The Integration of Artificial Intelligence into the Design of Immersive Learning Environments

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Abstract

The use of artificial intelligence is fundamental in immersive education environments, which focuses on the development of intelligent systems capable of learning, thinking, planning and making decisions. Objective: to capture the generalities of the use of artificial intelligence in the creation of immersive learning environments in higher education. Methodology: several databases were used to search for information on the subject, including: Scielo, Dialnet, ELSEVIER, Cochrane, Redalyc, among others, using the following descriptors: "Artificial Intelligence + higher education", "Artificial Intelligence + immersive education" and "Artificial Intelligence + immersive education + higher education", thus selecting 76 articles that met the inclusion criteria. The results are that the articles focus on the study, description, analysis and comparison, linked to the knowledge of new immersive technologies, as well as, in other cases, to the mastery of the digital competence of university professors, concluding that the use of artificial intelligence in immersive education environments in higher education offers great opportunities to improve the quality and effectiveness of teaching. It is clear that the combination of teaching methodologies and appropriate educational technologies contribute to a more enriching learning experience.

Keywords: teaching, learning, teaching techniques, artificial intelligence.

1. Introduction

In today's digital age, higher education has evolved rapidly due to technological advancement and the growing demand for more dynamic and interactive learning experiences (Galindo Durán, 2020). In this context, Chicaiza et, al (2023) Immersive learning environments have emerged as

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promising tools to transform the way students acquire knowledge and skills. However, the real revolution in this field has been the integration of artificial intelligence (AI) into the design of these environments, which has taken immersive education to a new level of personalization and efficiency.

In recent years, technology has transformed the way we teach and learn today, however, education has evolved to incorporate an emerging disruptive technology: Artificial Intelligence (hereinafter AI), understood as "a field of study that combines the applications of machine learning, algorithm production and natural language processing" (A'mar & Eleyan, 2021). Therefore, it is crucial to adapt to these changes in the educational field and consider how AI can be effectively integrated into education. A clear example of the inclusion of AI is that brought about by ChatGPT (Jiménez García, Orenes Martínez, & López Fraile, 2024); (García Peñalvo, Llorens Largo, & Vidal, 2024), But recent studies highlight that, if used properly, it can maximize teaching and learning (UNESCO, 2021) ; (Baidoo Anu & Owusu Ansah, 2023).

Artificial intelligence refers to the ability of machines to simulate and emulate human cognitive processes, such as learning, perception, and decision-making (Ruiz Muñoz & Yépez González, 2024). By combining AI with immersive learning environments, a unique symbiosis is achieved that expands educational possibilities and transforms the way students interact with content and study materials (Lameras & Sylvester, 2021). In this scientific article, we will explore in depth the integration of artificial intelligence in the design of immersive learning environments and how it improves the personalization of learning, adapting to the individual needs and learning styles of students.

However, these technologies have been adapted in various ways in higher education, one of the most revolutionary being immersive education. According to the Royal Spanish Academy - RAE, (2024), The term "immersion" refers to the fact that it makes the viewer experience a virtual reality as if it were authentic. Prince Torres (2022).

2. Materials and Methods

The present research focused on a bibliographic documentary review methodology, where various databases were used to search for information related to the researched topic, among which are: Scielo, Dialnet, ELSEVIER, Cochrane, Redalyc, among others. A randomized and consecutive search was carried out, using the following descriptors: "Artificial Intelligence + higher education", "Artificial Intelligence + immersive education" and "Artificial Intelligence + immersive education + higher education". The results were selected according to criteria of Spanish and English, relevance, thematic correlation and date of publication in the last five years, dispensing with a few records of previous data, but with current and relevant content for the present research. The bibliographic material collected consisted of scientific articles, in general, clinical guidelines, e-books, clinical trials, consensus, protocols, postgraduate and doctoral theses, news bulletins and/or brochures from official or private institutions with a recognized track record in the scientific-academic field and other information, considered of interest and with the value of scientific evidence at the discretion of the authors.

Table 1. Criteria Applied for the Selection of Documents

Criteria	Inclusion	Exclusion
Typology	Scientific articles	Book Chapters, Conference Proceedings
Availability	Open Access & Text complete	Paid, summary only, or without full-text access
Type of study	Applied research	Review articles, theoretical, non-design implementing, instrument validation, and training
Participants	University Education Faculty	Teachers or students from other stages
Publication Date	2019-2024	Anterior a 2019
Language	Spanish and English	Other languages

Development

Learning Environments

In this sense, immersive education refers to the creation of learning environments that completely envelop the student, generating a practical and highly interactive experience, enhanced through the use of:

1.   Augmented reality: According to Montenegro and Fernandez (2022) It is a technology that "integrates signals captured from the real world with signals generated by computers, makes them correspond in the construction of new coherent realities, which complement and coexist in the real world and the virtual world, enriching cognitive experiences" (p. 3), with which a correspondence is made between the artificial world and the experiences of the tangible environment. On the other hand, Martínez, Fernández and Barroso (2021) They state that augmented reality is useful when it comes to arousing interest in courses that are facilitated and in the same way, it helps to focus attention on the aspects unraveled in the classes.

