



Experiential psychological mechanisms in immersive learning: Presence, embodiment, and engagement as mediator in learning outcomes

Dona Mustika^{a,b}, Dedi Kuswandi^a, Ika Andriani Farida^a, Iden Rainal Ihsan^c

^aTeknologi Pembelajaran, Universitas Negeri Malang

Jl. Cakrawala No.5, Sumbersari, Kec. Lowokwaru, Kota Malang, Jawa Timur 65145

^bPendidikan Fisika, Universitas Samudra

Jl. Prof. Dr. Syarief Thayeb, Meurandeh, Langsa Lama, Langsa City, Aceh 24416

^cDepartment of mathematics, National Taiwan Normal University

88, Sec.4, Ting-Chou Road, Taipei, 116059, Taiwan

*Corresponding author, e-mail: dona.phys@gmail.com

ARTICLE INFO

Article history:

Received: 28-12-2025

Revised: 29-04-2026

Accepted: 12-05-2026

Keywords:

Immersive learning; presence; embodiment; engagement; experiential learning



This is an open access article under the [Creative Commons Attribution-ShareAlike 4.0 International](https://creativecommons.org/licenses/by-sa/4.0/) license.

Copyright © 2026 by Authors. Published by Universitas Negeri Malang.

ABSTRACT

Emerging immersive technologies such as Virtual Reality (VR) and Augmented Reality (AR) have driven a transformation in experience-based learning. However, the psychological mechanisms that bridge immersive experiences to learning outcomes have not yet been systematically defined. This study aims to examine and synthesise the roles of presence, embodiment, and engagement as psychological mediators in immersive learning from the perspective of experiential psychology. The method used in this study is a systematic conceptual review, with articles identified using Google Scholar as the data source. The results of the theoretical mapping indicate that direct sensory experience serves as a sensorimotor foundation for evoking a sense of presence. That sense of presence, in turn, supports cognitive and affective engagement. Together, these three components form a mutually reinforcing psychological construct with learning outcomes. Therefore, this study makes a significant conceptual contribution by presenting a more structured and evidence-based framework for designing and evaluating immersive technology-based learning environments.

INTRODUCTION

Enhancements in immersive technologies such as VR, AR, and MR, offer students new ways to engage with learning materials through visually rich, interactive experiences that closely resemble real-life situations (Reiser et al., 2025). These technologies are widely regarded as a means of enhancing student motivation, conceptual understanding, and overall engagement (Acevedo et al., 2024; Pitelinskiy et al., 2025). However, research findings indicate that the impact on learning outcomes is not always consistent. In certain situations, student interest may increase without a corresponding significant improvement in understanding (Bhat et al., 2025). On the other hand, the use of technology can lead to distractions, cognitive overload, or an excessive emphasis on visual elements rather than the learning and thinking processes themselves (Sweller,

2020). This highlights that the effectiveness of immersive learning depends not only on the technology used but also on the psychological mechanisms that influence the learning experience.

Within this framework, three key psychological constructs are of paramount importance: presence, embodiment, and engagement. Presence describes the sensation of “being there” in a virtual environment; embodiment relates to physical engagement, self-representation, and sensorimotor interaction; while engagement refers to learners’ cognitive, emotional, and behavioral participation (MacDowell & Lock, 2023). Collectively, these constructs are considered to mediate the relationship between immersive experiences and learning outcomes. However, although they have been extensively discussed in the literature, presence, embodiment, and engagement are often studied in isolation and rarely conceptualised as part of an integrated and systematic mechanism.

This theoretical review integrates insights from experiential psychology, embodied cognition, and educational psychology to explain the functions of presence, embodiment, and engagement, while proposing a conceptual framework that identifies these three constructs as mediating factors in immersive learning. This article aims to explore how theories of experiential psychology explain the roles of presence, embodiment, and engagement in immersive learning (RQ 1), as well as how these constructs can be conceptually formulated as mediating mechanisms linking immersive experiences to learning outcomes (RQ 2).

To support the systematic conceptual analysis conducted in this study, three interrelated perspectives were adopted as the primary analytical framework. First, Kolb’s Experiential Learning Theory (Kolb, 2015) serves as the core framework for explaining how deep experiences can foster meaningful learning through a continuous cycle of concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Second, Embodiment Cognition Theory emphasised the crucial role of bodily and sensorimotor interactions in shaping cognition, arguing that knowledge is developed not only through mental processes but also through physical engagement and interaction with the surrounding environment (Fenwick, 2003; Xu et al., 2022). Third, Educational Psychology provides a perspective for understanding how cognitive, affective, motivational, and behavioural dimensions collectively influence the depth and quality of learning outcomes (Makransky & Petersen, 2021). Collectively, these three theoretical perspectives serve as a conceptual foundation for identifying, analysing, and synthesising the roles of presence, embodiment, and engagement as psychological mediators in an immersive learning environment.

CONCEPTUAL BACKGROUND

Experiential Learning

From the perspective of experiential learning, learning is understood not merely as the process of receiving information, but as the process of experiencing, interpreting, and constructing meaning through an individual’s direct engagement with their environment. Kolb (2015) defines learning as “the process by which knowledge is created through the transformation of experience”. In other words, knowledge is produced through changes in the meaning of experience. According to Kolb, this process unfolds through four dialectical and continuous modes of learning, cycling through concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Kolb’s perspective is rooted in the ideas of John Dewey and Kurt Lewin. Dewey (1986) emphasises that not all experiences are educational; what matters most is designing experiences that are “fruitful” and well-organised to guide student learning. In other words, the educator’s task is to create a series of well-structured learning experiences, as these foster a deeper understanding. Another experiential learning model developed by Lewin suggests a perspective on the dynamics of change in which the internal learning process is viewed through a three-stage model: unfreezing (breaking old habits), change (transforming), and refreezing (establishing new habits). Lewin’s model demonstrates that to achieve new understanding, old mental structures must be “unfrozen,” followed by a transformation of experience, and finally, the new structure is consolidated (Kolb, 2015).

