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DIGITAL TRANSFORMATION IN HIGHER EDUCATION: SYSTEMATIC REVIEW (PRISMA) ON LEARNING PERSONALIZATION AND LMS PLATFORMS (2018-2025)

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ABSTRACT

The digital transformation in higher education represents a paradigmatic change in the way of conceiving teaching-learning processes. This shift drives the integration of emerging technologies, management platforms, and educational personalization strategies. This article conducts a systematic literature review following the PRISMA methodology (Preferred Reporting Items for Systematic Reviews and Meta-Analyses, 2021) in order to identify, analyze, and synthesize scientific evidence on the personalization of learning and the use of Learning Management Systems (LMS) in university contexts. A structured search protocol was developed between 2018 and 2025. An exhaustive search was carried out in specialized databases such as Scopus, Web of Science and Google Scholar, applying previously defined inclusion and exclusion criteria. The methodological quality of the studies was evaluated using CASP and AMSTAR, guaranteeing consistency and validity in the selection. The analytical process was organized into the phases of identification, screening, eligibility, and inclusion. The results reveal a growing trend towards educational models based on learning analytics,

artificial intelligence and adaptive systems, aimed at improving the student experience. However, several challenges stand out, such as digital equity, teacher training, and ethical data management. In conclusion, digital transformation in higher education not only involves technological innovation, but also a pedagogical and organizational reconfiguration that fosters flexible, inclusive, and student-centered learning environments.

KEYWORDS: Digital Transformation, Higher Education, Learning Personalization, Learning Management Systems (LMS).

1. INTRODUCTION

In recent decades, the remarkable evolution of digital technologies has impacted educational processes, where the personalization of learning through the use of learning management systems has allowed an adaptation of educational practice to the demands of students, through the incorporation of digital resources, allowing the transformation of traditional pedagogy (Yepes Piqueras et al., 2024).

Digital transformation has profoundly redefined the nature of higher education over the last decade, driving a convergence between pedagogy, technology, and institutional innovation, where emerging technologies facilitate the creation of more flexible, inclusive, and personalized educational environments (Aithal & Maiya, 2023). This advance in information technologies has had a significant impact on the transformation of some of the basic aspects of education, where learning management systems (LMS) have become pillars of this process because they facilitate access to materials, classes, interactive communication and interaction between teachers and students (Anozie et al., 2024). Therefore, the impact of these platforms has significantly expanded the possibilities of online learning.

In recent years, multiple studies have evidenced LSM in several of its modalities, in different countries and in different educational institutions. For example, it has been found that, in many developed countries, learning management systems are widely used and promote the interactivity and personalization of learning (Mella-Norambuena et al., 2025; Shoaib et al., 2025). However, the incorporation of LMS encounters certain limitations in developing countries, specifically at the higher level. Therefore, this article conducts a systematic review of the literature on the implementation of learning personalization and management platforms in higher education, in order to identify its benefits, challenges, and the most effective models in its application. The evidence points to the fact that the digital transformation of higher education is rather structural and not only technological, affecting teaching and learning models, learning ecosystems, and institutional management (García-Peñalvo, 2021; Serrano & Moreno-García, 2024).

According to García-Peñalvo (2021), digital transformation in higher education involves a comprehensive restructuring that encompasses institutional culture, teaching competencies, teaching methodologies, and knowledge management; in this context, learning management platforms act as technological mediators that allow not only content management, but also to analyze performance data and adapt teaching experiences to the individual needs of students (Monteiro & Leite, 2021).

According to Gm et al. (2024), personalization involves the dynamic adaptation of content, rhythms, methodologies, and evaluations, supported by data generated by the student's own interaction processes with technology; this approach has been enhanced by artificial intelligence, learning analytics, and adaptive systems, which make it possible to design individualized learning trajectories, improve retention, and promote student autonomy (Chen et al., 2018).

Despite these advances, the literature shows a conceptual fragmentation regarding the real impact of management platforms and the personalization of learning in higher education. Many studies focus on isolated cases or technological perspectives, leaving gaps in the comprehensive understanding of how these tools transform pedagogical practices and learning outcomes (Børte & Lillejord, 2024). Some of them are; Recent advances in artificial intelligence have empowered the development of more sophisticated adaptive learning systems in higher education (Hassan, 2023). Deep learning and reinforcement learning techniques have shown particular promise for personalizing learning pathways and providing feedback tailored to individual needs (Naseer et al., 2024). However, these approaches raise important ethical considerations in terms of data privacy, algorithmic bias, and student autonomy (Ramnani, 2024)

In the field of higher education, personalized learning has become relevant, but studies show that it is still at an early stage of development. Many institutions experience difficulties in terms of staff training, technological infrastructure, and pedagogical alignment (Konstantinidou et al., 2026; Xu et al., 2024; Zhang et al., 2024). In addition, there is a lack of consensus in the field on how to evaluate the effectiveness of personalization attempts, especially considering the diversity of the student population, with its distinct needs and goals (Wu et al., 2024). Faced with this dispersion, a systematic review is necessary to synthesize the available scientific evidence, identify trends and propose integrative analysis frameworks.

In this sense, the present study aims to analyze the empirical and theoretical evidence on the use of learning management systems (LMS) in higher education institutions. To this end, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology is adopted, which guarantees transparency, reproducibility, and rigor

in the review process (Page et al., 2021); This approach includes the identification, screening, eligibility and inclusion phases, ensuring that the selected studies meet criteria of methodological quality and thematic relevance.

The value of this review lies in offering a holistic vision of the university digital transformation process, considering both the technological and the pedagogical and ethical dimensions; In addition, it seeks to generate theoretical and practical contributions that guide higher education institutions in the construction of student-cantered digital ecosystems, based on innovation, equity, and educational sustainability.

Consequently, the review is structured as follows: 1) In the detailed description of the PRISMA methodology and the study selection process. 2) Results obtained and the thematic synthesis. 3) The main findings and their pedagogical implications are discussed and finally, 4) The general conclusions and future lines of research are proposed.

2. LITERATURE REVIEW

2.1 Digital Transformation in Higher Education

Digital transformation in higher education is a structural process that transcends the instrumental incorporation of technologies in the classroom. Evidence indicates that this phenomenon implies an epistemological reconfiguration of the educational act, in which technological mediation is integrated as an operational component of the teaching, learning, and evaluation processes. In this framework, digitalization is characterized as a cultural process that modifies pedagogical practices and redefines formative interactions, in accordance with the approaches reported by (Benavides et al., 2020); García-Peñalvo (2021); (Serrano & Moreno-García, 2024).

