening, eligibility assessment,* and *inclusion*.

A comprehensive literature search was conducted across major academic databases, including Scopus, Web of Science, ERIC, and Google Scholar (for supplementary coverage). Search queries were constructed using combinations of key terms related to the study focus. The search was limited to peer-reviewed journal articles and conference proceedings published in English within a recent time frame, i.e., 2015–2026, to capture contemporary developments in AI and immersive technologies.

Initial screening was conducted based on title relevance and abstract relevance. Studies were excluded if they: (i) Focused solely on technical system development without pedagogical implications, (ii) Did not involve learning contexts, and (iii) Were not related to distance, online, or flexible learning environments. Duplicates across databases were removed at this stage.

Full-text articles were assessed using the following inclusion criteria: (i) Explicit focus on immersive learning, AI in education, or technology-enhanced learning, (ii) Relevance to learner experience, instructional design, or learning outcomes, (iii) Applicability to distance, online, or flexible learning contexts, and (iv) Empirical, conceptual, or review-based contributions with clear scholarly grounding. Exclusion criteria included: (i) Studies lacking methodological clarity, (ii) Opinion pieces without analytical depth, and (iii)Studies unrelated to educational settings

The final corpus consisted of studies that met all criteria and provided meaningful insights into: (i) Characteristics of immersive learning, (ii) Role of AI in enhancing learning experiences, (iii) Design principles for distance education, and (iv) Student engagement, interaction, and outcomes. The selection process was documented to ensure transparency and may be presented using the available tools.

Data Extraction and Coding

A structured data extraction protocol was employed to systematically capture relevant information from each selected study. Extracted data included: (i) Bibliographic information (author, year, source), (ii) Study context (education level, modality, technology used), (iii) Conceptualization of immersive learning, (iv) Role of AI or adaptive systems, (v) Reported learning outcomes, (vi) Student experience factors (engagement, presence, personalization), and (vii) Design implications and recommendations

The extracted data were then subjected to qualitative coding, using a combination of: (i) Deductive coding, based on predefined dimensions (e.g., immersion, engagement,

personalization) derived from the theoretical foundation) and (ii) Inductive coding, allowing new themes to emerge from the data. This dual approach ensured both theoretical alignment and openness to novel insights.

Data Analysis and Synthesis

The analysis followed a *thematic synthesis approach*, consisting of three stages. They are: (i) Descriptive Thematic Analysis, i.e., initial coding results were grouped into descriptive categories reflecting recurring patterns across studies, such as: (a) Forms of immersive experience, (b) Types of AI-supported personalization, (c) Modes of interaction and engagement, and (d) Barriers and enabling conditions in distance learning. (ii) Analytical Theme Development, i.e., the descriptive themes were then interpreted at a higher level to identify: (a) Core characteristics of immersive learning materials from the student perspective, (b) Relationships between design elements and learner experience, and (c) Cross-cutting principles relevant to OFDL contexts – This stage directly addressed the first research question. (iii) Framework Synthesis, i.e., building on the analytical themes, the study employed a framework synthesis approach to develop the proposed AIDE framework. This involved: (a) Mapping identified characteristics to design dimensions, (b) Structuring these dimensions into a coherent process model, and (c) Aligning the framework with theoretical constructs and learning outcomes

In addition, a conceptual hypothesis model was derived to link design elements (AIDE) with learning outcomes through immersive learning experience, addressing the second and third research questions.

Trustworthiness and Rigor

To ensure the quality and credibility of the study, several strategies were employed. It includes: (i) Transparency: Clear documentation of search strategy, inclusion criteria, and analysis procedures, (ii) Consistency: Use of structured coding and iterative refinement of themes, (iii) Theoretical grounding: Alignment with established learning theories and prior research, and (iv) Analytical rigor: Integration of multiple sources and triangulation of findings across studies. Where applicable, peer debriefing or expert review may be incorporated to strengthen interpretive validity.

Methodological Contribution

Beyond synthesizing existing literature, this study contributes methodologically by demonstrating how an SLR can be extended into design-oriented knowledge production. By integrating thematic synthesis with framework development and conceptual modeling, the method moves beyond description toward actionable pedagogical innovation.

In short, through this rigorous qualitative SLR approach, the study provides a robust foundation for identifying learner-centered characteristics, developing the AIDE framework,

and proposing a theoretically grounded model linking immersive design to learning outcomes in AI-enhanced distance education.