Experiential learning integrates cognitive, emotional, and physical dimensions simultaneously into the learning process. Meaningful learning experiences generally require

emotional engagement, sustained attention, and active physical participation. Emotional engagement enhances personal relevance and supports memory retention, while cognitive engagement contributes to information processing, drawing conclusions, and integrating concepts. On the other hand, physical participation through action, manipulation of objects, or interaction with the environment enriches mental representations and strengthens meaning-making (Kolb, 2013).

Experiential learning in conventional educational settings still faces several challenges; efforts to create authentic learning experiences are often hindered by constraints related to time, space, accessibility, safety risks, and ethical considerations (Roberts, 2018). In many cases, learning activities fail to generate meaningful engagement or provide contextual situations that accurately reflect real-world conditions. On the other hand, experiences that are too simplistic or limited may be ineffective in fostering active student engagement (Sudgen, et al, 2021). In response to these challenges, technological advancements are opening new opportunities for designing, simulating, and facilitating richer learning experiences. Immersive technology enables the design of learning environments that closely resemble real-world contexts, while still giving educators greater control over the learning process (Baxter & Hainey, 2024). However, the success of this technology depends not only on its technical sophistication but also on how effectively it is integrated into the experiential learning process. Therefore, experiential learning must first be understood as a foundational theoretical framework before exploring the nature of immersive learning and the psychological mechanisms that influence learning outcomes.

Immersive Learning as a Psychological Experience

Immersive learning refers to an educational approach that provides experiential and interactive learning through technology capable of overcoming the limitations of the physical environment. Its primary goal is to offer learning experiences that are difficult or even impossible to achieve in a conventional setting (MacDowell & Lock, 2023). Furthermore, immersive learning environments are intentionally designed to foster a sense of presence, engagement, and realism similar to authentic real-world situations. Technology, such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), allows learners to actively interact with digital objects, environments, and simulations that are typically demanding to present in traditional educational contexts (Enyedy & Yoon, 2021).

One of the defining characteristics of immersive learning is the feeling of “being there”, often referred to as “presence”, which describes the subjective experience of feeling physically present, with the virtual environment being displayed. Presence enables virtual learning experiences to be meaningful, and the understanding gained in VR tends to resemble real-world experiences when users feel present (MacDowell & Lock, 2023). Presence can encompass spatial presence, social presence, and co-presence with other agents, thereby creating a more authentic experiential framework. Dengel and Mägdefrau (2019) identified a sense of presence as a key predictor of learning outcomes. This means that when learners feel as though they are actually present in a situation—rather than merely observing it—the cognitive processes involved often become more contextual and action-oriented. Thus, immersive learning does not merely enhance visual appeal; rather, it modulates how individuals interpret the learning situation. Through experiential learning, immersive learning has a strong foundation in meaning and understanding, as concrete experiences accompanied by a sense of presence serve as an effective medium for knowledge transformation.

Immersive learning also engages the body through interaction, movement, and control—a process known as embodiment (Xu et al., 2022). Embodiment is the sensation that the virtual body is fully under one’s control (Makransky & Petersen, 2021). Self-representation through avatars, manipulation of virtual objects, and the ability to freely explore space create an experience that emphasises the body’s role as a medium for thinking and understanding. Slater and Wilbur (1997) argued that the quality of visual representation and user interaction in virtual environments plays a crucial role in determining the level of immersive and presence experienced by users. Therefore, virtual environments that feature realistic graphics and interactive features tend to create a stronger sense of presence, which, in turn, enhances the potential for effective learning transfer.

Furthermore, engagement is recognised as a key aspect of the immersive learning experience. In immersive learning, engagement refers to the extent to which learners are cognitively, emotionally, and behaviorally involved when interacting with a virtual environment (Lee et al., 2024). Within this framework, engagement goes beyond mere interest or fleeting attention; rather, it encompasses learners' active participation in information processing, decision-making, and efforts to achieve learning objectives (Mills, 2020). However, without meaningful engagement, a visually appealing immersive environment may serve merely as entertainment rather than facilitating deep conceptual understanding.

The arguments outlined above unveil that the effectiveness of immersive learning does not depend solely on the sophistication of the technology or hardware used. Rather, meaningful learning experiences must be designed with an emphasis on the quality of learners' subjective experiences, including their sense of presence, engagement, and emotional and sensory connection. By considering the cognitive (understanding and visualisation), affective (motivation and emotion), and sensorimotor (physical movement and bodily interaction) dimensions, a more holistic theoretical framework can be developed. In this context, presence, embodiment, and engagement are psychological mediators that connect immersive media to learning outcomes. Therefore, an integrated theoretical review of these three concepts is decisive for explaining how immersive experiences contribute to improving student learning outcomes.

METHOD

This article employed a Systematic Theoretical Review or Systematic Conceptual Review approach as its methodological approach. Unlike a conventional systematic literature review, which primarily synthesises empirical evidence, this approach aims to identify, interpret, and integrate theoretical concepts relevant to a specific field of study. Furthermore, a systematic theoretical review focuses on refining theoretical constructs and conceptual integration within a field of study (Torraco, 2016). Therefore, the primary objective of this review is to develop a more comprehensive and integrated conceptual understanding of the variables under investigation, namely presence, embodiment, and engagement, as the primary psychological mechanisms underpinning immersive learning.