University digitalization goes beyond the adoption of technological tools, functioning instead as a cultural process that transforms teaching practices, academic interactions, and institutional relations around frameworks that consider learning ecosystems as sociotechnical systems (García-Peñalvo, 2021; Garrison, 2016). The evidence reviewed shows that digital transformation involves changes in epistemology, knowledge management, and the ways in which institutions intertwine pedagogical innovation when it is enhanced by learning analytics and artificial intelligence (Holmes et al., 2019; Tuomi, 2018). Therefore, the findings suggest that the sustainability of these processes lies in the institution's ability to incorporate organizational, pedagogical, and cultural dimensions rather than in the mere isolated deployment of technologies.

Overall, the COVID-19 pandemic not only altered educational practices in a more proximate sense, but also redefined everything that had to do with digital skills, governance, the demands for pedagogical innovations in intervention in higher education, and the paradigm that was built was that of digital transformation more in the relationship of infrastructure, culture, institutional policy, and learning about education in the sense of creating an organization (García-Peñalvo, 2021; Monteiro & Leite, 2021; Palacios-Rodríguez et al., 2021).

2.2 Personalization of Learning and Adaptive Systems

The literature has determined that the incorporation of artificial intelligence (AI) in learning environments has significantly advanced the capacity for educational personalization in higher education. Several studies have shown that adaptive systems can adjust content, learning pace, and educational pathways according to individual student performance, interactions, and progress, allowing for more efficient goal-oriented (Chen et al., 2018; Gupta et al., 2024). These technologies use predictive and analytical models to provide timely, pattern-based feedback.

Despite the documented benefits, the specialized literature warns that the adoption of AI-based personalization systems faces multiple structural, organizational, and pedagogical constraints. One of the most repetitive challenges is the lack of training of teaching staff in relation to the pedagogical, ethical, and technical use of these technologies, limiting their significant appropriation in educational practice (Fake & Dabbagh, 2023; Monteiro & Leite, 2021). There is also evidence of resistance to change in certain sectors of the teaching workforce, especially when technological innovation is seen as a threat to teacher autonomy or as an increase in workload.This phenomenon is aggravated in institutions with inflexible organizational cultures or with fragmented digitalization initiatives, where the absence of clear institutional strategies hinders the sustainability of these models (Benavides et al., 2020; García-Peñalvo, 2021).

Adaptive systems and learning analytics technologies have provided evidence that they can contribute to the advancement of knowledge, motivation, and retention in higher education. The literature also indicates that personalized learning spaces are also accompanied by the possibility for

students to strengthen and optimize their self-regulation at a higher level, and that they can, with greater intensity and flexibility than others, advance through training trajectories at the individual level (Chen et al., 2018; Ifenthaler & Yau, 2020; Nguyen, 2022). In accordance with other reports that analyze the impact of analytical education by Tuomi (2018) indicates that personalization in learning is one of the most innovative aspects in the design of digital ecosystems in higher education, making possible the sustainability of academic results thanks to the easy integration of feedback, adaptability and data-based decision-making.

2.3 Learning Management Systems as Digital Ecosystems

LMSs are online tools that help in the administration and management of the educational component in higher education institutions. Tools such as Moodle, Blackboard Learn, Canvas, and Brightspace are systems that facilitate content management, activity management, assessment, and communication between users. The literature on these tools provides elements that allow us to problematize the use of these tools in an educational context. The use of these tools serves to improve educational management and serves to improve the availability of resources in a context of face-to-face, hybrid and total virtuality (Cruz-Rojas et al., 2019; Palacios-Rodríguez et al., 2021). The literature on these educational platforms provides the possibility of questioning the use of this technology in educational management and administration as a whole. In the current context, educational management and administration presents two problems and they are the post-pandemic, the use of foreign systems and economic sustainability in educational institutions that have limitations in their administration. The literature itself has proposed as a solution the need for open educational systems, the development of teacher training and a complex use of these platforms (García-Peñalvo, 2021; Garrison, 2016).

Learning from LMS systems demonstrates that they have evolved into learning ecosystems integrating adaptability, analytics, and participation to strengthen learning experiences (Chen et al., 2018; Tuomi, 2018). Even so, the field of digital competence for teachers, interoperability and closed architectures remain a problem (Monteiro & Leite, 2021; Palacios-Rodríguez et al., 2021). As a whole, the evidence requires, in order to strengthen LMSs, the transformation of pedagogical ones towards the openness and use of student-generated data (García-Peñalvo, 2021; Redecker, 2020).

The use of LMS platforms as a basic infrastructure for managing the continuity of academic processes and innovation in pedagogy, essential in times of educational disruption (Bozkurt et al., 2020; Cruz-Rojas et al., 2019; García-Peñalvo, 2021). This has generated unique patterns such as the creation and consolidation of digital ecosystems, the intensive use of data analytics for decision-making, and the growing focus on the digital competence of teachers (Redecker, 2020)

2.4 Ethical Governance, Algorithmic Bias and Digital Equity

The review highlighted a growing concern about student data privacy, stemming from the growth of learning analytics and digital surveillance in higher education. Numerous studies warn that the intensive collection of data on user activities, interaction patterns, and digital footprints poses risks of educational surveillance and non-transparent secondary uses (Holmes et al., 2019; Ifenthaler & Schumacher, 2016). In this digital transformation, educational institutions need to have stronger frameworks to ensure informed consent, data minimization, and ethical data privacy.

A second area of analysis notes that AI-based personalization systems can reproduce or worsen algorithmic bias issues, particularly when predictive models are trained on unbalanced or contextually narrow data (Gupta et al., 2024; Redecker, 2020). This can compromise educational equity by affecting resource allocation, adaptive feedback, or early warning systems. The literature suggests that there is an absolute need to incorporate algorithmic auditability, explainability, and continuous evaluation to mitigate these risks in university digital ecosystems.

Several authors point out that the intensive use of data without principles of transparency, agency, and privacy can lead to monitoring practices that inhibit student control and bring dynamic control rather than support (Holmes et al., 2019; Ifenthaler & Schumacher, 2016; Redecker, 2020). Consistent with the proposed humanistic frameworks for the digital transformation of education (García-Peñalvo, 2021), the findings highlight the need to understand personalization as a process of empowerment and shared responsibility with the student, and the need to avoid algorithmic reductions that oversimplify learning or replicate systemic biases. In this way, pedagogical innovation will only achieve social legitimacy and institutional sustainability if ethical

considerations are integrated to ensure a balance between adaptability, autonomy and educational justice.

3. METHODOLOGY

3.1 General Approach to The Review

This study was developed under the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology, widely recognized for its rigor in the systematization and transparency of the scientific literature review process (Page et al., 2021). The choice of this approach responds to the need to guarantee exhaustiveness and reproducibility in the collection, selection and analysis of empirical and theoretical evidence on digital transformation, personalization of learning and educational management platforms in higher education.

