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The use of immersive technologies in Higher Education: A systematic review

El uso de tecnologías inmersivas en la Educación Superior: una revisión sistemática

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Abstract

Higher education is undergoing a structural transformation driven by the integration of immersive technologies, such as Virtual Reality (VR), Augmented Reality (AR), and 360° video, which are redefining contemporary learning ecosystems. The objective of this study is to analyze the scientific evidence on the application, pedagogical effectiveness, and determining factors of the use of these tools in the university setting. A systematic review based on the PRISMA protocol was conducted, consulting high-impact databases such as Scopus, Web of Science, and SciELO. The analysis included studies focused on the pedagogical impact and cognitive and motivational learning outcomes. The results indicate that immersive technologies optimize academic performance, enhance intrinsic motivation, and facilitate the understanding of abstract concepts through sensory immersion and practice in safe environments. It was identified that effectiveness depends on the degree of immersion and a robust techno-pedagogical design that includes didactic activities before and after the technological experience. The study concludes that these tools possess transformative potential. However, its success depends on overcoming the digital divide and providing ongoing teacher training. Critical and ethical integration into structured teaching models is imperative.

Keywords: Immersive technologies, higher education, virtual reality.

Resumen

La educación superior atraviesa una transformación estructural impulsada por la integración de tecnologías inmersivas, como la Realidad Virtual (RV), la Realidad Aumentada (RA) y el video 360°, que redefinen los ecosistemas de aprendizaje contemporáneos. Este estudio tuvo como objetivo analizar la evidencia

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científica sobre la aplicación, efectividad pedagógica y factores determinantes del uso de estas herramientas en el ámbito universitario. Como método, se empleó una revisión sistemática fundamentada en el protocolo PRISMA, consultando bases de datos de alto impacto como Scopus, Web of Science y SciELO. El análisis incluyó estudios centrados en el impacto pedagógico y los resultados de aprendizaje cognitivo y motivacional. Los resultados, indican que las tecnologías inmersivas optimizan el rendimiento académico, potencian la motivación intrínseca y facilitan la comprensión de conceptos abstractos mediante la inmersión sensorial y la práctica en entornos seguros. Se identificó que la efectividad depende del grado de inmersión y de un diseño tecno pedagógico sólido que incluya actividades didácticas previas y posteriores a la experiencia tecnológica. Se concluye que estas herramientas poseen un potencial transformador; sin embargo, su éxito está condicionado a la superación de brechas digitales y a la capacitación docente continua. Es imperativa una integración crítica y ética en modelos didácticos estructurados.

Palabras clave: Tecnologías inmersivas, educación superior, realidad virtual.

Introduction

This study presents a systematic review of the use of immersive technologies in higher education, emphasizing the transformation currently underway through the incorporation of Virtual Reality (VR), Augmented Reality (AR), and 360° video, a development that ranks among the most significant shifts in the contemporary educational landscape. Sánchez-Caballé and Esteve-Mon (2023) note that university digitalization accelerated markedly in the wake of the COVID-19 crisis, spurring new modes of teaching and learning. In this context, García et al. (2025) argue that the pandemic exposed the limitations of traditional information-transmission models, highlighting the need to move toward more interactive and interconnected educational environments. Similarly, Cabero-Almenara and Roig-Vila (2019) emphasize that these resources foster student motivation and engagement through more dynamic learning experiences. The central problem addressed here, therefore, concerns the need to assess their pedagogical effectiveness while overcoming structural, technical, and economic barriers, and to move beyond isolated practices by grounding their use in a theoretical framework capable of transforming traditional models into dynamic, interactive settings.

The adoption of immersive technologies has promoted the development of hybrid educational ecosystems that demand a pedagogical and ethical restructuring of university institutions. Juárez-Vázquez et al. (2026) argue that this process entails rethinking faculty roles and the organization of formative processes. Along these lines, Chonata (2023) observes that digital tools are essential for teacher self-directed learning and ongoing technological updating. Angulo et al. (2023) further note that these tools enable interaction with simulations that carry no real-world risks, thereby facilitating the transfer of competencies. Consistently, Radianti et al. (2020) report positive effects on motivation, participation, and academic performance, evidencing a shift from content-centered models toward experiences oriented toward authentic problem-solving.

The importance of studying this phenomenon is justified by the growing demand for advanced digital literacy and the need to respond to the challenges of a highly technological labor market. Soriano-Sánchez and Jiménez-Vázquez (2025) demonstrate analytically that augmented reality significantly increases student motivation at the university level. This immersive pedagogical resource enhances academic performance and enriches the overall educational experience by enabling interactive, dynamic learning on a global scale. At the regional level, Espinoza et al. (2025) point out that virtual reality offers opportunities to democratize access to high-quality practical experiences. Similarly, Camacho et al. (2020) consider technological mediation essential for ensuring educational continuity in contexts marked by inequality. Consequently, these tools provide access to virtual laboratories and simulations that, due to economic or geographic constraints, would otherwise remain inaccessible to students.