The article identification phase utilised the academic search platform Lens.org, which is linked to the Google Scholar database as its primary source. It was chosen because it provides transparent filtering of academic publication metadata that can be tracked through clearly defined search parameters. The strategy combines key concepts with Boolean operators: ("immersive learning" OR "immersive education") AND ("presence" OR "spatial presence" OR "telepresence") AND ("embodiment" OR "embodied cognition" OR "virtual embodiment") AND ("engagement" OR "cognitive engagement" OR "learning engagement"). These keywords were systematically formulated from the core constructs underpinning the research questions, following a PICO-inspired keyword derivation framework widely applied in systematic review studies (Methley et al., 2014). This set of keywords is drawn from established terminology, as reported in various influential and frequently cited studies in this field. Specifically, the concept of "immersive learning" is adapted from the work of MacDowell and Lock (2023) and Mystakidis and Lympouridis (2023). The terms "presence" and "spatial presence" are based on the studies by Slater and Wilbur (1997) and Dengel and Mägdefrau (2019). Meanwhile, "embodiment" and "embodied cognition" are based on the frameworks proposed by Kilteni et al. (2012) and Xu et al. (2022). The terms "engagement" and "cognitive engagement" are adapted from studies by Makransky and Petersen (2021) and Lee et al. (2024). By grounding the search terms in theoretically established literature, this strategy minimises arbitrary keyword selection and strengthens the reliability and replicability of the search procedure. Moreover, no publication year restriction was applied because this study aims to examine and compare conceptual and theoretical perspectives, rather than to investigate temporal trends or recent advancements. Such an approach aligns with the conventions of conceptual review studies, where theoretical development and the synthesis of ideas are prioritised over publication chronology. The inclusion and exclusion criteria established for this study are presented in Table 1.

Table 1. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Document Type	Journal articles, academic books, or book chapters that explore or discuss the concepts of presence, embodiment, or engagement in the context of immersive learning	Empirical studies that report only quantitative data without explicitly discussing the concepts and context of immersive learning
Article Categories	Literature that presents theoretical perspectives, conceptual models, or approaches	Opinion pieces, editorials, or non-academic publications
Conceptual relevance	Discussing presence, embodiment, or engagement from a conceptual or theoretical perspective	Merely using the term merely using the term without a conceptual definition without a conceptual definition
Relationship with the mediator	Explaining or linking presence, embodiment, and engagement as mediators (of learning outcomes), either explicitly or implicitly	The article that only reports on the direct effects on learning outcomes without addressing the underlying psychological mechanisms
Educational Context	Formal and non-formal education (training)	Entertainment without an educational context, such as video games and industrial simulations
Theoretical depth	It provides definitions and relationships among constructs or offers a theoretical model, framework, or argument	Merely describes the concept in a descriptive (superficial) manner
Language	English and Indonesian	In addition to English and Indonesian

The article selection process follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The PRISMA diagram documented the number of articles received and selected at each stage of the process. The literature selection process consists of four main stages:

1. Identification: All documents relevant to the keyword combination were extracted from Lens.org.
2. Preliminary screening: Removal of duplicates and selection based on titles and abstracts.
3. Eligibility: Evaluation of the full text against inclusion and exclusion criteria.
4. Final inclusion: Documents meeting the criteria were selected for conceptual analysis.

The analysis was conducted using a conceptual analysis approach, which is a method for identifying operational definitions, key dimensions, relationships among constructs, and the contribution of each concept to the understanding of the immersive learning process. The analysis focused on: (1) a conceptual framework for presence, embodiment, and engagement; (2) the role of these three constructs within the framework of educational psychology (particularly experiential learning); and (3) the mediating role of these concepts on learning outcomes in the context of immersive learning environments.

The synthesis was conducted thematically, by grouping the literature into categories based on conceptual contributions and relationships among psychological variables.

The article selection and screening process was conducted by the first author, who independently performed all stages of identification, title and abstract screening, full-text eligibility assessment, and final inclusion based on the predetermined inclusion and exclusion criteria. To minimise the risk of selection bias, a structured screening protocol was applied consistently at each stage. In cases of uncertainty regarding article eligibility, the decision was made through iterative discussion with the co-authors, who served as critical reviewers in the final selection. Inter-rater consistency was ensured through periodic reviews of selected articles using an inclusion criteria checklist.

Figure 1 shows the results of the article selection process conducted using the PRISMA method. In accordance with the PRISMA procedures, a total of 18 articles were ultimately selected for inclusion in this study.