RESULT AND DISCUSSION

This section presents the results of the systematic literature review and interprets them in light of the study's rationale, research gaps, theoretical foundation, and methodological approach. The findings are organized around three core analytical strands aligned with the research questions: (1) the characteristics of immersive learning materials from the distance learner perspective, (2) the development of the AIDE framework as a design response, and (3) the conceptual linkage between immersive design and learning outcomes. Each subsection integrates *evidence-based synthesis* with *critical reflection*.

Core Characteristics of Immersive Learning Materials from Distance Learners' Perspectives

The synthesis of the selected studies reveals that immersive learning in OFDL is best understood not as a function of technology alone, but as a *multidimensional learner experience* (Muzata, Singh, Stepanov & Musonda, 2024). Across the literature, several interrelated characteristics consistently emerged, which can be clustered into five higher-order dimensions: immersive experience, personalization, engagement, support systems, and sustainability.

First, *perceived presence and experiential meaning-making* emerged as foundational. Studies consistently show that learners report deeper understanding when they feel cognitively and contextually "situated" within a learning scenario (Xia & Guo, 2025). This aligns with constructivist and experiential learning theories, where knowledge is actively constructed through meaningful engagement with context-rich environments (Levin, Semenov & Gorsky, 2025). Second, *AI-supported personalization* plays a critical role in shaping immersion. Adaptive pathways, tailored feedback, and intelligent recommendations enhance relevance and reduce cognitive overload (Jaiswal, Gupta & Chen, 2026). Learners perceive such environments as more responsive and supportive, which strengthens both engagement and persistence (Sultana, Latheef, Siby & Ahmad, 2025; Khalifeh, Santiago, & Palau, 2026). Third, *interactive agency and sustained engagement* are central to immersive learning (Makransky & Petersen, 2023). Learners value environments that allow them to make decisions, control pacing, and actively participate in knowledge construction (Song & Cai, 2024). Engagement is consistently found to be multidimensional, involving cognitive effort, emotional involvement, and behavioral participation (Reeve, Basarkod, Jang, et al., 2025). Fourth, *feedback and self-regulated learning support* are particularly important in distance settings (Yu, 2023). Immediate and actionable feedback, often facilitated by AI, helps learners navigate their progress and maintain motivation (Zhan, Boud, Dawson & Yan, 2025). This reduces the sense of isolation commonly associated with distance education. Fifth, *accessibility, inclusivity, and authenticity* are critical enabling conditions (Silva, Pimentel, Duarte, Escarpini, Sousa, Cruz & Silva, 2025). Immersive learning is meaningful

only when it is accessible across devices and bandwidth conditions, inclusive of diverse learner needs, and connected to real-world applications. Authentic tasks enhance transferability and long-term learning value (Salinas-Navarro, Vilalta-Perdomo, Michel-Villarreal & Montesinos, 2024).

While these characteristics are widely supported, the literature reveals a persistent imbalance: many studies emphasize high-end technologies (VR) without adequately addressing accessibility and scalability (Gao, Su, Wang & Tao, 2025). This creates a risk of *exclusive immersion,* where only technologically privileged learners benefit. Furthermore, the student perspective is often inferred rather than directly examined, indicating a need for more empirical, learner-centered research (Tang, 2024).

From Characteristics to Design: The AIDE Framework

Building on the identified characteristics, the analysis advances the AIDE framework (AI-Driven Immersive Design for Education) as a structured response to the lack of integrative design models in literature.

The framework organizes immersive learning design into the following five interrelated phases (Pitsikalis, Kostas & Vitsilaki, 2024; Lazou & Tsinakos, 2025; Chigbu & Makapela, 2025). They are: (i) Analyze: Understanding learner profiles, contexts, and constraints, (ii) Immerse: Designing experiential, context-rich learning scenarios, (iii) Differentiate: Enabling AI-driven personalization and adaptivity, (iv) Engage: Fostering interaction, agency, and sustained involvement, and (v) Sustain: Supporting feedback, assessment, and continuous improvement.

The findings indicate that effective immersive learning design is not linear but *iterative and cyclical*, with continuous feedback loops informing refinement. Each phase corresponds to both theoretical principles and empirically observed learner needs. For instance, the Analyze phase directly addresses transactional distance by aligning design with learner context, while the Differentiate phase operationalizes AI-driven personalization.

Importantly, the framework translates abstract characteristics into *actionable design logic*, thereby addressing one of the key research gaps identified earlier. It also integrates multiple theoretical strands, including constructivism (Immerse), self-determination theory (Engage), and adaptive learning (Differentiate), into a coherent model.

Although the AIDE framework offers conceptual clarity, its current form remains *theoretically derived* rather than empirically validated. The literature provides strong support for individual components, but fewer studies examine how these elements function in combination (Snyder, 2019). Additionally, the implementation of AI-driven differentiation raises ethical and practical concerns, including data privacy, algorithmic bias, and over-reliance on automation. These issues must be carefully considered in future applications.