The expansion of this field is also reflected in sustained growth in scientific output. López et al. (2019) identify an accelerated increase in research on augmented reality in higher education. Suh and Prophet (2018) likewise document a significant expansion of studies related to immersive technologies. Bonales-Daimiel et al. (2024) highlight that immersive technologies are evolving into highly favorable digital spaces for all generations, facilitating social interaction, improving academic engagement, and enabling practical simulations across diverse controlled settings. In a complementary vein, Martínez-Requejo et al. (2024) report that a considerable proportion of studies employ immersive virtual reality devices, while Luna et al. (2023) underscore growing interest in analyzing the relationship between these technologies and self-regulated learning. Collectively, these precedents confirm that digital immersion represents a consolidated trend within contemporary educational innovation (García Cruz & Castillo Lescano, 2025).

From a disciplinary standpoint, this research is situated at the intersection of educational technology and university didactics. Macanchí et al. (2020) emphasize that readiness and active participation constitute the first step toward building a robust culture of university innovation, an approach that is fundamental to pedagogical and didactic processes in professional teaching. Within this framework, Li et al. (2023) stress the importance of interdisciplinary collaboration across computer science, education, the arts, and business management without disciplinary limitations, concluding that user- and student-centered design is vital for optimizing satisfaction and cognitive interaction. Angulo et al. (2023) similarly maintain that effectiveness depends on sound techno-pedagogical design, while Da Costa et al. (2023b) underscore the need to overcome constraints related to technological infrastructure and faculty digital competence.

Notwithstanding growing academic interest, significant knowledge gaps persist. Espinoza et al. (2025) point to the limited attention given to the specific challenges facing Latin America. Furthermore, contradictory findings emerge regarding the effectiveness of these tools. Although Luna et al. (2023) highlight benefits related to motivation and learning, other studies caution against risks such as cognitive overload and academic distraction. In this regard, Soriano-Sánchez and Jiménez-Vázquez (2025) maintain that effectiveness depends not solely on augmented reality itself, but that improvements are enhanced by the ARCS model, which encompasses Attention (A), Relevance (R), Confidence (C), and Satisfaction (S). These dimensions are essential for fostering effective student learning and for personalizing contemporary university instruction.

Another relevant gap concerns the absence of integrative syntheses that examine these technologies from a transdisciplinary perspective. Juárez-Vázquez et al. (2026) observe that much of the existing research theorizes retrospectively about already-implemented practices, without developing conceptual models that account for issues such as the redistribution of academic authority, ethics, or self-regulated learning within immersive environments.

For these reasons, conducting a systematic review is particularly pertinent for organizing, evaluating, and critically interpreting the available evidence (Sánchez-Caballé & Esteve-Mon, 2023). Yépez-González and Solís-Franco (2025) maintain that this method enables an understanding of complex phenomena from a critical standpoint, while Flores et al. (2026) emphasize its rigor, transparency, and replicability. Accordingly, this study aims to analyze the scientific evidence on the application of immersive technologies in higher education, identifying the factors that condition their pedagogical effectiveness and their impact on student performance and motivation.

Methodology

This study adopts an interpretive paradigm, which, as Hernández-Sampieri and Mendoza (2018) contend, seeks to understand educational phenomena through the meanings constructed by social actors. This approach enables a critical analysis of how technologies transform teaching and learning processes in higher education (García et al., 2025). Qualitative hermeneutics further supports the interpretation of educational experiences as a basis for grounding pedagogical innovations (Candia, 2021), while narrative synthesis contributes to understanding the development of competencies and contemporary academic

dynamics (Gaona-Portal et al., 2024). The interpretive paradigm is therefore appropriate for critically examining the evidence on immersive technologies in ways that benefit students.

The systematic review constitutes a rigorous method for identifying, evaluating, and synthesizing existing scientific production (Sánchez-Caballé & Esteve-Mon, 2023). These authors emphasize that its connection to the qualitative approach lies in the possibility of interpreting complex phenomena without experimental manipulation of variables, making it suitable for studying the integration of immersive technologies in higher education (Yépez-González & Solís-Franco, 2025; Tramullas, 2020). It is further characterized by structured, transparent, and replicable procedures (Page et al., 2021).

This study focused on international publications from the period 2018–2026 addressing learning and immersive technologies, particularly virtual reality and augmented reality, and examined their pedagogical impact across diverse university contexts.

From a qualitative perspective, the research prioritizes the understanding and interpretation of empirical evidence beyond statistical indicators (Flores et al., 2026), as well as its influence on learning and student motivation (Martínez-Requejo et al., 2024).