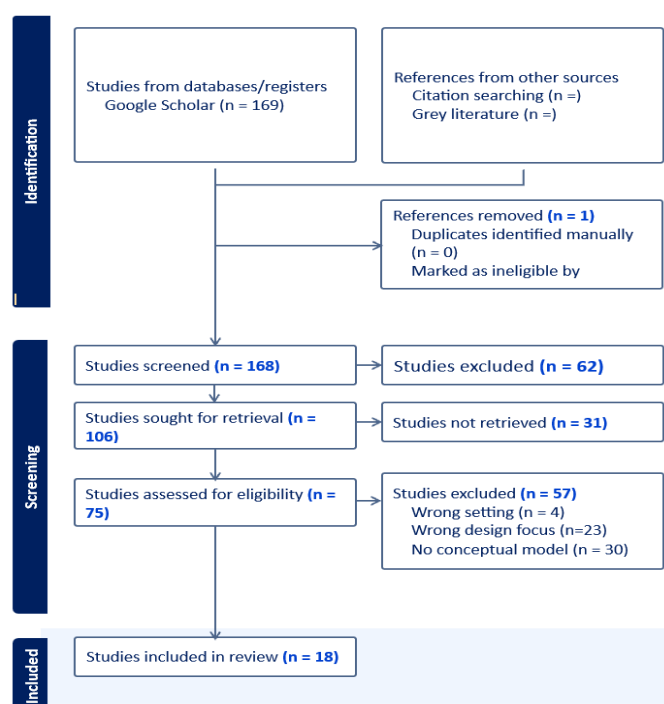


Figure 1. Results of article selection using PRISMA

RESULT: THEORETICAL MAPPING

The following is based on the foundational framework of Kolb's Experiential Learning Theory, Embodied Cognition Theory, and Educational Psychology. Collectively, these frameworks serve as a guide in selecting presence, embodiment, and engagement as primary psychological constructs examined in this analysis. Each construct is closely related to specific dimensions highlighted in their respective theories, where presence corresponds to the concrete experience phase of Kolb's experiential learning cycle, embodiment relates to the sensorimotor process emphasised in Embodied Cognitive Theory, and engagement encompasses the cognitive, affective, and behavioural dimensions highlighted in Educational Psychology.

Presence: Definition, conceptual dimensions, psychological mechanisms, and mediating functions

Presence in immersive learning refers to the psychological experience of feeling physically and mentally present within a virtual environment that is perceived as authentic and realistic (Harrington et al., 2021; Kalina & Johnson-Glenberg, 2020; Zhang et al., 2022). This construct encompasses several dimensions, including spatial presence, which relates to the awareness of being within a virtual space; self-presence, which reflects the perception of oneself as part of the virtual environment; and social presence, which involves the perception of the other individuals during virtual social interaction (Chenais & Görden, 2024; Pagano et al., 2020).

From a psychological perspective, experiential psychology conceptualises presence as a multifaceted cognitive process that emerges through sensory and emotional engagement in direct experience. Interaction across various sensory modalities, including visual, auditory, and kinaesthetic channels, enhances learners' perception of presence in virtual learning environments, thereby enabling emotional and cognitive engagement (Tan, 2019). In this context, presence reinforces the "concrete experience" phase in Kolb's experiential learning cycle by making the learning experience more authentic, meaningful, and context-based (Liu et al., 2024).

The sense of presence acts as a mediating factor linking immersive learning experiences to educational outcomes (Davis et al., 2022). It significantly supports knowledge acquisition, particularly for students with limited prior knowledge. Conversely, among learners with strong prior knowledge, the effect of the sense of presence is significantly reduced (Mulders & Träg, 2023). Furthermore, presence is most effective when learners are allowed to control, interact, and actively participate. This sense of presence stimulates deeper affective engagement and cognitive

processing, which in turn enhances retention and conceptual understanding (Kalina & Johnson-Glenberg, 2020). Therefore, the presence cannot be considered a consistently effective moderating factor in enhancing learning interest appears to exert only a partial influence on attitude.

Mediator embodiment: Conceptual definitions, psychological mechanisms, and mediating functions

Embodiment refers to the integration of physical actions into digital learning experiences. However, embodiment is not simply about physical movement but rather involves linking physical actions with cognitive processes to support the construction of meaning (Liu et al., 2024; Davis et al., 2022). In immersive learning, embodiment occurs when learners use their bodies to actively control and manipulate content. This embodiment can occur on a figural scale (small movements within an avatar), a vista scale (viewing broad representations from a distance), and an environmental scale (exploring space/the environment) (Zhang et al., 2022; Lee-Cultura & Giannakos, 2020). Therefore, the embodiment approach is a framework that places the body, sensorimotor process, and environmental context at the center of cognitive development.

From a psychological perspective, embodiment refers to the idea that knowledge and concepts are acquired not only through mental processes but also through physical activities such as movement, body gesture, touch, and changes in body posture. The involvement of the body makes the learning experience more engaging, meaningful, and memorable (Tan, 2019). Thus, embodiment integrates bodily actions, sensory perceptions, and cognitive processes into a holistic learning experience (Chenais & Görden, 2024). Within this framework, the body functions as a perception-action system. When learners actively control, manipulate, and interact with learning content through bodily movement, they develop a sense of autonomy and kinaesthetic engagement that enhances attention and involvement in the task. This interaction goes beyond simple more activities, as it contributes to the formation of body-based mental representations that transform abstract ideas into more concrete and easily understandable experience (Pagano et al., 2020). This mechanism further enhances the sense of presence as participants feel “truly present” within the learning situation, and the level of presence is influenced by the quality of agency and bodily interaction; in this context, embodiment serves as a predictor of presence. Consequently, presence and embodiment are interrelated (Liu et al., 2024). In immersive learning, immersive technologies such as VR create an “embodiment illusion” through multisensory integration. Although it is an illusion, users can experience it as if it were real (Hulsen, 2024).

As a mediator, embodiment transforms physical sensations into conceptual understanding and retention. Studies show that active bodily engagement enhances knowledge transfer, emotional engagement, and cognitive efficiency (Chenais & Görden, 2024). Body representations that align with learning content also enhance students’ focus, motivation, and participation (Tan, 2019). In addition to serving as a psychological mediator, embodiment also acts as a moderator in determining the strength of the influence of embodied learning on learning outcomes. High levels of embodiment produce a significantly greater effect on learning performance compared to moderate or low levels of embodiment (Liu et al., 2024).

Engagement: Definition, conceptual dimensions, psychological mechanisms, and mediating functions

Engagement is viewed as the metaverse system’s ability to make students feel involved, active, and autonomous, rather than merely present in a virtual space. Emotional and motivational engagement also helps students feel more connected to the narrative and the experience (Li & Yu, 2023). Engagement can also turn into a distraction or off-task activity if it is not designed with pedagogical considerations in mind. Engagement is a multidimensional response to the design of engaging and interactive experiences. There are three main dimensions of engagement: cognitive (thinking, processing, problem-solving), emotional (enthusiastic, interested), and active behavior (actively participating, performing tasks) (Calvert & Hume, 2022).