1.   Virtual Reality: Menjívar Valencia (2021) They establish that it is "an advanced user interface, whose characteristics involve visualization and movement in three-dimensional environments and interaction with elements in said environment" (p. 86) with which the conversion of educational models is promoted, studying with particularity each case in which it can be applied.

2.   Mixed reality: Regarding mixed reality, De Jesús and Ayala (2021) He clarifies that it combines augmented reality, holographs, artificial intelligence, a data storage that can become infinite in the cloud and all in an environment that never stops being physical and real, so it represents a fusion of virtual reality and augmented reality. Similarly, Alonso et, al (2024) They emphasize that this conjunction of elements allows the promotion of both practical and theoretical learning.

3.   3D immersive learning: It is also a context referred to as a metaverse or virtual world, which according to Ayala et, (2020) It is a persistent representation that offers the possibility of synchronous interaction between users and between them and the world, within a space designed in the form of a navigating universe and thus, it is also a way of representing reality so that problems that are observed within tangible environments are addressed in the future.

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However, the integration of AI in education is not without its challenges. Ethical questions and privacy concerns arise in the collection and use of student data.

Innovative pedagogical methodologies powered by artificial intelligence

The fusion of education with artificial intelligence has given rise to a transformative educational landscape, in which pedagogical methodologies have been revitalized through the incorporation of advanced technologies. One of the most prominent advances in this regard is the integration of artificial intelligence into online learning environments. Online education platforms, powered by AI algorithms, analyze student performance and provide personalized recommendations for studying, identifying areas of difficulty and suggesting specific resources to address them. This enables a student-centred approach, where each individual can progress at their own pace and receive the necessary support (Ayuso del Puerto & Gutiérrez Esteban, 2022); (Sekeroglu, Dimililer, & Tuncal, 2019).

Table 2. Classification of Generative AI Tools with Potential Educational Use

Text Generation	Research support	ChatPDF, Consensus, Elicit, Humata, Klavier, SciSpace Copilot, Scite Assistant, Trinka
	Chatbot	ChatGPT, ChatSonic, Claude
	Content Creation	Jasper, Notion
	Language Teaching	Twee
	Personal Resume Builder	Resume Builder
	Exam Generator	Conker. Monic
	Office tools	Google Workspace, Microsoft 365 Copilot
	Search Engine	Microsoft Bing, Perplexity, You
	Text Paraphrasing	Quillbot
Image Generator	Graph Builder	GraphGPT
	Image Generator	Adobe Firefly, Bing Image Creator, Craiyon, DALL·E 2, Deep Dream Generator, Dream by Wombo, Leap, Midjourney, NightCafe, Stable Diffusion Online, Starryai, Stockimg, Visual ChatGPT
	Presentation Builder	ChatBA, Decktopus, GPT for Slides, SlidesAI, Gamma.
Video Generator	Video to Text Converter	YoutubeDigest
	Video Generation	Fliki, Gencraft, Imagen video, Make a video
3D Object Generation	3D Object Generation	AICommand, DreamFusion, GET3D, Imagine 3D
Audio Generation	Speech-to-text converter	Otter, Transkriptor
	Audio Generation	AudioLM, Lovo, Murf.ai, Voicemaker
	Voice Modulator	Voicemod
Source Code Generation	Code debugging	Adrenaline, Code GPT
	Code Generation	Amazon CodeWhisper, Codeium, Ghostwriter, Github copilot, Text2SQL
AI-generated text detection	Plagiarism checker	Turnitin
	AI-generated text detection	AI Text Classifier, GPTZero

Source: Authors' own creation

It is critical to note that while AI presents ample opportunities for education, it is not a one-size-fits-all solution to educational problems. Therefore, it is essential to use it consciously and

thoughtfully, appropriate to the specific educational context, in order to maximize its potential benefits (Mulders, Buchner, & Kerres, 2020).