The search strategy employed combinations of Spanish and English terms relevant to the topic and object of study, using Boolean operators and truncation to broaden or delimit results. The search was conducted in May 2026 across the Scopus, Web of Science (WOS), and SciELO databases, using the following terms:

Tecnologías AND Inmersivas, Tecnologías AND Inmersivas AND Educación, Tecnologías AND Universidad, Educación AND Superior AND Inmersivas, Tecnologías AND Aprendizaje AND Inmersivas, Educación AND Aprendizaje AND Superior, Inmersivas AND Educación AND Superior, Educación AND Superior AND Tecnologías, Educación AND Superior AND Tecnologías AND Inmersivas, Tecnologías inmersivas AND Educación Superior, Aprendizaje Inmersivo AND Universidad, Aprendizaje Inmersivo AND Educación, Realidad virtual AND Educación superior, Realidad aumentada AND Universidad, Tecnologías Inmersivas AND Educación superior, Aprendizaje inmersivo AND Universidad, Realidad virtual AND Estudiantes, Realidad virtual AND Docentes, Tecnologías AND Educación AND Estudiantes, Tecnologías AND Educación AND Docentes, Tecnologías AND Inmersivas AND Docentes, Tecnologías AND Inmersivas AND Estudiantes, Realidad virtual OR Realidad aumentada AND Educación superior, Tecnologías inmersivas OR Aprendizaje Inmersivo AND Educación superior OR universidad, Tecnologías AND Inmersivas NOT Escolares, Estrategias AND Didácticas AND Aprendizaje, Tecnologías inmersivas AND Educación superior, Tecnológicas AND Superior AND Pedagógicas, Aula invertida AND Aprendizaje, Aula invertida AND Educación, Estrategias AND digitales AND Educación, Competencias AND digitales AND Educación, Herramientas AND Digitales AND Educación, Herramientas AND Tecnológicas AND Educación superior, Innovación AND Docente AND Superior, Tecnologías AND Emergentes AND Educación, Inmersive AND Technolog, Virtual AND Reality, Augmented AND Reality, Mixed AND Reality, Extended AND Reality, Immersive AND learning.

The selection process yielded a total of 1,420,203 documents (1,016 in Scopus, 959 in Web of Science, and 1,418,228 in SciELO), from which 1,420,171 were excluded. Subsequently, 148 articles were removed for lacking open or free access, 8,200 for duplicate records, 29,628 for falling outside the educational domain, 1,118,070 for not aligning with the study objective, 84,095 for not corresponding to the university level, 178,920 for publication prior to 2018, and 992 for being published in languages other than Spanish or English. Ultimately, 32 articles were retained for the final sample.

To ensure methodological rigor, the systematic review followed the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) guidelines, which establish clear criteria for the identification, screening, eligibility, and inclusion of scientific studies, thereby consolidating the transparency and quality of the review process (Page et al., 2021).

The process was organized into five phases aligned with methodological proposals for systematic reviews in educational settings.

Phase 1. Review planning

The review objective, research questions, and methodological protocol were established. Inclusion and exclusion criteria, information sources, and search mechanisms were defined to ensure transparency and reproducibility (Page et al., 2021).

Phase 2. Systematic literature search

A comprehensive search was conducted across scientific databases using search equations built with Boolean operators and controlled terms, aiming to identify as many relevant studies as possible on the use of immersive technologies in higher education (Siddaway et al., 2019).

Phase 3. Study selection

Retrieved records underwent a screening process in which duplicates were removed and eligibility was assessed according to the established criteria, initially reviewing titles and abstracts and subsequently the full texts of potentially suitable studies, following the PRISMA 2020 flow (Page et al., 2021).

Phase 4. Data extraction and evaluation

The included studies were analyzed using a data extraction matrix that collected information on authors, year of publication, context, methodology, sample, immersive technologies employed, and key findings. Methodological quality was also assessed to reinforce the reliability of the synthesis (Aromataris & Munn, 2020).

Phase 5. Synthesis and analysis of results

The collected information was organized and synthesized through descriptive and thematic analysis, identifying trends, methodological approaches, educational applications, benefits, limitations, and research opportunities concerning immersive technologies in higher education, following recommendations for evidence synthesis in systematic reviews (Aromataris & Munn, 2020).