In psychological mechanisms, engagement is composed of various factors, including affective, cognitive, motivational, and phenomenological dimensions. Several references indicate that these dimensions play a role in the emergence of the psychological mechanism of engagement. First, engagement can result from the level of immersion created, where this immersion enhances a

sense of presence and the enjoyment of learning, which in turn fosters intrinsic motivation and encourages sustained engagement in learning activities (Yu et al., 2025). Second, engagement can result from immersive tasks and embodied interactions, where movement, object manipulation, and exploration trigger emotional stimuli and physiological arousal that strengthen attention and curiosity, thereby keeping learners focused and engaged (Barrow et al., 2024). Third, engagement can arise from performance expectations, in which immersive technology is viewed as a tool to support task completion. When learners are given relevant and meaningful tasks, they tend to view learning activities as valuable and achievement, thereby fostering engagement as a rational and motivational response to meaningful learning experience (Khlaif et al., 2025). This mechanism also explains the mediating role of engagement in learning outcomes, functioning as a psychological bridge that transforms the immersive experience from mere visual stimulation into a meaningful learning process.

DISCUSSION (SYNTHESIS)

The three psychological mediators examined (presence, embodiment, and engagement) are widely regarded as essential components in determining the effectiveness of immersive technology-based learning. Although many studies, particularly those examining Virtual Reality (Barrow et al., 2024), emphasised presence as a key aspect of the immersive learning experience, these studies often fail to address its functional relationship with engagement and embodiment. Such an approach leads to a reductionist perspective in which presence is treated as the sole determinant of learning effectiveness. Examining these variables in isolation may obscure their integrated roles as interrelated psychological mechanisms that collectively shape the experience into meaningful learning outcomes (Mystakidis & Lympouridis, 2023).

These three mediating variables are interrelated rather than functioning independently, thereby creating a reciprocal pathway that enriches the overall learning experience. Embodiment serves as the sensorimotor foundation for the emergence of a sense of presence, which refers to the feeling of “being” with a virtual environment. When learners perceive their bodies as coherent representations through experiences such as body ownership and agency, they tend to develop a stronger cognitive and emotional sense of presence. This heightened sense of presence then fosters deeper emotional and cognitive engagement in the learning process. Such a mediating relationship is clearly illustrated in the CAMIL (Cognitive Affective Model for Immersive Learning) framework, where immersive design influences learning outcome through a sequential process involving presence, embodiment, and engagement. Within this framework, embodiment is conceptualised as a design feature that directly influences presence while indirectly shaping engagement and learning outcome (Makransky & Petersen, 2021). Consequently, immersive technology design alone does not substantially improve learning outcomes unless its effects are mediated through embodiment, which in turn enhances presence and affective engagement.

Embodiment as the sensorimotor foundation of experience

Embodiment acts as the major gateway to an immersive experience, which refers to the extent to which learners perceive the sensorimotor representation of their bodies within a virtual environment. It provides a physiological and perceptual grounding in virtual reality through active bodily interaction, whether physical (body movements in space) or representational (via an avatar or control device) (Zhang et al., 2022). This representation encompasses aspects such as body ownership (the sense of ownership of one’s virtual body), agency (control over one’s actions), and self-location (the perception of one’s presence in virtual space) in creating a sense of internal realism within the virtual world (Kilteni et al., 2012; Gonçalves et al., 2022).

Psychologically, embodiment lays the groundwork for affective and cognitive engagement as it fosters body awareness within the learning environment. Learners do not merely “see” the content, but also “feel” and “experience” it physically (see Figure 2). This physical interaction transforms the learning experience into a profound sensorimotor event, thereby fostering cognitive interaction with the virtual environment. This bodily experience (embodiment) mediates concrete experience in experiential learning (Fenwick, 2003).