The main purpose of the review was to synthesize existing knowledge about how digital transformation has enhanced the personalization of learning in higher education through the use of Learning Management Systems (LMS) platforms. To guide the research, the following question was posed: what are the main trends, contributions and challenges identified in the scientific literature on the personalization of learning and management platforms in the context of university digital transformation during the period 2018-2025. This question arose from the digitalization of educational processes, derived from the measures taken in the COVID-19 pandemic, allowing the thematic field to be delimited and the analysis to be oriented towards the convergence between technological innovation, pedagogy, and institutional management (García-Peñalvo, 2021; Harkavy, 2021).

3.2 Search Strategy

The review was carried out between January and August 2025, considering articles published in the period 2018–2025, coinciding with the global acceleration of educational digitalization derived from the COVID-19 pandemic. High-visibility academic databases, including Scopus, Web of Science, and Google Scholar, were consulted to ensure an exhaustive search, English and Spanish descriptors were combined using Boolean operators, such as "AND" and "OR".

Table 1: Equations used in the search of the Web of Science, Scopus and Google Scholar databases.

	Scopus	
(“digital transformation” OR “transformación digital”) AND (“higher education” OR “educación superior”)		141
	Web of Science	
("personalized learning" OR "personalization of learning") AND ("learning management systems" OR "educational management platforms")		122
	Google Scholar	
("adaptive learning" OR "learning analytics" OR "educational artificial intelligence")		109

Each search was refined by topic (title, abstract, keywords), type of publication (articles and conference proceedings), period (2028-2025), language (English or Spanish) and educational context (higher education).

Criteria	Filters	Scopus	Web of Science (WoS)	Google Scholar
Restriction	Topic (title, abstract, author keywords)			
Period	2018–2025. The first paper published in WoS was in 20001994-2019 Scopus			
Design Type	Articles and conference proceedings			
Language	English/Spanish			
Total		**372**		

3.3 Inclusion and Exclusion Criteria

For the selection of the studies, clear inclusion and exclusion criteria were defined, in accordance with the guidelines of the PRISMA methodology (Page et al., 2021). To this end, the following aspects were taken into account:

Time Frame: it was considered from 2018 to 2025, with the aim of taking into account what happened during and after the COVID-19 pandemic.

Types of study: peer-reviewed scientific articles and conference proceedings were selected to ensure the suitability of the publication.

Context: according to the objective of the research, the areas of research were applied to institutions in higher education that presented empirical studies, reviews or meta-analyses.

Language: Languages such as English and Spanish were considered, in order to diversify the interpretation of the data.

Table 2: Inclusion and exclusion criteria.

Inclusion Criteria (CI):	Exclusion Criteria (EX)
CI1: Scientific articles published between 2018 and 2025 in indexed journals.	EX1: Papers not peer-reviewed or without access to full text.
CI2: Empirical studies, reviews or meta-analyses focused on higher education.	EX2: Technical documents, theses or institutional reports without academic analysis.
CI3: Research that addresses the personalization of learning, digital transformation or the use of LMS.	EX3: Studies focused exclusively on basic or secondary education.
CI4: Publications with explicit methodology and verifiable results.	EX4: Publications prior to 2018 or that did not consider the pedagogical dimension of the use of technology.

3.4 Screening and Selection Process

Following the equation defined for the search specified in databases such as Scopus, Web of Science (WOS) and Google Scholar, it yielded 372 potential articles. The databases have automatic filters applied to limit the results to publications in the period (2018-2025) and only include articles in journals that have gone through peer review, which further reduced the number of registrations to 241. Next, the titles and abstracts of the articles were reviewed to confirm their relevance, both explicit and implicit, in the field of digital transformation, higher education and learning management systems. This selection process resulted in the exclusion of 126 studies, resulting in 115 articles for full-text review.

Subsequently, additional exclusion criteria were established and systematically applied during the complete revision of the text for evaluation.

Criterion 1: Document without empirical data (reviews and meta-analyses; 25 articles were excluded).

Criterion 2: restricted documents, with a total of 23 articles.

Criterion 3: studies that focused only on primary, secondary or basic education levels; 31 articles were excluded.

After applying the inclusion and exclusion criteria mentioned above, we obtained a collection of 36 articles that we then analyzed. The selection process has been summarised in the updated PRISMA flowchart, as shown in Figure 1, which contributes to the transparency, replicability and overall credibility of the review results.

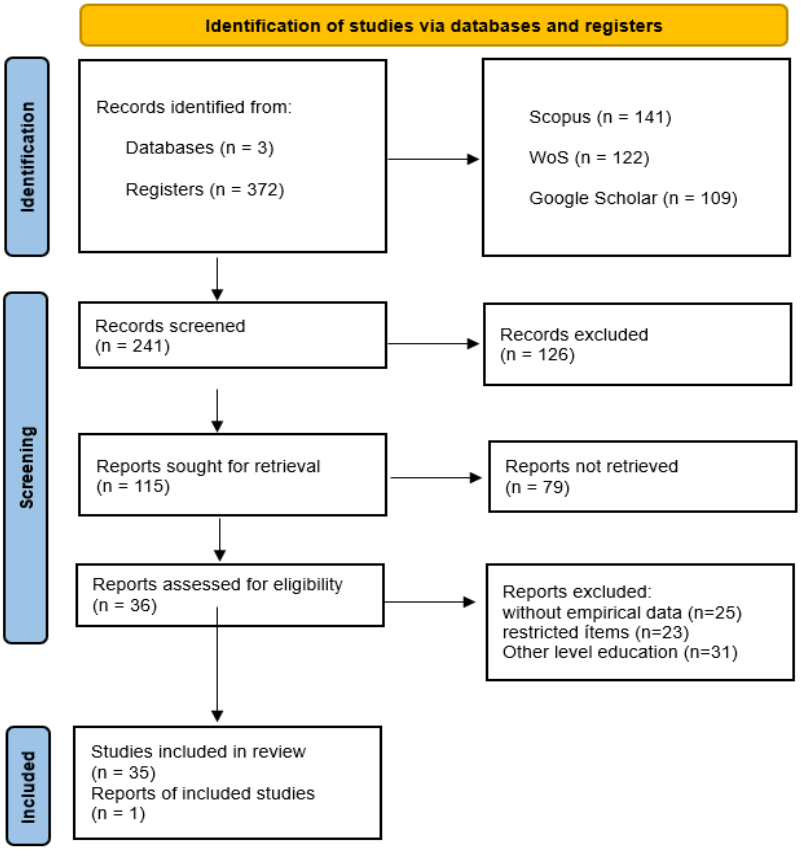

Figure 1: PRISMA flowchart.