Table 1. *Inclusion and exclusion criteria.*

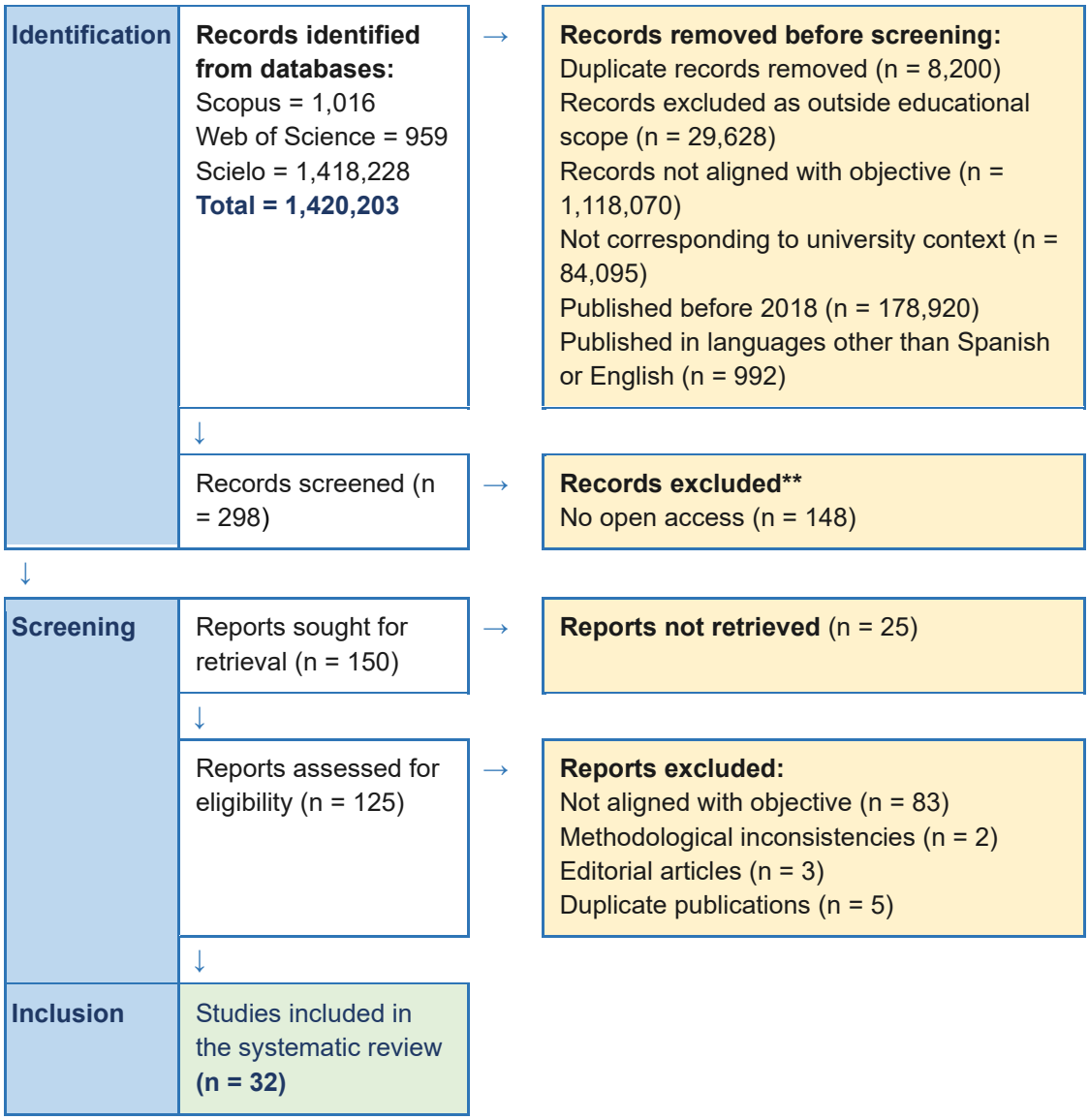
Inclusion	Exclusion
Scientific articles published in indexed journals (Scopus, WOS, SciELO, Redalyc, Latindex).	Documents lacking methodological and structural characteristics.
Studies focusing on immersive technologies, higher education, immersive learning, technological tools, teaching methodologies with digital technologies, virtual/augmented reality, and flipped classroom.	Documents not corresponding to scientific articles: essays, reviews, technical reports, theses, or book chapters.
Publications in Spanish or English.	Studies not set within the higher education context.
Articles published between 2018 and 2026.	Duplicate publications identified across different databases.
Research conducted in higher education settings.	Articles without full-text open access.
Articles with full-text open access.	Articles published before 2018 or after 2026.
A final total of **32 articles** were included in the systematic review.	

Source: Authors' own elaboration

PRISMA 2020 Flow Diagram

Figure 1. *Flow diagram of study selection according to PRISMA 2020.*

Identification of studies through databases and records



Note: ** Page et al. (2021) — PRISMA 2020.

Figure adapted from the PRISMA format with authors' own data.

Results

This section presents a synthesis of the selected studies on the use of immersive technologies in higher education, allowing the identification of trends, approaches, and contributions from the scientific evidence. The information gathered is organized in the following table, which lists the source databases, authors, study context, and main conclusions, facilitating comparative analysis and interpretation of the systematic review findings.