Consequently, it is necessary to carry out a critical and rigorous reflection to ensure the effectiveness and responsibility in the use of AI in education. In this sense, teachers have a fundamental role in the integration of AI in education. Korhonen et, al (2022) argues that teachers need to have specific knowledge in technology and pedagogy related to AI in order to effectively integrate it into education. In addition, they must have an ethical understanding to evaluate AI-based decisions and ensure that they are used responsibly and equitably.

This idea has already been worked on by Carring (2016), when he designed the Padagogy Wheel for technology integration, which is a tool designed to help teachers integrate technology into their pedagogical practices, focusing on pedagogy rather than technological applications. The reason why this wheel is a tool to improve the design and assessment of student-centered learning is because each section of the wheel interconnects with the other sections, meaning that learning is not a linear process, but is an ever-evolving process.

In this sense, Allan Carrington's Wheel of Pedagogy consists of several concentric rings: 1) central ring that presents the six cognitive levels of Bloom's Taxonomy

2) next ring with the four degrees of technological integration according to the SAMR Model.

3) outer rings that contain examples of technological tools and applications that can be used at each cognitive and technological integration level.

Based on these ideas, Carrington's Pedagogical Wheel (2017) combines the two theoretical frameworks mentioned above (Bloom's Taxonomy and SARM Model) into a visual representation (see Figure 1) that facilitates the selection of appropriate technological tools and strategies for each level of cognitive ability and technological integration.

Allan Carrington's Wheel of Pedagogy has proven to be an effective tool for improving the quality of teaching (Cabrera Leonardini, 2021) and learning in the context of technology. However, the wheel does not consider AI as a technology that can be integrated into teaching and learning.

For this reason, and in view of the changes that AI is causing in the field of education, the effective integration of AI in education at any of its stages is becoming increasingly easier, thus transforming education by sub stantially improving it, as long as it is used responsibly and consciously (Pombo, 2023).

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Figure 1. Allan Carrington's Wheel of Pedagogy

Source: Carrington (2017).
https://designingoutcomes.com/Padagogy_Wheel_Translations/Padagogy_Wheel_V4_SPANISHv1_HD.pdf

For this reason, the creation of a Pedagogy Wheel for AI, as proposed by Allan Carrington in his original model, is crucial to take advantage of this emerging technology in the teaching and learning process, as it facilitates the selection of appropriate AI technology tools and strategies for each level of cognitive ability and AI technology integration. In doing so, it seeks to create a more personalized, interactive, and effective educational environment that fits the needs and expectations of students in today's digital and technological age.

Table 3. Bloom's Taxonomy for Artificial Intelligence

	Description	Description applied to AI	AI Examples
Remember	At this level, the student should be able to recall previously learned information. This includes the ability to recognize and retrieve information, such as data, terms, events, and concepts.	At this level, AI can help students recall information more efficiently through the use of memory and information retrieval systems.	Teaching process: AI can be used to create question-and-answer systems that allow students to review concepts and remember important information. Learning process: Students use AI tools to make automatic summaries of text or create mind maps that help them remember key information.

Cognitive Skill Levels

Understand	At this level, the student should be able to comprehend the information. This involves the ability to interpret the meaning of information, make inferences, and explain ideas in their own words.	At this level, AI can help students understand more complex concepts by providing examples and analogies that are easy to comprehend.	Teaching process: AI can be used to create simulations or interactive visualizations that help students understand complex concepts. Learning process: Students use AI tools to translate texts into other languages or to get definitions of unfamiliar words.
Apply	At this level, the student should be able to apply previously learned information to new or different situations. This includes the ability to use the Acquired knowledge to solve problems, perform tasks, and make decisions.	At this level, AI can help students apply what they've learned to real-world situations through the use of simulations and virtual scenarios.	Teaching process: AI can be used to create personalized recommendation systems that suggest specific activities or exercises for students to apply what they've learned. Learning process: Students use AI tools to create multimedia presentations or to design creative projects that apply the concepts learned.
Analyze	At this level, the student should be able to break down information into its components and examine their relationships. This involves the ability to identify patterns, detect errors, and evaluate logic.	At this level, AI can help students analyze complex information more efficiently, identifying patterns and relationships in large data sets.	Teaching process: AI can be used to analyze student data and provide detailed information about their progress, strengths, and weaknesses. Learning process: Students use AI tools to analyze large data sets or to identify patterns in complex information.
Evaluate	At this level, the student should be able to make critical judgments and assessments about information. This involves the ability to compare and contrast, judge and evaluate the quality of information.	At this level, AI can help students assess their own learning and progress through the use of feedback and evaluation systems.	Teaching process: AI can be used to create automated assessment systems that provide instant feedback to students and teachers on student performance. Learning process: Students use AI tools to self-assess and receive feedback on their own performance.
Create	At this level, the student should be able to use the information gained to create something new. This involves the ability to generate new ideas, devise creative solutions to problems, and create unique products.	At this level, AI can help students create original content through the use of content generation tools.	Teaching process: AI can be used to create immersive and personalized learning environments that allow students to create original content and express their creativity. Learning process: Students use AI tools to create multimedia content or to develop innovative solutions to complex problems.