Linking Design to Experience: Immersive Learning as a Mediating Construct

A key finding of this study is that the impact of immersive learning design on outcomes is *indirect and mediated by learner experience* (Sam, Mu'min, Riyanto, Iskandar, Abid & Melati, 2025). Across the reviewed studies, design features such as interactivity, personalization, and feedback do not automatically lead to improved outcomes unless they are perceived and experienced meaningfully by learners (Fortuna, Prasetya, Samala, Rawas, Criollo-C, Kaya, Raihan, Andriani, Safitri, & Nabawi, 2025).

This supports the conceptualization of *Immersive Learning Experience* (ILE) as a higher-order construct encompassing presence, engagement, personalization, interaction, and support. The findings reinforce that: (i) Well-designed immersive environments enhance ILE and (ii) Strong ILE, in turn, leads to improved learning outcomes. The design-to-experience-to-outcome pathway is consistent with constructivist and experiential learning theories, which emphasize the central role of learners' interpretation and engagement.

A notable limitation in the literature is the lack of standardized measures of immersive learning experience. Many studies rely on isolated indicators (e.g., engagement or satisfaction), which may not capture the full multidimensional nature of immersion (Marconi, Longo & Cabitza, 2026). This fragmentation underscores the importance of developing validated instruments, such as the proposed ILES-DE, to support more robust empirical testing.

Immersive Learning and Multidimensional Learning Outcomes

The analysis further reveals that immersive learning contributes to a broad range of learning outcomes, which can be categorized into the following four domains. They are: (i) Cognitive outcomes: Enhanced conceptual understanding, critical thinking, and knowledge retention. (ii) Affective outcomes: Increased motivation, satisfaction, and positive attitudes toward learning. (iii) Behavioral outcomes: Greater participation, persistence, and self-directed learning behaviors. (iv) Transfer and sustainability outcomes: Improved ability to apply knowledge in real-world contexts and support for lifelong learning (Soelistya, Julhadi, Rahmi, Priyatiningsih, Siregar, Supriatna & Saputra, 2023; Lee, Lee, Hwang & Woo, 2025; Dubinsky & Hamid, 2024; Yu, Shi, Dong & Kang, 2025; Zhi & Wu, 2023).

These findings align with the study's theoretical foundation, particularly experiential learning and self-determination theory. Immersive environments that support autonomy, competence, and relatedness are more likely to produce sustained engagement and meaningful learning. However, the literature suggests that *transfer and sustainability outcomes are less frequently measured*, despite being highly relevant to contemporary educational goals. This represents a critical gap, especially in the context of global priorities emphasizing lifelong learning and adaptability.

While positive outcomes are widely reported, many studies rely on short-term evaluations and self-reported data. There is limited longitudinal evidence demonstrating the lasting impact of immersive learning. Additionally, the novelty effect of immersive technologies may temporarily inflate engagement and motivation, raising questions about long-term effectiveness (Lee, Chen & Basu, 2025).

Implications for Distance Learning and AI-Enhanced Pedagogy

Synthesizing across findings, this study highlights several key implications for the design of immersive learning in OFDL, as follows. First, immersion should be understood as a *pedagogical condition rather than a technological feature*. Effective design prioritizes learner experience over technological complexity. Second, AI plays a transformative role when used to *enhance personalization and support*, rather than merely automating processes. Its value lies in enabling responsiveness and adaptability at scale (Gadi, Khan, Islam & Suhluli, 2026; Wessel, Adam, Benlian, Majchrzak & Thies, 2025).

Third, accessibility and inclusivity must be embedded as *core design principles*, not afterthoughts. This is essential for ensuring equitable learning opportunities in diverse distance learning contexts. Fourth, immersive learning design must address the *full spectrum of learning outcomes*, including long-term transfer and sustainability, rather than focusing solely on engagement or immediate performance (du Preez & Jacobs, 2025; Gawlik-Kobylińska, 2026).

Synthesis of Findings

In response to the research questions, the findings can be summarized in the following three main concerns. They are: (i) Immersive learning materials in distance education are characterized by *multidimensional, learner-centered experiences* encompassing presence, personalization, engagement, and support. (ii) These characteristics can be systematically translated into the AIDE framework, which provides a structured and practical model for design. (iii) The relationship between design and learning outcomes is *mediated by immersive learning experience,* highlighting the importance of learner perception and engagement.