Table 1. *Main characteristics of the analyzed studies.*

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No.	Database	Author(s)	University/ Context	Study conclusions
1	Scielo	Bonilla et al. (2022)	La Gran Colombia University / Colombia	Immersive technologies and gamification grounded in constructivist models significantly enhance academic outcomes in higher education.
2	Scielo	Flores et al. (2026)	César Vallejo University / Peru	The flipped classroom, integrated with digital technologies, stands out as an effective strategy for fostering active and autonomous learning. This approach also improves motivation and self-regulation, optimizing academic results and student satisfaction with technology use.
3	Scopus	Mazlan et al. (2025)	Universiti Kebangsaan Malaysia, Selangor / Asia	The flipped classroom optimizes performance, participation, and student satisfaction through interactive methods and student-centered learning.
4	Latindex	Chonata (2023)	Benito Juárez University / Mexico	Digital tools facilitate teacher self-directed learning and ongoing technological updating, highlighting concept maps and infographics as effective strategies.
5	Scielo	Gaona-Portal et al. (2024)	Israel University – Quito / Ecuador	Overcoming faculty resistance to traditional education is key to leveraging students' high levels of digital competence.
6	Redalyc Latindex	Andrade (2025)	Rumiñahui Higher Technological Institute / Ecuador	Digital tools optimize teaching by making interaction more dynamic and motivating educational stakeholders. Teacher training is essential for integrating innovative methodologies that generate meaningful learning in university students.
7	Scopus Scielo	Da Costa et al. (2023)	National University / Costa Rica	Lack of digital competence and connectivity limit pedagogical integration in face-to-face settings, requiring institutional training for both faculty and students.
8	Scielo	García et al. (2025)	Association of Communication Researchers / Venezuela	The educational impact of digital technologies depends on their critical integration into structured didactic models, rather than on their sophistication.
9	Scopus Web Of Science	Sánchez-Caballé & Esteve-Mon (2023)	Catholic University of Loja / Spain	Limited faculty digital competence constitutes the main barrier to successfully implementing problem-based learning strategies.
10	Scipus Web Of Science	Juárez-Vásquéz et al. (2026)	Catholic University of Loja / Spain	Generative AI is reconfiguring higher education through hybrid pedagogies that safeguard critical thinking and teaching authority.
11	Scopus Scielo	Villegas-Dianta et al. (2025)	National University of	Webquest fosters motivation and collaboration but requires rigorous planning and teacher

No.	Database	Author(s)	University/ Context	Study conclusions
			Costa Rica / Costa Rica	training in methodological and technological competencies.
12	Scielo Latindex	Candia (2021)	Autonomous University of Puebla / Mexico	Redesigning spaces and technological applications to stimulate perceptual channels optimizes infrastructure and significantly motivates learning.
13	Scielo Doaj Latindex	Macanchí et al. (2020)	"Carlos Rafael Rodríguez" University of Cienfuegos / Ecuador	Participation in technological innovation processes and readiness are essential for building a culture of innovation, particularly valuable in university education and teaching didactics.
14	Scielo Dialnet Latindex	González & Sandoval (2021)	Libertador Experimental Pedagogical University / Venezuela	Teaching innovation should focus on technologies and disciplinary competencies, integrating research to strengthen university social responsibility.
15	Redalyc	Camacho et al. (2020)	Luis Vargas Torres Technical University of Esmeraldas / Ecuador	Despite digital divides, technology is indispensable for meeting academic objectives and preventing school year suspension in Latin America.
16	Scopus Web Of Science Eric Doaj	Criollo-C et al. (2023)	University of the Americas in Quito / Ecuador	Virtual reality and mobile learning optimize education through greater immersion, significantly motivating students and professionals.
17	Scopus Web Of Science Eric Doaj	Çelik & Baturay (2024)	Samsun University and Konya Food and Agriculture University / Turkey	Innovation lies in student-centered pedagogical design, integrating emerging technologies to generate meaningful experiences.
18	Scopus Web Of Science	Ortega-Mohedano (2024)	University of Salamanca / Spain	Critical integration of AI redefines educational roles, humanizing learning through ethical collaboration between teachers and students.
19	Scopus Doaj	Escós & Gonzálvez (2026)	University of Valencia / Spain	Integrating smartphones requires digital competencies to consolidate genuinely innovative and effective pedagogical models in higher education faculty.
20	Scopus Doaj	Queralt et al. (2026)	Rovira i Virgili University / Spain	Technological integration requires systematically documenting application evidence and meeting rigorous pedagogical criteria.