Source: Authors' own creation

Building Meaningful Connections Through Artificial Intelligence

In order to be able to use a technology in teaching and learning processes with criteria and knowledge of the facts, it is first necessary to know its possibilities and limits without being carried away by extremism, which is usually especially biased when a potentially disruptive trend makes its appearance, as has happened with generative AI, whose penetration has been

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especially accelerated. Therefore, prior to sharing reflections on the implications of this technology in the educational context, a prospective study will be carried out aimed at both the tools that are already available with potential educational use, and the contributions that have been made from academia in the first six months since the tsunami caused by ChatGPT.

Advantages and Challenges of Integrating Artificial Intelligence in Education

Two forces are converging in the world of education. The world is moving at a rapid pace with technology at hand. On the other hand, we see classical methods and stagnant educational systems. AI takes its place and shows us a firmer step towards the future of education, as it not only improves efficiency, but redefines the way we conceive of education. From facilitating teaching to promoting equity and inclusion, the benefits are as tangible as they are transformative.

1.   Make teaching easier: Teachers can use AI to automate administrative tasks, freeing them up to focus on teaching. Personal interaction becomes the main focus.

2.   Stimulates individual and group learning: Smart tutoring systems can be tailored to each student's learning needs, promoting more effective, personalized, and engaging learning.

3.   Enables student monitoring: Applications of artificial intelligence and AI algorithms can track student performance in real-time, providing immediate feedback that can improve information comprehension and retention.

4.   Simplifies education management: AI can improve the efficiency of administrative and management tasks in schools, from class scheduling to grade management.

5.   Promotes equity and inclusion: AI systems can be tailored to the needs of all students, regardless of their skill level, background, or physical or intellectual abilities, thus having a positive impact of AI on educational equality.

6.   Combat's school dropout: AI can identify students at risk of dropping out of school and provide early interventions, contributing to improvements in academic performance and the success of each program of study.

7.   Includes smart tutoring systems: Smart tutoring systems can provide personalized assistance to students, adapting to their pace and learning style. Not only does this complement the teacher's work, but it also offers a more individualized approach.

8.   Apply remote assessments: With AI supporting remote assessments, flexibility in the educational process is promoted. Students can be assessed more effectively, and results can be analyzed quickly and accurately.

9.   Implement online learning systems: AI can enrich the learning experience in virtual environments, adapting to students' individual preferences and abilities. This makes learning more interactive and personalized.

10.   Collecting and analyzing school data: AI can collect and analyze education data to identify patterns, trends, and areas for improvement.

11.   Create personalized learning content: AI can generate educational content tailored to each student's specific needs. This goes beyond superficial personalization, offering a truly adaptive curriculum that helps drive educational innovation.
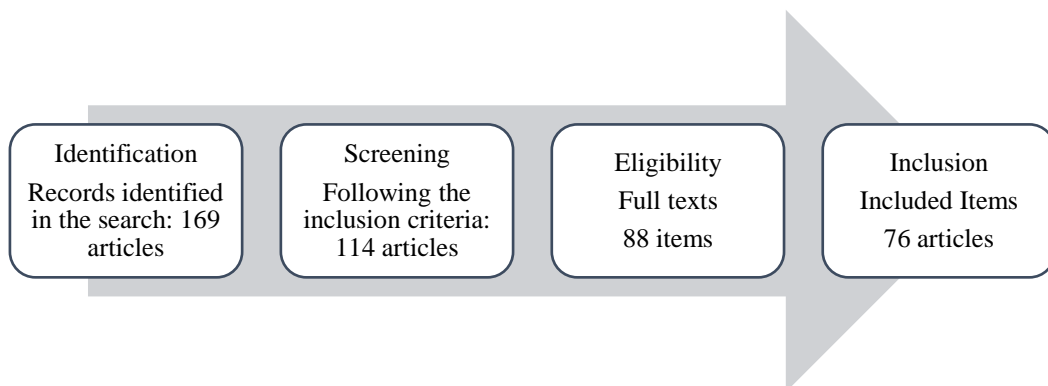
Challenges and Ethical Considerations

That is the other side of the coin, and what makes it important to approach technological tools with a responsible perspective and in line with the core educational policies of our century. To name a few, these are the challenges in the field of education:

1.   Lack of real personalization: Although AI in education aims to adapt to the individual needs of students, there is a risk that personalization will be superficial and not adequately reflect the complexities of each student's learning process.