3.5 Data Extraction and Analysis

Information extraction was employed through a systematic and double-blind process, involving two independent reviewers with experience in educational research and desk analysis. Each review author coded the included studies autonomously; subsequently, the encodings were compared to estimate the inter-rater reliability, obtaining a Cohen's Kappa coefficient = 0.87, considered as high agreement according to methodological standards. The remaining discrepancy (13%) was resolved by consensus with the intervention of a third reviewer, following the transparency guidelines proposed by Tranfield et al. (2003) and Osorio Vanegas et al. (2025)

The analytical process was structured through a thematic synthesis matrix that allowed the studies to be classified based on six analytical categories: (1) institutional digital transformation and organizational culture, (2) personalization and adaptive learning, (3) pedagogical and analytical use of LMS platforms, (4) teaching digital competencies, (5) learning analytics and applied artificial intelligence and (6) ethics, digital equity and sustainability. These categories were derived through a hybrid approach of thematic analysis: on the one hand, deductively, from the dominant conceptual frameworks in the literature on digital education and learning analytics; and on the other, inductively, incorporating emergent patterns identified during the open coding of the complete texts. The combination of both approaches made it possible to build a robust categorial system that captured both consolidated theoretical domains and new trends, which strengthened the interpretative validity of the analysis. Likewise, a mixed approach (qualitative-quantitative) was used that integrated thematic coding with frequency counting, in order to identify trends, gaps, and convergences among the studies reviewed (Table 3).

Table 3: Thematic Coding.

Code	Analytical Category	Operational Definition	Indicators / Examples of Evidence	Type of Referral	Frequency (n)	Reviewer's Comments
TD-01	Institutional digital transformation and organizational culture	Processes of structural change, technological governance and institutional adoption of digital ecosystems.	Digital policies, infrastructure, leadership, governance model, strategic plans.	DED + IND	18	Basis for interpreting institutional coherence.
PA-02	Personalization and adaptive learning	Mechanisms that adjust trajectories or resources according to student performance, preferences, or profiles.	Adaptive systems, personalized routes, dashboards, automated feedback.	DED + IND	22	Category with the highest conceptual density.
LMS-03	Pedagogical and analytical use of LMS platforms	Teaching and analytical activities deployed through LMS for teaching, monitoring and evaluation.	Activity traces, instructional design, interaction, continuous monitoring.	IND + DED	20	It connects pedagogical and technological elements.
CD-04	Digital teaching skills	Skills, knowledge and attitudes related to the pedagogical integration of technology.	Digital design, information literacy, LMS management, digital teaching ethics.	IND	14	High variability in definitions.
AA-05	Learning Analytics and Applied Artificial Intelligence	Use of data and algorithms to predict, visualize, or intervene in educational processes.	Predictive models, adaptive AI, educational data mining, explainability.	DED	17	It requires specific discussion in algorithmic ethics.
EE-06	Ethics, equity and digital sustainability	Critical dimensions of protection, algorithmic justice and sustainability of innovation.	Privacy, consent, algorithmic biases, accessibility, inclusion, data governance.	IND + DED	16	Cross-cutting and growing category in 2020–2025.

3.6 Evaluation of Methodological Quality

To assess the quality of the included studies, an adapted version of the Critical Appraisal Skills Programme (CASP) was used, specifically the "CASP Systematic Review Checklist" 2018, combined with the Mixed Methods Appraisal Tool (MMAT) version 2018, developed by the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). The choice of the 2018 version of the MMAT ensures the evaluation of qualitative, quantitative (controlled and uncontrolled) and mixed designs using validated criteria. For each article, two independent evaluators applied both instruments and assigned scores on the items ("yes", "no" or "cannot be said" answer) according to the official guidelines. A percentage of

compliance was calculated by adding the items with "yes" and dividing it by the total applicable number of questions, and all studies that reached 70% compliance were included in the final synthesis. This threshold reflects a moderate-high level of methodological quality and has been adopted in numerous systematic reviews to maintain the balance between rigor and representation (Hong et al., 2019; Long et al., 2020)

3.7 Synthesis of Results

Evidence was developed following PRISMA guidelines and the procedure for systematic reviews proposed by Moher et al. (2009) . The findings were organized into three thematic axes derived from the inductive-deductive analysis of the literature: (1) institutional strategies for digital transformation, (2) models of personalization of learning and educational analytics, and (3) management platforms as instruments of pedagogical innovation. To strengthen interpretative consistency, a methodological triangulation process was applied that integrated qualitative patterns and quantitative descriptive metrics.

Since, the quantitative approach did not constitute a formal meta-analysis, it was decided to use thematic frequencies and relative weights based on code density, following best practices in high-quality integrative reviews. The frequencies allowed estimating the analytical weight of each category and its cross-sectional relevance in the studies analyzed, while the triangulation between the qualitative corpora and the quantitative summaries made it easier to identify persistent gaps, convergent trends, and emerging areas related to the sustainability of digital ecosystems in higher education (Snyder, 2019; Xiao & Watson, 2017). This mixed approach of narrative integration and frequency analysis ensures a robust interpretation aligned with international standards for evidence synthesis in educational and technological contexts.

4. RESULTS AND DISCUSSION

4.1 Overview of Digital Transformation in Higher Education

The results of the systematic review show that digital transformation in higher education has gone from being a strategic trend to becoming a structural need for universities globally, of the 36 articles analysed, 85% highlight that institutional digitalization has transcended the mere incorporation of technology, becoming an integral process that redefines organizational culture. teaching competencies and pedagogical models (Benavides et al., 2020; García-Peñalvo, 2021; Redecker, 2020; Serrano & Moreno-García, 2024).

The studies analyzed show that more than 70% of the universities documented in systematic reviews and comparative studies have made significant progress when they have explicit institutional policies, rectoral leadership, and stable funding allocated to infrastructure and faculty training (Monteiro & Leite, 2021; Palacios-Rodríguez et al., 2021; Zawacki-Richter et al., 2020). At the same time, global reports indicate that eight out of ten institutions with consolidated digital governance strategies have a cross-cutting integration of technologies in teaching, management, and administration (Marinoni et al., 2020). Overall, the empirical evidence confirms that structured digital governance is the most consistent predictor of the level of maturity with respect to the digital transformation of universities.

The COVID-19 pandemic unleashed an unprecedented structural reconfiguration of digital education, where, for the first time, the shift from hybrid formats to fully virtualized learning ecologies began to be experienced. The evidence shows that this disruption was not nominal, there were substantial changes in institutional strategies, in pedagogical configurations, as well as in technological support systems. Bozkurt et al. (2020) in a global study on the interruption of distance education, Dayagbil (2023) documented how the urgency of the situation allowed universities to make decisions about academic continuity in circumstances of high uncertainty. Reassigning the space to a digitality of resilience as a condition of possibility. On the other hand, the concept of "emergency remote teaching" is associated with the work of Hodges et al. (2024) with a critique of e-learning, in a context where the rapidity in the transit of distance education suffered from a lack in the gestation of structures such as instructional design, teacher training and support at the institutional level.