No.	Database	Author(s)	University/ Context	Study conclusions
21	Scopus	Ayala et al. (2023)	Autonomous University of Yucatán (UADY) / Mexico	Holistic technological environments improve performance and enhance metacognition, self-regulation, and comprehensive digital competence development in students.
22	Scopus	Martínez – Requejo et al. (2024)	European University of Madrid / Spain	The effectiveness of immersive technologies depends on the degree of immersion, recurrent practice, and pre- and post-technological didactic activities.
23	Scopus	Bonales - Daimiel et al. (2024)	Complutense University of Madrid / Spain	Perceptions of the metaverse vary, and regulatory frameworks are proposed to ensure equity, ethics, and security in digital spaces.
24	Scopus Web Of Science	Luna et al. (2023)	Armed Forces University ESPE - Ecuador and University of Jaén / Spain	Virtual and augmented reality are well-suited for self-regulated learning, significantly improving academic performance, motivation, and self-efficacy.
25	Scopus	Espinoza et al. (2025)	National University of Education (UNAE), Azogues / Ecuador	Virtual reality enhances motivation and understanding; its sustainability depends on structural investment and regional teacher training.
26	Scopus	Soriano-Sánchez & Jiménez-Vázquez (2025)	Ramon Llull University and University of Jaén / Spain	Augmented reality positively impacts motivation and academic performance, validating it as an effective immersive pedagogical resource for personalizing learning.
27	Scopus	Angulo et al. (2023)	Téluq University / Canada	Immersive technologies enhance learning when supported by sound techno-pedagogical design, with cautions regarding physical risks, cognitive overload, and high costs.
28	Scopus Web Of Science	Li et al. (2023)	University of Tsukuba / Japan	Virtual reality revolutionizes the interactive experience, enhancing cultural engagement and transforming artistic learning within immersive digital spaces.
29	Scopus Web Of Science	Tang et al. (2022)	Hong Kong Polytechnic University / China	Immersive technologies significantly improve surgical skills and reduce operative times, validating them as effective and safe educational resources.
30	Scopus Web Of Science	Suh & Prophet (2018)	City University of Hong Kong / China	Immersive technology research is rapidly increasing; key factors are classified to understand how these technologies systematically affect experience and performance.

No.	Database	Author(s)	University/ Context	Study conclusions
31	Scopus Web Of Science	Belmonte et al. (2019)	University of Granada / Spain	Research on augmented reality in higher education has grown rapidly, highlighting its pedagogical effectiveness and production leadership.
32	Scopus Web Of Science	Yépez-González & Solís-Franco (2025)	University of Guayaquil / Ecuador	AI and AR improve educational motivation, provided that the digital divide and insufficient teacher training are overcome through ethical integration.

Technology-based teaching innovation and social responsibility

Technological innovation must incorporate transfer to productive sectors in order to strengthen university social responsibility. Such linkage is essential for promoting sustainable development and reducing digital inequalities. This perspective benefits students by democratizing access to knowledge and reinforcing their social commitment. At the same time, it fosters the development of ethical competencies needed to lead meaningful transformations in their professional and civic environments. González and Sandoval (2021) note that technology transfer to productive and cultural sectors enhances university social responsibility. In this vein, Yépez-González and Solís-Franco (2025) maintain that progress requires ethical policies to reduce digital inequality and democratize access to knowledge. Juárez-Vázquez et al. (2026), meanwhile, define the need for hybrid ecosystems in which the teacher functions as a critical orchestrator, strengthening autonomous thinking against algorithmic dependency.

Immersive technologies applied to fostering self-regulated learning

The literature demonstrates that virtual reality and augmented reality support autonomous learning and the management of one's own formative process, constituting suitable pathways for strengthening self-efficacy and academic commitment. They allow students to organize goals and monitor progress within reliable interactive environments, thereby reinforcing the metacognitive capacity required to tackle independent academic challenges. Luna et al. (2023) maintain that these tools increase motivation, self-efficacy, and academic self-regulation. Similarly, Martínez-Requejo et al. (2024) emphasize that their effectiveness depends on constructivist approaches that promote active participation and continuous reflection. Finally, Angulo et al. (2023) affirm that these resources facilitate autonomous exploration and enable students to effectively manage their own learning pace.

Holistic technology implementation and strengthening of digital competencies

Digital transformation requires an integrated vision centered on strengthening digital competencies so that students assume a proactive and autonomous role. This holistic perspective enhances academic performance by reducing failure rates and reinforcing self-regulation and metacognition among students. It also facilitates the acquisition of critical skills necessary for successful professional performance in the knowledge society. Ayala et al. (2023) argue that holistic implementation improves academic performance and student self-regulation. Queralt et al. (2026) similarly underscore the importance of documenting application evidence and meeting rigorous pedagogical criteria. Gaona-Portal et al. (2024) further emphasize that overcoming institutional resistance is indispensable for consolidating educational innovation processes.