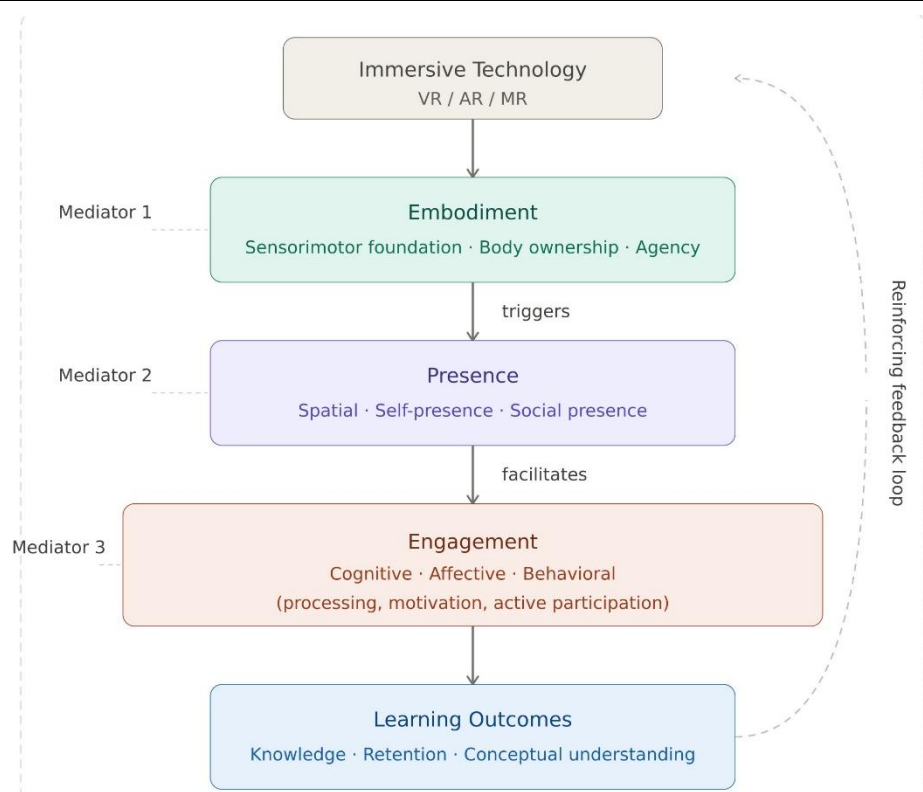


Figure 2. Psychological mediation model of immersive learning

Presence as a perception of existence and subjective reality

After embodiment provides learners with a “body” in the virtual world, presence allows learners to feel that they “are” within it (Makransky & Petersen, 2021). Presence enables learners to believe that the interactions taking place are psychologically real. Therefore, presence cannot be separated from embodiment, as a consistent body perception forms the foundation of a realistic sense of presence. Appropriate representations of the virtual body result in increased spatial presence and the plausibility illusion (Hofer et al., 2020), which are significant aspects in the creation of subjective presence.

Presence enhances emotional engagement by creating an authentic, meaningful, and contextual environment. When learners feel fully present, they are more responsive to learning stimuli and tend to be more connected to instructional objectives. Although presence is often considered the central focus of immersive learning experiences (Kalina & Johnson-Glenberg, 2020; Mulder & Trag, 2023), presence alone is insufficient to explain learning effectiveness. A sense of presence is significantly correlated with engagement and learning outcomes. Therefore, it is vital to integrate presence, embodiment, and engagement as layered mediators.

Engagement as cognitive, affective, and behavioral activation

Engagement is both a consequence and a catalyst of presence and embodiment (Makransky & Petersen, 2021). When learners feel physically present in the learning space (embodiment) and psychologically immersed in the learning situation (presence), their mental, emotional, and physical engagement increases significantly. A loss of time perception, increased focus, and intrinsic satisfaction are signs that learners are in a state of full engagement (Kim et al., 2013; Van et al., 2021).

Engagement encompasses cognitive, affective, and behavioural dimensions. All three reinforce information processing and facilitate the formation of long-term knowledge. Engagement is also a strong predictor of academic performance, learning motivation, and persistence in completing tasks. In achieving learning outcomes, engagement acts as a mediator in the cognitive-affective intensification process, which influences the depth of information processing and conceptual integration.

Implications for experiential learning

The three mediators—presence, embodiment, and engagement—can represent the characteristic cycle of learning in Kolb’s experiential learning model, namely that learning occurs when individuals actively experience, reflect on, and construct meaning from their experiences. Concrete experience is achieved through embodied interaction; reflective observation is reinforced by presence, which enables full attention and awareness; abstract conceptualisation is facilitated by cognitive engagement; and active experimentation emerges through behavioural engagement directed toward content exploration. In other words, these mediators not only mediate between technology and learning but also reshape the entire learning process itself to make it more immersive, reflective, and active. This indicates that this mediation pathway not only explains cognitive processes but also makes room for affect and bodily perception as integral parts of the learning process. The interaction among these three mediators is also dynamic and has the potential to form a feedback loop. The synergy between presence, embodiment, and engagement also creates optimal conditions for the occurrence of flow—a psychological state in which a person is fully absorbed in experiential learning activities.

Furthermore, the findings of the above synthesis also provide a conceptual foundation for an immersive learning model grounded in experiential psychology, which posits embodiment, presence, and engagement as multi-layered mediators. Within this framework, the relationship between immersive experiences and conceptual learning is influenced by learners’ sense of presence, engagement, and identification. Rather than adopting a simplistic stimulus-response view, this model emphasised the dynamic interaction between perception, emotion, and acting during the experiential learning process.

Furthermore, evaluating the effectiveness of immersive technology-based learning environments (VR/AR/MR) can no longer rely solely on measures of cognitive achievement or technical usability. Such evaluation must also encompass psychological dimensions, including emotional engagement, a sense of presence, and sensorimotor engagement. This perspective opens up opportunities for the development of a psychometric assessment instrument. Instruments designed to evaluate interactions involving the body, a sense of presence, and engagement can provide a more comprehensive and accurate understanding of the impact of immersive learning interventions.

CONCLUSION

This study synthesised conceptual insights from 18 reviewed articles to examine and organise the three primary psychological mediators, namely embodiment, presence, and engagement, in immersive learning through the lens of experiential psychology. The results indicate that these factors operate in an interrelated and sequential manner, reinforcing one another as mediating mechanisms that link immersive experiences to learning outcomes. Embodiment supports the formation of realistic body representations, which enhance learners’ sense of presence in virtual environments and subsequently foster stronger cognitive, emotional, and behavioural engagement. The synthesis emphasises that effective immersive learning experiences depend not only on technological design, but also on the activation of deep psychological mechanisms. Therefore, these three mediators need to be explicitly considered in the design, implementation, and evaluation of immersive technology-based learning systems. This study provides a theoretical foundation for developing a holistic, transformative, and experience-based learning model.

Several limitations of this study should be acknowledged. First, the article identification and screening procedures were largely conducted by a single reviewer. Although a systematic protocol and predefined inclusion criteria were applied consistently to minimise subjectivity, the absence of two independent reviewers may have increased the potential for selection bias. Therefore, future research is advised to encompass at least three independent reviewers and apply measures of inter-rater reliability, such as Cohen’s Kappa coefficient, to enhance the methodological rigor of the screening process. Second, although the literature search combined Lens.org with the Google Scholar database, reliance on a single database may have limited the scope of the retrieved literature. Consequently, some relevant theoretical and conceptual studies indexed only in other major academic databases, including Scopus, Web of Science, or ERIC, may

not have been identified. Future systematic conceptual reviews on immersive learning are advised to adopt a multi-database search approach to improve the comprehensiveness and reliability of the literature coverage.