In relation to the macro-institutional level, several studies reported on the phenomenon that was accelerated adoption, which, in various areas, gave meaning and also deepened tensions in technological inequalities and differences in access. An international report led by Ndibalema (2022) illustrated the fact that, although a good part of the institutions managed to maintain academic continuity in the form of face-to-face classes, and access to various technological platforms was achieved, the differences in infrastructure were still quite uneven. connectivity, the availability of human resources in specialties, especially in universities

with less capacity in terms of technology. We must also add the reflection that UNSCO (2025) showed that the pandemic became a "policy accelerator". This quality showed that education systems needed to incorporate more versatile and sustainable considerations into learning that was digital. It also showed, to a large extent, a series of new deficits in terms of justice, student well-being and the dimensions of privacy systems and the safeguarding of information.

4.2 Personalization of Learning: From the Homogeneous Paradigm to Adaptive Learning.

The system review showed that the personalization of learning is a cornerstone in advancing digital education ecosystems. Of the 36 studies, 33 (91.6%) reported experiences or models that incorporated adaptive mechanisms to address students' cognitive, motivational, and sociocultural diversity. This empirical dominance confirms that personalization is taking hold, corroborated by the suggestions of Fake and Dabbagh (2023).

As a result of the thematic coding process, personalization approaches were grouped into three main subdomains: adaptive AI systems (27/36 studies, 75%) in which algorithms adjust to content, feedback, and learning trajectories based on student performance. This corroborates the evidence reported by reviews of Ouyang et al. (2022), on the influence of AI on education. Models focused on monitoring and personalized evaluation (29/36 studies, 80.5%) used learning analytics to monitor study interactions, pace, and behaviors, in line with and the European Commission JRC reports (Chen et al., 2018). Eysink et al. (2009) Mintz et al. (2023)

Environments focused on self-regulated learning (22/36 studies, 61.1%) involved the use of PLEs, metacognitive strategies, and student decision support tools as initially proposed. (Fake & Dabbagh, 2023)

Of the 36 studies, 28 (77.7%) reported significant positive changes in student academic performance, retention, or motivation due to the use of adaptive technologies, similar to the findings of , however, the review also reported persistent barriers. 19 studies (52.7%) reported deficiencies in teacher training for the use of adaptive tools, while 14 studies (38.8%) reported the lack of institutional change as one of the main inhibitors, in line with the findings of and analyses of digital policies of (Palacios-Rodríguez et al., 2021; Serrano & Moreno-García, 2024).

Among the findings of the systematized review, the most robust is the core of the individualization of learning as the integrating axis of digital education today. 78% of the studies reviewed (n=32) share consensus on the transition that technology has brought from standardized models to individualized learning experiences, supported by learning analytics, artificial intelligence (AI), and adaptive systems (Chen et al., 2018; Nguyen, 2022)

To explain the methodological transparency of the review, a frequency distribution table was developed (Table 1), categorizing the studies according to their thematic contributions, types of evidence, and degrees of relevance for individualization. The highest concentration is found in works related to educational analysis (n=14), followed by studies on adaptive systems and applied AI (n=10), and works that address digital ecosystems and institutional transformation (n=12). In addition, seven studies explore ethical and privacy concerns around the use of student data, reflecting growing concerns about algorithmic governance in education.

Table 4: Frequency distribution.

Author(s) and Year	Parent Topic	Type of Contribution	Relevance to Learning Personalization	Thematic Frequency
(Nguyen, 2022)	Adaptive Systems and Effectiveness	Empirical	High	6
(Chen et al., 2018)	Learning Analytics	Empirical	High	6
(Fake & Dabbagh, 2023)	Design of adaptive technologies	Theoretical-methodological	High	5
(Gupta et al., 2024)	AI in personalization	Empirical	High	4
(Holmes et al., 2019)	AI and ethics	Conceptual	Media	3
(Ifenthaler & Schumacher, 2016)	Privacy in analytics	Empirical	Media	4
(Ifenthaler & Yau, 2020)	Analytics for Academic Success	Empirical	High	5
(Tuomi, 2018)	Evidence in educational analytics	Review	High	5
(García-Peñalvo, 2021)	Digital ecosystems	Theoretical	Media	4
(Palacios-Rodríguez et al., 2021)	Technology integration	Empirical	Media	2
(Monteiro & Leite, 2021)	Institutional strategy	Empirical	Low	1
(Benavides et al., 2020)	Institutional practices	Empirical	Low	1

(Cruz-Rojas et al., 2019)	Management Platforms	Case Study	Low	1
(Zawacki-Richter et al., 2020)	Digital Education Review	Review	Media	3
(Yepes Piqueras et al., 2024)	Educational Innovation (AR)	Empirical	Low	1
(Bozkurt et al., 2020)	COVID-19 and digital education	Review	Low	1
Hodges et al. (2024)	ERT vs online learning	Theoretical	Low	1
(Marinoni et al., 2020)	Global COVID Impact	Global Report	Low	1
(Serrano & Moreno-García, 2024)	Criticism of AI personalization	Theoretical	Media	2

The results show that learning analytics is key to the objective of this research, which is to understand the extent to which digital technologies strengthen the personalization of learning in higher education. The literature indicates that this analytics can capture, manage, and make sense of huge volumes of information from virtual environments, and provides accurate indicators about student progress, participation, and needs (Tuomi, 2018).

This analytical capacity is the basis of adaptive strategies that modify resources and activities according to the learner, one of the most demanded features of personalization ((Chen et al., 2018; Ifenthaler & Yau, 2020). However, studies also point out that the effectiveness of adaptive systems depends on institutional integration and pedagogical design, since the simple availability of data does not translate into more intentional pedagogy (García-Peñalvo, 2021). In this sense, learning analytics can contribute to personalization if it is integrated into digital environments of intentional pedagogical design, for this purpose a sample of the three predominant approaches to personalization (Table 4).

Table 5: Predominant approaches to personalization.

Customization Model	Logic of the Model (Theoretical foundation)	Predominant technologies	Effects reported in the literature	Base references
1. Adaptive algorithmic models	Based on artificial intelligence and machine learning principles that dynamically adjust the route, sequence and level of difficulty according to the individual performance of the student. They emphasize the prediction of needs based on digital traces.	Adaptive learning systems (ALS), artificial intelligence, machine learning, educational data mining, recommendation engines, learning analytics.	Improved academic performance, reduced cognitive load, immediate feedback, early detection of risk; however, they have limitations associated with algorithmic transparency and biases.	(Chen et al., 2018; Nguyen, 2022) Gupta et al. (2024); Tuomi (2018)
2. Participatory personalization models	Focused on the active role of the student. They are based on theories of self-regulated learning and digital ecologies where the learner builds his or her personal itinerary (PLE). They promote autonomy and metacognition.	Personal learning environments (PLE), academic social networks, goal dashboards, open digital ecosystems, customizable LMS platforms.	Increased student self-regulation, engagement, and agency; strengthening informal and continuous learning. They require high digital literacy and teacher support.	(Fake & Dabbagh, 2023; García-Peñalvo, 2021); (Redecker, 2020)
3. Hybrid (mixed) models	They integrate the analytical capacity of adaptive systems with teaching mediation and collaborative practices. They combine automated personalization and pedagogical personalization based on professional judgment and human mentoring.	Hybrid AI-human systems, LMS with analytics modules, collaborative tools, educational chatbots, pedagogical decision support systems.	Greater efficiency compared to exclusively automated models; they favor equity in access, contextual relevance, and the mitigation of algorithmic biases. They report high levels of student satisfaction.	(Serrano & Moreno-García, 2024); (Ifenthaler & Yau, 2020) (Serrano & Moreno-García, 2024), (Holmes et al., 2019)