Collaborative strategies and student autonomy with emerging technologies

Emerging technologies foster the simultaneous development of autonomy and collaboration. Methodologies such as the flipped classroom and Webquest allow students to manage individual paces

through the social construction of knowledge. These tools enhance self-direction and commitment, transforming the teacher into a facilitator of individual responsibility and cooperative work. Escós and Gonzálvez (2026) highlight that the educational integration of smartphones requires digital competencies to consolidate innovative practices. Villegas-Dianta et al. (2025) demonstrate that methodologies such as Webquest strengthen the interplay between individual and cooperative work. Ayala et al. (2023) conclude that holistic technological environments enhance student self-direction, interdependence, and academic responsibility.

Determining factors in the pedagogical effectiveness of immersive technologies

The effectiveness of immersive technologies depends on multiple pedagogical and personal factors. Integration into didactic models, degree of immersion, and recurrent practice emerge as fundamental for optimizing outcomes. These tools benefit university students by facilitating comprehension of abstract concepts, raising intrinsic motivation, and strengthening self-efficacy through safe-environment simulations. Martínez-Requejo et al. (2024) maintain that the degree of immersion, recurrent practice, and complementary didactic activities condition learning outcomes. Angulo et al. (2023) likewise emphasize the need for a sound techno-pedagogical design responsive to student needs. Finally, Suh and Prophet (2018) note that individual characteristics and the alignment between technology and content significantly influence learning optimization.

Optimization of student performance through technological innovations

The reviewed studies concur that emerging technologies favor academic performance and the development of key competencies by reducing failure rates and raising grade averages. These innovations allow for personalized learning, fostering metacognition, self-regulation, and self-efficacy. They also optimize comprehension of abstract concepts and practical skills within safe environments, thereby enabling effective educational outcomes. Ayala et al. (2023) maintain that holistic implementation strengthens self-regulation and significantly improves learning outcomes. Bonilla et al. (2023) similarly emphasize that combining constructivist approaches with online simulators contributes to raising the quality of university education. Along the same lines, Mazlan et al. (2025) provide evidence that the flipped classroom increases performance and student satisfaction by promoting methodologies centered on active student participation.

Educational optimization through immersion with emerging technologies (VR/AR)

Immersive technologies hold considerable potential for enriching university learning by optimizing comprehension of complex concepts and elevating motivation. These tools benefit students through safe-environment simulations that improve practical skills and self-efficacy. They also facilitate self-regulated learning and knowledge retention, substantially transforming the traditional educational experience. Criollo-C et al. (2024) maintain that virtual reality optimizes educational processes through immersive experiences and practical applications of knowledge. Luna et al. (2023) similarly affirm that these tools favor self-regulated learning, strengthening academic performance and self-efficacy. Complementarily, Martínez-Requejo et al. (2024) highlight that digital immersion improves comprehension of complex concepts and student motivation.

Technological barriers and lack of digital competence in face-to-face teaching

Despite the observed benefits, obstacles limit technological integration, including insufficient teacher training and connectivity gaps. Overcoming these challenges benefits university students by democratizing access to knowledge and ensuring equitable learning. Effective integration enhances participation and creativity, optimizing academic performance through dynamic environments that strengthen professional competencies. Da Costa et al. (2023) argue that connectivity issues and low digital competence continue to hinder the incorporation of technological tools in classrooms. Gaona-Portal et al.

(2024) identify teacher resistance to change as a significant barrier. Similarly, Sánchez-Caballé and Esteve-Mon (2023) emphasize that limited faculty technological training constitutes one of the main challenges for educational innovation.

Critical integration of technologies into structured didactic models

The evidence indicates that technology alone does not guarantee better educational outcomes; its impact lies in critical integration within structured didactic models. This approach benefits university students by fostering meaningful, autonomous, and contextualized learning. It also optimizes motivation and participation, transforming technical resources into effective pedagogical tools for successful professional and academic performance. García et al. (2025) maintain that success depends on critical integration within structured didactic models. Çelik and Baturay (2024) similarly note that emerging technologies must be grounded in pedagogical designs that promote authentic learning experiences. Finally, Ortega-Mohedano (2024) emphasizes that the educational value of these tools resides in their conscious, ethical, and higher-education-enriching use.

Discussion

The review findings demonstrate that the effectiveness of immersive technologies in higher education transcends the mere availability of hardware, positioning pedagogical integration as the decisive factor for success within the educational system. The results reveal that superior outcomes are achieved through rigorous didactic planning, continuous practice, and complementary activities, as Martínez-Requejo et al. (2024) contend. In this vein, the use of Virtual Reality (VR), Augmented Reality (AR), and methodologies such as the Flipped Classroom significantly enhances active participation, autonomy, and academic performance among university students. López et al. (2019) likewise affirm the exponential growth of AR at this level, while Tang et al. (2022) provide evidence that these tools are indispensable for optimizing practical skills and operational efficiency in fields such as medicine and engineering, as well as in education.