Funding

This research did not receive any specific funding from public, private, or non profit organisations.

Conflict of interest

There is no potential conflict of interest.

Data availability statement

All data are available from the author.

Disclosure of AI Use

The authors used OpenAI's ChatGPT to revise and refine the language used in introduction. All generated content has been carefully reviewed and verified by the authors.

REFERENCES

- Acevedo, P., Magana, A. J., Walsh, Y., Will, H., Benes, B., & Mousas, C. (2024). Embodied immersive virtual reality to enhance the conceptual understanding of charged particles: A qualitative study. *Computers & Education: X Reality, 5*, 100075. <https://doi.org/10.1016/j.cexr.2024.100075>
- Barrow, J., Hurst, W., Edman, J., Ariesen, N., & Krampe, C. (2024). Virtual reality for biochemistry education: the cellular factory. *Education and information technologies, 29*(2), 1647-1672. <https://doi.org/10.1007/s10639-023-11826-1>
- Baxter, G., & Hainey, T. (2024). Using immersive technologies to enhance the student learning experience. *Interactive Technology and Smart Education, 21*(3), 403-425. <https://doi.org/10.1108/ITSE-05-2023-0078>
- Bhat, K. R., Verma, V., & Craig, S. D. (2025). Mobile augmented reality impacts engagement, but not learning. *Computers & Education: X Reality, 7*, 100122. <https://doi.org/10.1016/j.cexr.2025.100122>
- Calvert, J., & Hume, M. (2022). Immersing learners in stories: A systematic literature review of educational narratives in virtual reality. *Australasian Journal of Educational Technology, 38*(5), 45-61. <https://doi.org/10.14742/ajet.7032>
- Chenais, N., & Görden, A. (2024). Immersive interfaces for clinical applications: current status and future perspective. *Frontiers in neurorobotics, 18*, 1362444. <https://doi.org/10.3389/fnbot.2024.1362444>
- Davis, T. J., Merchant, Z., & Kwok, O. M. (2022). An examination of practice-based virtual simulations and pre-service mathematics teaching efficacy and outcome expectancy. *Education Sciences, 12*(4), 262. <https://doi.org/10.3390/educsci12040262>
- Dengel, A., & Mägdefrau, J. (2019, June). Presence is the key to understanding immersive learning. In *International Conference on Immersive Learning* (pp. 185-198). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-23089-0_14
- Dewey, J. (1986, September). Experience and education. In *The educational forum* (Vol. 50, No. 3, pp. 241-252). Taylor & Francis Group. <https://doi.org/10.1080/00131728609335764>
- Enyedy, N., & Yoon, S. (2021). Immersive environments: Learning in augmented+ virtual reality. In *International handbook of computer-supported collaborative learning* (pp. 389-405). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-65291-3_21
- Fenwick, T. (2003). Reclaiming and re-embodiment experiential learning through complexity science. *Studies in the Education of Adults, 35*(2), 123-141. <https://doi.org/10.1080/02660830.2003.11661478>
- Gonçalves, G., Melo, M., Barbosa, L., Vasconcelos-Raposo, J., & Bessa, M. (2022). Evaluation of the impact of different levels of self-representation and body tracking on the sense of presence and embodiment in immersive VR. *Virtual Reality, 26*(1), 1-14. <https://doi.org/10.1007/s10055-021-00530-5>
- Harrington, M. C., Bledsoe, Z., Jones, C., Miller, J., & Pring, T. (2021). Designing a virtual arboretum as an immersive, multimodal, interactive, data visualization virtual field trip. *Multimodal Technologies and Interaction, 5*(4), 18. <https://doi.org/10.3390/mti5040018>
- Hofer, M., Hartmann, T., Eden, A., Ratan, R., & Hahn, L. (2020). The role of plausibility in the experience of spatial presence in virtual environments. *Frontiers in Virtual Reality, 1*, 2. <https://doi.org/10.3389/frvir.2020.00002>