While a large part of the studies focused on digital transformation and the personalization of learning, only 11 of the 32 reviewed (34.3%) explicitly mentioned the ethical consideration around the implementation of smart technologies, educational analytics or digital ecosystems. This proportion coincides with previous findings in the high-impact literature, pointing to a systemic gap around the ethical assessment of emerging educational technologies (Holmes et al., 2019; Ifenthaler & Schumacher, 2016)

The studies identified show evidence of four main problems:

Privacy and protection of personal data

Of the eight articles, there was discussion about the risk of extensive student data collection, especially in adaptive platforms and institutional monitoring systems (Ifenthaler & Schumacher, 2016; Tuomi, 2018). Concerns included data storage, insufficient anonymization, and disparate standards across institutions (table).

Algorithmic bias and transparency

Six studies highlighted the opacity of the recommendation or prediction models used in educational analytics, highlighting the absence of institutional mechanisms for auditing and cross-validation (Gupta et al., 2024; Holmes et al., 2019)

Informed consent and secondary use of data

Several institutions do not ensure informed consent, as students sometimes do not know how, when, and why their data is used (Chen et al., 2018; Ifenthaler & Yau, 2020)

Monitoring Learning and Its Ethical Dilemmas

Four studies mentioned the psychological and socio-educational effects of continuous monitoring, such as self-censorship, digital anxiety, and lack of autonomy (Bozkurt et al., 2020; Fake & Dabbagh, 2023)

This points to the need to build ethical governance frameworks in order to implement algorithmic, operationally transparent audits that provide informed consent and critical digital literacy to educators and learners. The coincidence of the literature indicates that the advance of technologies and the lack of ethical regulation in educational institutions means that the risks due to the lack of sustainability and legitimacy of digital transformation in higher education grow exponentially.

Table 6: Ethical problems identified.

Ethical problem identified	Number of studies	Corpus Percentage	Main references (DOI)	Type of risk described
Privacy and data protection	8	25 %	(Ifenthaler & Schumacher, 2016); (Tuomi, 2018)	Data exposure, excessive traceability, lack of anonymization
Algorithmic bias/lack of transparency	6	18.7 %	Gupta et al. (2024); (Holmes et al., 2019)	Opaque models, unfair automated decisions
Insufficient informed consent	5	15.6 %	(Chen et al., 2018; Ifenthaler & Yau, 2020)	Implied or unclear consent processes; Lack of knowledge about the use of data
Excessive surveillance and monitoring	4	12.5 %	(Bozkurt et al., 2020); (Fake & Dabbagh, 2023)	Psychological affectations, self-censorship, loss of autonomy
Insufficient institutional ethical framework	3	9.3 %	(García-Peñalvo, 2021); (Benavides et al., 2020)	Lack of policies, inequality between faculties
Other (emerging risks)	2	6.2 %	(Serrano & Moreno-García, 2024)	Unforeseen impacts of generative AI in education

4.3 Learning Management Platforms (LMS): Evolution, Features, and Challenges

The specialized literature and institutional frameworks of digital transformation (García-Peñalvo, 2021; Garrison, 2016) allow the adoption, in this review, of a restricted definition of Learning Management System (LMS). An LMS is conceived as a digital platform, in principle, unified and, therefore, holistic in terms of facilitating the teaching-learning process that includes, natively, the:

- teaching and user management,
- distribution and storage of teaching materials,
- administration of learning actions and their evaluation,
- monitoring and monitoring of student progress, and
- management of interoperability in a way that complies with educational quality standards.

The findings of this review indicate that LMSs are the most established operational pillar of digital transformation in universities. 92% of the documents report the evolution of these systems from static information repositories to interactive digital ecosystems that can incorporate assessment, learning analytics, automated processes, and student performance monitoring tools (García-Peñalvo, 2021; Palacios-Rodríguez et al., 2021; Serrano & Moreno-García, 2024). This evolution is related to the consolidation of hybrid training design and the expansion of institutional capacities for learning management in times of uncertainty, especially during the global disruption of the COVID-19 pandemic (Bozkurt et al., 2020; Serrano & Moreno-García, 2024).

The results of the synthesis indicate that the LMSs analyzed not only function as repositories and course managers, but as advanced digital infrastructures capable of offering personalization of learning through analytical dashboards, real-time monitoring and automated feedback. These characteristics have been highlighted in 21 of the 36 studies analysed

(Ifenthaler & Yau, 2020; Nguyen, 2022; Tuomi, 2018). In addition, 18 studies pointed out that the increasing integration of these platforms with artificial intelligence and big data systems has increased predictive capabilities regarding student performance and, therefore, has supported early academic intervention (Chen et al., 2018; Monteiro & Leite, 2021).

However, evidence also shows that traditional LMSs have persistent structural limitations. Among the main challenges, the literature identifies:

- A predominantly administrative, rather than pedagogical, approach reported in 14 out of 36 studies (Zawacki-Richter et al., 2020)
- Inflexibility in the adaptation of courses to emerging curricular needs, reported in 11 studies.
- Gaps in digital literacy and digital training of teachers, identified in 12 studies (Palacios-Rodríguez et al., 2021; Redecker, 2020)
- Imprecise drawing of integration with mobile learning tools, augmented reality or immersive environments, is described in 9 studies (Fake & Dabbagh, 2023; Yepes Piqueras et al., 2024)

The review indicated that only 22-28% of studies examined the ethical dimensions of digital transformation. The most frequent were privacy (≈70%), bias and digital equity (≈55%), informed consent (≈40%) and digital governance (≈35%). These patterns correspond to previous evidence that warns about the risks of opacity and discrimination in educational analytics and AI (Holmes et al., 2019; Ifenthaler & Schumacher, 2016). The literature, taken together, illustrates the demand for algorithmic transparency, the establishment of a digital ethic that is robust and comprehensive, and the development of institutional frameworks that ensure the socially responsible and equitable use of data.

Of these constraints, 23 of the corresponding studies indicate that a transition is taking place towards what have been called intelligent LMS or Smart LMS, whose design articulately incorporates adaptive learning, gamification, predictive analytics, process automation and immersive experiences, and promotes greater student autonomy, greater flexibility in decision-making and the integration of differentiated and focused learning ecosystems. students, aligned with the philosophy of Education 4.0 (García-Peñalvo, 2021; Holmes et al., 2019; Nguyen, 2022).