These results, interpreted in light of García et al. (2025), imply a paradigm shift in which immersive technology acts as a mediational structure that reorganizes formative time and space. In this regard, Juárez-Vázquez et al. (2026) contend that these tools should not be viewed as isolated resources but as catalysts for active learning that reposition the student in a leading and autonomous role (Andrade, 2025; Belmonte et al., 2019). This transition demands that institutions move beyond technical pilots toward hybrid ecosystems in which teachers assume the function of critical orchestrators of complex experiences. In sum, the findings of Martínez-Requejo et al. (2024) and Espinoza et al. (2025) demonstrate that the educational value resides in the tools' capacity to facilitate comprehension of abstract concepts through authentic experimentation within simulated environments.

In relation to prior literature, this study aligns fully with Suh and Prophet (2018), who validated the accelerated expansion of immersive research and the need to understand the relationship between immersion and performance. The findings also concur with Luna et al. (2023), who identified VR and AR as suitable pathways for strengthening self-regulation and motivation. However, although innovation often generates a certain optimism, Angulo et al. (2023) note that some findings diverge from purely positive visions, cautioning against risks such as digital distraction, high costs, or cognitive overload. In contrast to early studies centered primarily on technical sophistication, recent evidence presented by Martínez-Requejo et al. (2024) underscores that pedagogical efficacy is strictly conditioned by the implementation of didactic activities both before and after the technological experience. Furthermore, the results contrast with the reality described by Sánchez-Caballé and Esteve-Mon (2023), who identify limited faculty digital competence as a critical barrier curbing the potential of these innovations in traditional classrooms.

On another front, Martínez-Requejo et al. (2024) and Tang et al. (2022) emphasize that the likely mechanisms underpinning these benefits rest on the principle of "learning by doing," which allows interaction with virtual objects and experimentation in safe environments without real-world consequences.

Along these lines, sensory immersion amplifies psychological presence, reducing extrinsic cognitive load and facilitating focus on meaningful elements (Angulo et al., 2023; Espinoza et al., 2025). Soriano-Sánchez and Jiménez-Vázquez (2025) further contend that another key mechanism is the immediate feedback provided by immersive systems, which strengthens students' self-efficacy perceptions when confronting complex tasks. Finally, the integration of gamification elements acts as a neurocognitive trigger that elevates engagement and academic satisfaction (Bonilla et al., 2023; Mazlan et al., 2025).

According to Andrade (2025) and Da Costa Polonia et al. (2023), the practical implications require universities to prioritize continuous faculty training programs and organizational change over technical sophistication. Nevertheless, Angulo et al. (2023) caution against critical limitations such as the physical risks of cybersickness and cognitive overload, which are compounded by high infrastructure costs and the persistent digital divide identified in the region (Angulo et al., 2023; Espinoza et al., 2025). In this order, Espinoza et al. (2025) and Yépez-González and Solís-Franco (2025) argue that regional sustainability fundamentally depends on structural investment policies and ethical technological integration (Espinoza et al., 2025; Yépez-González & Solís-Franco, 2025). In summary, Martínez-Requejo et al. (2024) maintain that the scarcity of longitudinal studies limits current understanding of the transfer of these learning outcomes to long-term real-world professional performance (Espinoza et al., 2025; Martínez-Requejo et al., 2024). Altogether, the dearth of longitudinal studies represents a critical gap in educational and organizational research, restricting comprehension of how acquired knowledge is integrated, adapted, and sustained within academic and workplace settings over time.

Conclusions

This systematic review has enabled an analysis of the available scientific evidence on immersive technologies in higher education, confirming their capacity to strengthen teaching and learning processes. The studies reviewed show that these tools foster more active student participation, promoting autonomy, academic engagement, and improved formative outcomes. Consequently, immersive technologies constitute valuable pedagogical resources for optimizing university education through more interactive, student-centered learning experiences.

A key finding indicates that pedagogical effectiveness does not depend exclusively on the level of technological sophistication, but rather on its adequate integration within structured didactic models. The planning of activities before, during, and after the immersive experience, together with a sound techno-pedagogical design and opportunities for continuous practice, promotes deeper and more meaningful learning. In addition, these technologies contribute to strengthening motivation, self-regulation, and self-efficacy, competencies essential for autonomous learning in university contexts.

However, the review identified limitations that hinder sustainable implementation. Notable among these are insufficient technological infrastructure, high investment and maintenance costs, digital divides, and limited faculty technological competence. Institutional resistance associated with traditional teaching models also persists. To this must be added the scarcity of longitudinal studies that would allow assessment of the long-term impact of these technologies on knowledge retention and transfer.

Finally, the study concludes that the future of higher education demands hybrid learning ecosystems in which emerging technologies, such as generative artificial intelligence and extended reality, complement rather than replace teaching practice. To this end, it is essential to promote institutional policies oriented toward continuous training, technological investment, and the ethical integration of educational innovation, thereby ensuring inclusive, sustainable education prepared for the challenges of the twenty-first century.

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