- Hulsen, T. (2024). Applications of the metaverse in medicine and healthcare. *Advances in Laboratory Medicine/Avances en Medicina de Laboratorio*, 5(2), 159-165. <https://doi.org/10.1515/almed-2023-0124>
- Kalina, E., & Johnson-Glenberg, M. C. (2020, June). Presence and platform: Effects of embodiment comparing a 2D computer and 3D VR game. In *2020 6th international conference of the immersive learning research network (iLRN)* (pp. 31-37). IEEE. <https://doi.org/10.23919/iLRN47897.2020.9155160>
- Khlaif, Z., Salama, N., Hamamra, B., & Mousa, A. (2025). Factors Influencing Educators' Perspectives on Accepting Extended Reality in Health Care Education: Qualitative Study. *JMIR Medical Education*, 11, e65042. <https://doi.org/10.2196/65042>
- Kilteni, K., Groten, R., & Slater, M. (2012). The sense of embodiment in virtual reality. *Presence: Teleoperators and Virtual Environments*, 21(4), 373-387. <https://doi.org/10.3390/encyclopedia3020026>
- Kim, Y. H., Kim, D. J., & Wachter, K. (2013). A study of mobile user engagement (MoEN): Engagement motivations, perceived value, satisfaction, and continued engagement intention. *Decision support systems*, 56, 361-370. <https://doi.org/10.1016/j.dss.2013.07.002>
- Kolb, D. A. (2013). The process of experiential learning. In *Culture and processes of adult learning* (pp. 138-156). Routledge. <https://doi.org/10.1016/B978-0-7506-7223-8.50017-4>
- Kolb, D. A. (2015). *Experiential learning: Experience as the source of learning and development Second Edition* (p.76). New Jersey: Pearson Education Inc. ISBN: 978-0-13-389240-6
- Lee-Cultura, S., & Giannakos, M. (2020). Embodied interaction and spatial skills: A systematic review of empirical studies. *Interacting with Computers*, 32(4), 331-366. <https://doi.org/10.1093/iwcomp/iwaa023>
- Lee, S. M., Yang, Z., & Wu, J. G. (2024). Live, play, and learn: Language learner engagement in the immersive VR environment. *Education and Information Technologies*, 29(9), 10529-10550. <https://doi.org/10.1007/s10639-023-12215-4>
- Liu, J. Y. W., Mak, P. Y., Chan, K., Cheung, D. S. K., Cheung, K., Fong, K. N., ... & Maximo, T. (2024). The effects of immersive virtual reality-assisted experiential learning on enhancing empathy in undergraduate health care students toward older adults with cognitive impairment: Multiple-Methods study. *JMIR medical education*, 10, e48566. <https://doi.org/10.2196/48566>
- Li, M., & Yu, Z. (2023). A systematic review on the metaverse-based blended English learning. *Frontiers in Psychology*, 13, 1087508. <https://doi.org/10.3389/fpsyg.2022.1087508>
- MacDowell, P., & Lock, J. (Eds.). (2023). *Immersive education: Designing for learning*. Springer Nature. <https://doi.org/10.1007/978-3-031-18138-2>
- Makransky, G., & Petersen, G. B. (2021). The cognitive affective model of immersive learning (CAMIL): A theoretical research-based model of learning in immersive virtual reality. *Educational psychology review*, 33(3), 937-958. <https://doi.org/10.1007/s10648-020-09586-2>
- Methley, A. M., Campbell, S., Chew-Graham, C., McNally, R., & Cheraghi-Sohi, S. (2014). PICO, PICOS and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. *BMC Health Services Research*, 14, 579. <https://doi.org/10.1186/s12913-014-0579-0>
- Mills, N. (2020). 11 Engagement and Immersion in Virtual Reality Narratives. *Student engagement in the language classroom*, 11. <https://doi.org/10.21832/9781788923613-014>
- Mulders, M., & Träg, K. H. (2023). Presence and flow as moderators in xr-based sustainability education. *Sustainability*, 15(23), 16496. <https://doi.org/10.3390/su152316496>
- Mystakidis, S., & Lympouridis, V. (2023). Immersive learning. *Encyclopedia*, 3(2), 396-405. <https://doi.org/10.3390/encyclopedia3020026>
- Pagano, A., Palombini, A., Bozzelli, G., De Nino, M., Cerato, I., & Ricciardi, S. (2020). ArkaeVision VR game: User experience research between real and virtual paestum. *Applied Sciences*, 10(9), 3182. <https://doi.org/10.3390/app10093182>
- Pitelinskiy, K., Makovey, S., Aldag, A., & Vertaeva, V. (2025). Impact of immersive learning tools on student motivation and academic participation. *Revista Conrado*, 21(107), e4931-e4931.
- Reiser, R. A., Carr-Chellman, A.A., & Dempsey, J. V. (Eds. 5). (2025). *Trends and issues in instructional design and technology* (p. 409-461). Newyork: Taylor & Francis. <https://doi.org/10.4324/9781003502302>
- Roberts, J. (2018). From the editor: The possibilities and limitations of experiential learning research in higher education. *Journal of Experiential Education*, 41(1), 3-7. <https://doi.org/10.1177/1053825917751457>

- Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. *Presence: Teleoperators and virtual environments*, 6(6), 603-616. <https://doi.org/10.1162/pres.1997.6.6.603>
- Sugden, N., Brunton, R., MacDonald, J., Yeo, M., & Hicks, B. (2021). Evaluating student engagement and deep learning in interactive online psychology learning activities. *Australasian Journal of Educational Technology*, 37(2), 45-65. <https://doi.org/10.14742/ajet.6632>
- Sweller, J. (2020). Cognitive load theory and educational technology. *Educational technology research and development*, 68(1), 1-16. <https://doi.org/10.1007/s11423-019-09701-3>
- Tan, S. (2019). The rise of immersive learning. *Journal of Applied Learning and Teaching*, 2(2), 91-94. <https://doi.org/10.37074/jalt.2019.2.2.12>
- Torraco, R. J. (2016). Writing integrative reviews of the literature: Methods and purposes. *International Journal of Adult Vocational Education and Technology (IJAVET)*, 7(3), 62-70. <https://doi.org/10.4018/IJAVET.2016070106>
- Van Tuin, L., Schaufeli, W. B., & Van den Broeck, A. (2021). Engaging leadership: Enhancing work engagement through intrinsic values and need satisfaction. *Human Resource Development Quarterly*, 32(4), 483-505. <https://doi.org/10.1016/j.dss.2013.07.002>
- Xu, X., Kang, J., & Yan, L. (2022). Understanding embodied immersion in technology-enabled embodied learning environments. *Journal of Computer Assisted Learning*, 38(1), 103-119. <https://doi.org/10.1111/jcal.12594>
- Yu, N., Shi, W., Dong, W., & Kang, R. (2025). The impact of virtual reality immersion on learning outcomes: A comparative study of declarative and procedural knowledge acquisition. *Behavioral Sciences*, 15(10), 1322. <https://doi.org/10.3390/bs15101322>
- Zhang, X., Chen, Y., Hu, L., & Wang, Y. (2022). The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics. *Frontiers in psychology*, 13, 1016300. <https://doi.org/10.3389/fpsyg.2022.1016300>