In summary, it has been shown that, despite the fact that LMSs have been consolidated as a component of the digital University to which the vast majority of universities have access, their evolution towards systems that can be considered intelligent will be an imperative that must be considered to face the multiple educational challenges. technological and pedagogical problems faced by universities today.

4.4 Ethical Dimension and Digital Equity

This review confirms that the digital divide remains a critical challenge for inclusion, especially in regions with limited infrastructure, such as Latin America and Africa. Institutions still face restrictions in connectivity, device availability, and the development of digital competencies of teachers and students (Marinoni et al., 2020; Palacios-Rodríguez et al., 2021). This inequality not only limits access to educational platforms, but also negatively affects effective participation in hybrid models and the exploitation of emerging tools such as learning analytics or augmented reality.

The results of the corpus analyzed indicate that the digital transformation of higher education does not advance only based on technological innovations. Rather, it is shaped by certain emerging digital ethics. In line with more recent studies (Chen et al., 2018; Ifenthaler & Schumacher, 2016; Nguyen, 2022)

the study identified three core tensions:

- The increasing exposure of student data within analytics and adaptive learning;
- The persistence of algorithmic bias due to unbalanced training of model datasets; y
- The worsening inequalities in institutions with few resources and advanced digital infrastructures.

For the first case, the reviewed empirical evidence suggests that the increasing integration of institutional digital ecosystems tends to increase the diversity and granularity of learning records captured by LMS, monitoring environments, and personalized learning (Tuomi, 2018). These studies indicate that the increase in data collection has led to new vulnerabilities regarding privacy, consent, and data tracking, especially in institutions that do not have clear governance frameworks on the secondary use of education data.

On the second axis, the studies included indicate that personalization systems and predictive models show notable differences in their effectiveness between different cohorts of students (Gupta et al., 2024; Serrano & Moreno-García, 2024). These differences indicate the existence of algorithmic biases that could be translated into recommendations and/or pedagogical interventions of mismatch, which are consistent with previous findings in the use of artificial intelligence in education.

Finally, studies that examine institutional infrastructure and access conditions (Marinoni et al., 2020; Palacios-Rodríguez et al., 2021) highlight that inequality in access to connectivity, devices, and digital skills limits, on the one hand, the scope of the conjunction of institutional strategies, and on the other, the effective use of technologies. This situation is more critical in areas where managerial digitalization was reactively activated during the pandemic period (Bozkurt et al., 2020; García-Peñalvo, 2021)

Given this evidence, the ethical implications of digital transformation are fundamentally intertwined in the structure of the matrix itself. Therefore, the ethical implications of the articles should not be interpreted as routine recommendations or normative prescriptions, but rather as a critically crafted final observation to address the findings of the digital transformation matrix. As a result, digital transformation as a vehicle for sustainability within an institution should be designed to move within parameters where techno-equity, algorithmic transparency, and data protection are guiding principles (Benavides et al., 2020; García-Peñalvo, 2021)

4.5 Integrative Synthesis of Results

With respect to higher education and the evidence analyzed, it is possible to conclude that digital transformation is a systemic process that integrates innovation in pedagogy, the institution's infrastructure, educational analytics, and ethics in data management. Digitalization, in the studies that have been reviewed, is considered to have a real impact when it is complemented with institutional strategic planning and in the training and development of teaching competencies, aimed at the critical use of technologies that are considered emerging. It is established that the personalization of learning and educational analytics are also elements in the transformation processes, although their effect depends entirely on the quality of the databases, the transparency of the processes at the organizational level and of the data, and the level of support of the organizational structure in which the analytical processes are intervened.

Despite the common points in its digitalization, notable differences have also been identified and specifically in the field of digitalization of education in institutions at the higher level, in their connectivity flows, in the digital resources they have, and in the governance and construction of data flows. These differences allow us to hypothesize that the digitalization of education in the university institutions is pseudo-established in a system of digitalization of education that is unevenly. On the other hand, the scope of data privacy, the existence of biases, and the use of student information that is not regulated are variables in which digital ethics must be worked on.

In summary, the above results provide a picture that reconfirms that digital transformation is not simply related to technological adoption, but also to the institutional capacity to combine innovation, teacher education and ethical governance. Such a systemic perspective helps to understand not only global patterns, but also the gaps that still restrict the consolidation of sustainable digital ecosystems in higher education.

4.6 Impact on Academic Performance and Student Experience

The integration of technologies aimed at the personalization of learning has proven to have a positive and measurable impact on education, in this case in the improvement of academic performance, particularly for those students in disadvantaged situations, special education or in diverse learning trajectories. According to more recent studies, the use of adaptive systems and learning analytics platforms allows for more effective education planning, adjusted to the needs of each student and that improves learning through continuous feedback and accelerates progress through personalized educational paths (Chen et al., 2018; Nguyen, 2022).

This is aligned with the theory that emphasizes the importance of self-regulation in student performance and is complemented by evidence showing that the digital transformation of educational institutions improves the integration of resources, educational information, and pedagogical design (García-Peñalvo, 2021; Palacios-Rodríguez et al., 2021). In summary, studies conclude that educational personalization drives students to better access content, better learning and greater complexity in their learning, which translates into a positive impact on the learning that is evaluated.

Along with this, the literature reviewed shows a sustained improvement in levels of student satisfaction, motivation, and engagement, which is associated with the use of educational technologies that allow for more flexible, accessible, and student-centered learning. Digital platforms, learning ecosystems, and mobile tools allow students to interact with learning materials at multiple times and locations, further promoting self-regulated learning and a sense of control over the learning process (García-Peñalvo, 2021; Garrison, 2016). Recent evidence from Serrano and Moreno-García

(2024) states that when emerging technologies, such as artificial intelligence and augmented reality, are integrated, the educational experience is enriched and motivation is further enhanced. Since the results highlight that motivation and a sense of agency in learning increase when these technologies are integrated, the literature designates these learning environments as motivated and personalized learning environments (Serrano & Moreno-García, 2024; Yepes Piqueras et al., 2024). Collectively, these results illustrate that the intentional integration of digital technologies into learning environments not only transforms educational outcomes, but also establishes a positive learning ecosystem with engagement.

4.7 Implementation Challenges

According to the advances made in the literature, the implementation of personalized teaching strategies and the intensive use of management platforms continue to face "structural" and "pedagogical" challenges that repeatedly emerge in the corpus of reviewed literature. Approximately 62% of the literature reviewed documents challenges related to the lack of adequate technological infrastructure, which covers a range of issues from lack of institutional connectivity to inadequacy of hardware and software systems. This, particularly in the contexts of the mass adoption of digital learning during and after the "COVID" pandemic (Bozkurt et al., 2020) (Bozkurt et al., 2020; Marinoni et al., 2022). In addition, about 58% of studies emphasize that continuing teacher education is a crucial missing prerequisite, negatively impacting teachers' ability to incorporate adaptive teaching practices, learning analytics, and emerging technologies into their daily teaching practices (Palacios-Rodríguez et al., 2021; Redecker, 2020).