2.   Equity: AI can perpetuate or even exacerbate existing inequalities in the education system. For example, AI algorithms may be biased, or students with limited access to technology may be left behind.

3.   Privacy and security: The collection and use of personal data in educational settings through AI can raise concerns about the privacy and security of student information. It is critical to ensure robust measures to protect sensitive information, including when interacting with technologies such as ChatGPT. For more information, it is recommended to check out this post.

4.   Technological dependency: The use of artificial intelligence, robotics, and the multiple technological facilities of our times can make students and educators less dependent on important human skills, such as decision-making, critical thinking, and problem-solving.

5.   Quality of content: AI is only as good as the data provided to it. If the educational content is of low quality, student learning will suffer.

3. Results

Based on the fact that a systematic review requires having defined a previous action protocol that must be documented, the PRISMA framework, an acronym for Preferred Reporting Items for Systematic Reviews and Meta-Analyses, is one of the most widely used in systematic review articles, providing a framework that "helps authors who intend to improve the information of systematic reviews and meta-analyses" (García Peñalvoa, 2020). Figure 2 shows the process followed for the selection of the articles that make up this analysis. In this case, the phases of the Prism Framework are followed, as a tool that contributes to improving clarity and transparency in the publication of systematic reviews.

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Figure 2. Flowchart of the item selection process.

As can be seen, a total of 169 results were obtained in the initial search. After the application of the above inclusion criteria, the documents were reduced to 114 texts, 88 full-text documents were analysed as they met the predefined inclusion criteria, but once fully evaluated, and verified by reverse search, that in the bibliography of the primary documents retrieved in the search, no other source was identified that met the proposed inclusion criteria. All 76 articles were included in this literature review.

An analysis of the 76 selected articles showed that:

1.   It observes that 21 of the studies carried out in the contexts of universities with headquarters in the Spanish territory, while there are 55 articles that have samples of professors from other university institutions, coming from Argentina, Colombia, Venezuela, Mexico, Nicaragua, Peru, Brazil and Chile.

2.   Three main trends can be observed in terms of the objectives set by the different researchers. Firstly, the articles that focus on the study, description, analysis and comparison, linked to the knowledge of new immersive technologies, as well as, in other cases, to the mastery of the digital competence of university teaching staff.

3.   On the other hand, the second trend observed in the studies is the one that looks beyond the level or domain of the digital competence of the teaching staff, and integrates and analyzes, fundamentally, variables such as the predisposition towards the use of ICTs, and/or the beliefs associated with the use of digital technologies in teaching work.

4.   Undoubtedly, the shift to remote teaching enabled and encouraged flexibility and creativity, providing an opportunity to reflect on what university faculty do and how improvement could be achieved.

5.   In any case, the realization of this study allows us to situate the state of the art based on scientific evidence, which we believe will make possible not only reflections that motivate the improvement of institutional policies in the field of teacher training but also in terms of

educational innovation. We believe that integrating teaching methodologies and educational technologies, without forgetting the importance of carrying out a prior and competency-based analysis, which allows the identification of sociodemographic and digital variables that may be conditioning the teaching-learning process, can be a good starting point.

Finally, and although the realization of this work is limited to studies published only in the database of Scopus, Scielo, Latindex and that the progressive trend of publications related to the subject, leads to a relative obsolescence, after the completion of this work, the identification of training itineraries that work from the real training needs of university teaching staff is proposed as lines of future research. with special emphasis on the areas of competence that require not only a response from the teaching staff but, especially, that imply a responsible, critical and creative use of the tools on the part of the students.

4. Conclusions

the integration of artificial intelligence (AI) into the design of immersive learning environments has the potential to significantly transform the way people acquire knowledge and skills. By combining AI with virtual reality, augmented reality, and other immersive technologies, highly interactive and personalized learning experiences can be created. In addition, AI can simulate realistic and complex scenarios in virtual environments, giving students the opportunity to apply their knowledge in practical situations without risk. Importantly, however, integrating AI into immersive learning environments also poses challenges and ethical considerations. The collection and use of personal data should be approached with caution to ensure the privacy and safety of students.

Conflict of Interest

The authors declare that this study does not present conflicts of interest and, therefore, the processes adapted by this journal have been ethically followed, stating that this work has not been published in another journal partially or totally.

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