Overall, the findings advance the field by shifting the focus from *immersion as a technological possibility* to *immersion as a designable, learner-centered experience*. At the same time, the analysis underscores the need for more rigorous empirical validation, greater attention to inclusivity, and deeper exploration of the long-term impact on learning. These insights provide a strong foundation for both theoretical advancement and practical innovation in AI-enhanced distance education.

CONCLUSION

This study sets out to move the discourse on immersive learning beyond conceptual enthusiasm toward *practical, learner-centered implementation* in the context of AI-enhanced

distance education. By synthesizing current literature and translating it into the AIDE framework, the study contributes a structured pathway from design intention to learning experience and, ultimately, to meaningful outcomes. What emerges is not merely a model, but a reframing: immersive learning is less about technological intensity and more about the *quality of experience as perceived by the learner*.

The distinctive contribution of this study lies in three interrelated aspects. First, it *re-centers immersive learning from the learner's perspective*, particularly within open and flexible distance learning. While much of the existing literature privileges tools and platforms, this study foregrounds how learners *experience* immersion, positioning perception, engagement, and meaning making as the true drivers of effectiveness. Second, the study offers an *integrative design framework* (AIDE) that bridges previously fragmented domains: immersive pedagogy, AI-driven personalization, and distance learning theory. Rather than treating these as parallel conversations, the framework synthesizes them into a coherent and operational model that educators can adopt and adapt. Third, the study advances a *design → experience → outcome logic*, highlighting the mediating role of immersive learning experience. This shifts the evaluative focus from "What technology is used?" to "What kind of learning experience is created?" and "How does that experience translate into sustainable learning?" Taken together, these contributions position the study not only as a synthesis of knowledge but as a *design-oriented reorientation of the field*.

While the AIDE framework provides a structured approach, its effectiveness depends on how thoughtfully it is applied. Several critical considerations deserve attention. First, *context sensitivity is paramount*. The Analyze phase must go beyond superficial profiling to gain a deep understanding of learners' realities, including technological access, cultural context, and learning readiness. Without this grounding, even the most sophisticated immersive designs risk misalignment. Second, *immersion should not be equated with technological sophistication*. High-end tools such as VR or AI systems can enhance learning, but they are not prerequisites for immersion. In many distance learning contexts, especially those with limited resources, *well-crafted narratives, simulations, and problem-based tasks* can achieve equally powerful immersive effects. Third, *AI must remain pedagogically guided.* While AI enables personalization and scalability, it should not replace pedagogical judgment. Designers must remain attentive to issues of transparency, bias, and over-automation, ensuring that AI supports rather than dictates the learning process. Fourth, *accessibility and inclusivity must be designed from the outset*. Immersive learning that excludes certain learners due to bandwidth, device limitations, or accessibility barriers undermines its own purpose. The Sustain phase of AIDE should explicitly incorporate mechanisms for continuous evaluation of equity and access. Fifth, *iteration is essential*. The AIDE framework is inherently cyclical, and its strength lies in continuous refinement. Feedback loops, learning analytics, and student input should inform ongoing design improvements.

Beyond frameworks and models, there are deeper principles that can guide the creation of meaningful immersive learning experiences. These are not technical prescriptions, but

philosophical anchors for educators and designers navigating the AI era. At its heart, immersive learning is about *presence with purpose*. It is not enough to place learners in rich environments; those environments must invite them to think, to question, and to connect knowledge with life beyond the screen. Designers are called to remember that *technology amplifies intention*. If the intention is shallow, immersion becomes spectacle. If the intention is meaningful, even simple designs can become transformative. The power of AI and immersive tools lies not in their novelty but in how they are aligned with human learning (Cinar, Rafferty, Cutting & Wang, 2024). There is also a quiet truth in distance education: learners often journey alone. In this space, immersive learning becomes a way of *re-humanizing the digital experience*, creating moments where learners feel seen, guided, and connected, even in the absence of physical presence.

Finally, designing immersive learning in the AI era requires a balance *between innovation and humility*. Innovation pushes boundaries, but humility reminds us that learning is deeply human. No system, however advanced, can replace the learner's agency, curiosity, and capacity to make meaning (Luan, 2025). "From immersion to implementation" is ultimately a call to action. It invites educators and researchers to move beyond asking whether immersive learning works, toward asking *how it can be designed responsibly, inclusively, and meaningfully*. The AIDE framework offers one pathway, but its true value lies in how it is enacted in diverse educational realities. Please refer to the "Twelve Core Characteristics of Immersive Learning Materials (Extended) in OFDL Viewed from the Student Perspective (see in the Attachment). In the evolving landscape of AI-enhanced distance education, the challenge is not simply to design better technologies, but to design *better learning experiences*. And in that endeavor, the learner's perspective remains the most essential compass.

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