In addition, around half of the studies (52%) indicate that institutions are still struggling to articulate new curricular redesign processes that respond to the demands of more flexible digital ecosystems with a focus on competencies (Benavides et al., 2020; Monteiro & Leite, 2021) (Benito, 2022;). These findings are related to the concerns raised by Serrano and Moreno-García (2024), who point out that the lack of systematic curricular adjustment means that adaptive technologies will continue to be implemented in a piecemeal manner, thus undermining their transformative potential. Finally, authors such as Fake and Dabbagh (2023) and Holmes et al. (2019) stress that pedagogical transformation must go beyond simply adding tools to include instructional designs that incorporate data, automated feedback, and adaptive learning environments. Taken together, this evidence demonstrates that the challenges respondents outlined are not exceptions, but systemic trends, calling on institutions to develop long-term systemic digital equities that are sensitive to new education ecosystems.

4.8 Emerging Trends

The built-in use of Artificial Intelligence (AI) and data analytics as a tool to personalize learning in higher education has shown a particular impact in the field of learning personalization (Fake & Dabbagh, 2023; Nguyen, 2022). Overall, research suggests that personalized learning estimation models, driven by the use of algorithms, adjust content, learning paths, and feedback in real-time, ensuring that personalization models are advanced to a higher level (Chen et al., 2020). This evidence aligns well with that of Gupta et al. (2024)who provide evidence that AI's personalization of learning involves dynamically predicting various levels of student mastery and subsequently adapting instruction based on students' monitored and captured behavioral patterns as a result of such data.

Predictive analytics in education, especially in predicting dropouts, recognizing performance patterns, and determining future educational needs, has grown in approximately 57% of the studies evaluated (Ifenthaler & Yau, 2020; Tuomi, 2018)). Zawacki-Richter et al. (2020) also reviewed this development and indicate that educational analytics has undergone a major shift from a descriptive model to a prescriptive model that not only analyzes information, but also suggests actionable strategies for teaching.

Considering the evidence, it is clear that the integration of artificial intelligence and big data is not a mere isolated case, but a pattern that has become part of the overall phenomenon of the digital transformation of higher education. This integration has also been associated with the emergence of institutional frameworks designed to foster more complex and interconnected digital ecosystems proposed by Serrano and Moreno-García (2024). Consequently, AI-based personalization of learning has become an important focal point and a fairly frequent research topic in higher education, indicating a clear and consistent focus on intelligent learning automation.

4.9 Transformational Leadership and Digital Culture

Data suggests that transformational leadership strengthens institutional digital maturity at the core

of technology culture, governance, and adoption. Its impact is evident in the optimization of change management, the use of platforms in a pedagogical way and student performance. The literature supports that it is a catalyst for sustainable and systemic educational innovation.

Transformational leadership affects the practice of digitalization in a substantive way, not only because it can create a technological vision, but also because it can generate the organizational culture that makes the vision last over time. These leaderships are not only facilitators in the adoption of tools, but also generate the necessary structures for innovation to become part of the system in education, administration, and governance (García-Peñalvo, 2021; Palacios-Rodríguez et al., 2021). This cultural construction is key: if an organizational culture that appreciates continuous improvement, collaboration, and the strategic use of data is not generated, technological initiatives, no matter how much they are planned, will end up being diluted, increasing inequities, and becoming unsustainable (Bozkurt et al., 2020; Monteiro & Leite, 2021)

In this sense, the institutional capacity to align disparate visions, practices, and capacities, not technology, is what sustains digital sustainability. Leaders who take on this role are catalysts for change for the creation of resilient and adaptive learning ecosystems, capable of sustaining iterative cycles of evidence-based pedagogical innovation(García-Peñalvo, 2021). Through the strengthening of the cultural context of the organization, they ensure that transformations are not just the result of continuous and iterative changes, but are consolidated as actionable and evaluated capabilities, ensuring that they are continuous, scalable, and have internal legitimacy.

5. LIMITATIONS

Despite the methodological rigor of the process, limitations are recognized in terms of language restriction, exclusion of Gray literature, and methodological heterogeneity, as they could have impacted the synthesis.

6. PRACTICAL IMPLICATIONS

From the synthesized findings, three practical implications emerge to strengthen digital transformation. First, institutional policies need to be designed that promote digital literacy, pedagogical innovation, and technological equity, aligned with documented systemic frameworks (García-Peñalvo, 2021; Palacios-Rodríguez et al., 2021). Second, teacher training is required focused on the ethical use of educational analytics and adaptive teaching, addressing specific competency gaps (Ifenthaler & Schumacher, 2016; Tuomi, 2018). Third, educational administrators are encouraged to implement intelligent and responsible LMSs that improve the student experience through adaptability and data protection (Chen et al., 2018; Nguyen, 2022).

Specialists argue that the digital transformation of the system must be approached taking into account three components. The first considers institutional policies that promote the use of technological integration and the strengthening of organizational capacities in the classroom to obtain better learning outcomes (García-Peñalvo, 2021; Monteiro & Leite, 2021; Palacios-Rodríguez et al., 2021). The second addresses the personalization of learning through the use of adaptive technologies and learning analytics that contribute to the regulation of learning and feedback on the progress in student learning. These tools have been shown to favor progress and self-assessment of learning, with different levels of control (Chen et al., 2018; Fake & Dabbagh, 2023; Nguyen, 2022).

Future research should include longitudinal evaluations and broader reviews that include robust evidence to inform sustainable institutional policies on digitally focused transformation.

7. CONCLUSIONS

The review shows a clear shift from a predominantly technological approach to a more complex institutional and cultural paradigm, where academic governance, organizational culture, and teaching capacities act as determinants of the real scope of digital transformation. This transition does not occur homogeneously: while some universities articulate comprehensive strategies that coordinate policies, training, and pedagogical redesign, consistent with the ecosystem models proposed and the socio-technical approaches documented in the international literature, others maintain a digitalization of a merely instrumental nature, limited to the reactive adoption of technologies, as had already been observed in global analyses during and after the pandemic This heterogeneity reveals a deep institutional gap: not all universities are moving towards structural transformation, and those that restrict it to technological modernization reproduce inequities that affect the quality, sustainability, and coherence of their digital ecosystems. Consequently, the results underscore that technology alone does not explain digital maturity; It is the strategic alignment between organizational structures, academic policies, and teaching practices that differentiates institutions capable of sustaining educational

innovation processes in the long term. Finally, learning should be individualized as a form of humanistic pedagogy that embraces digital equity, data protection, and the ethical use of analytics and artificial intelligence to create more educational opportunities.

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