

University Digital Transformation: A Systematic Analysis Of Virtual Mediation In Higher Education

José Arlés Gómez Arévalo¹, Ana María Piñeros Ricardo², Cecilia Garzón Daza³, Marta Osorio De Sarmiento⁴, Fabiola Joya Rodríguez⁵, Marcela Orduz Quijano⁶, Luis Fernando Rodríguez⁷

¹Director of the Editorial Center Fundación Universitaria Juan N. Corpas (Bogotá, Colombia), Post-Doctorate in Science and Narrative, Post-Doctorate in Education and Interculturality, Doctor of Theology. MBA in General Management, Master in Philosophy. Author of articles on epistemology, education, educational management and spirituality, member of the Corpas Sana Group, Mail: jose.gomez@juanncorpas.edu.co, Orcid: <https://orcid.org/000-0003-1774-3399>

²Doctor in Education, Leader of the Corpas Sana Group and the Chair in Quality of Life, Rector of the Juan N. Corpas University Foundation, ana.pineros@juanncorpas.edu.co

³Post-doctorate in Education (Santo Tomás University), Studying a Post-doctorate in Policies and predictions of education quality assurance management (Simón Bolívar University). Doctor in Educational Sciences (Pedagogical and Technological University of Colombia), Master in Business Administration (University of Chapultepec), Master in Education (Javeriana University), Public Accountant (Antonio Nariño University). Research professor at the San Mateo University Foundation. Director of Quality and Control Processes at Catholic University of Colombia. ORCID: <https://orcid.org/0000-0002-4173-2609> Email: ceciliagarzon3@hotmail.com.

⁴PhD in Education, Dean of the Faculty of Education and Social Sciences (Juan N. Corpas Foundation, Bogotá), leader of the Cibeles Group (Categorized in B, Minciencias 2022), research professor in Educational Management, Pedagogy, Didactics. Qualitative Research, Didactics for the Teaching of English in Bachelor's Degrees. Post-doctorate in Narrative and Science from the University of Córdoba Argentina, PhD in Education from the University of Granada Spain, Specialization in Management of Educational Centers from the University of La Sabana Bogotá Colombia, Bachelor's Degree in Social Sciences from the University of La Sabana Bogota Colombia. Email: marta.osorio@juanncorpas.edu.co

⁵Specialist in Hospital Administration, Audit of Medical Accounts Universidad del Rosario, Doctor in Education Universidad Santo Tomas (Bogotá), Head of Pedagogy and teaching director of various disciplines of the School of Nursing email: fabiola.joya@juanncorpas.edu.co

⁶Postdoctoral Fellow in Education, Social Sciences, and Interculturality; PhD in Education; Master's in Education; Master's in Environmental Management and Auditing; Specialist in Business Management; Specialist in Community Management and Organization; Agricultural Engineer. Professor and Researcher in Doctorate and Postdoctoral Programs in Education. ' marcela_orduz@hotmail.com

⁷Nurse from Pontificia Universidad Javeriana, Specialization in Management in Health Services, Master's Degree in Direction and Management of Educational Centers, Master's Degree in Management and Control of Nursing Units, Doctor in Education, Quality Auditor for ISO 9000 standard, Unique Habilitation System; Unified System of Accreditation in Health and Education, PAMEC and Colombian technical standard for job training programs; Orcid: <https://orcid.org/0000-0001-8120-57>

Abstract: This article reports a document review of more of 100 studies published between 2020 and 2025 on virtual mediation in higher education and its role in university digital transformation. Searches were conducted in

Scopus, Web of Science, Scielo, and ERIC; peer-reviewed studies in Spanish and English focusing on teaching, assessment, or pedagogical management with virtual technologies were included. The thematic synthesis identifies five domains: (1) artificial intelligence and learning analytics, showing advances in personalization, feedback, and early risk detection; (2) immersive technologies (AR/VR) and the metaverse, enhancing motivation and experiential learning when infrastructure and sound instructional design are present; (3) hybrid models (synchronous hybrid/HyFlex), expanding access and flexibility where coherent course architectures exist; (4) LMS and online teaching, which act as the ecosystem's backbone when combined with active methodologies and teacher/social/cognitive presence; and (5) inclusion, accessibility, and public policy, requiring compliance with standards (e.g., WCAG 2.2) and the reduction of connectivity and skills gaps. Cross-cutting findings highlight four levers for responsible scaling: faculty professional development, data governance and AI ethics, formative assessment supported by analytics, and infrastructure and accessibility. Implications for curriculum design and institutional management are discussed. Limitations of the evidence–methodological heterogeneity and scarce longitudinal studies—are acknowledged, and a research agenda is proposed to foster sustainable and equitable impact.

Keywords: higher education; digital transformation; virtual mediation; artificial intelligence; learning analytics; augmented and virtual reality; HyFlex; educational accessibility.

INTRODUCTION:

This article was developed from a systematic documentary review focused on the analysis of academic research related to virtual mediation and digital transformation in higher education. The review was carried out during the first semester of 2025, mainly consulting high-impact academic databases such as Scopus, Web of Science (WoS), Scielo and ERIC, which guaranteed the quality and relevance of the selected sources. The procedure to carry out the research was based on a search for "keywords" in both Spanish and English related to the topic: higher education, emerging technologies, digital learning ecosystems, virtual mediation, etc. The period of analysis established was between 2020 and 2025, which is called by some authors as "post-pandemic", in order to identify the most recent works that emerged in this period of time. A selection criterion was to choose only peer-reviewed articles, published in English or Spanish, and that presented empirical results, conceptual reviews, or proposals applied in the university context related to the main topic of the article.

Studies focused on higher education that analyzed the implementation of virtual technologies in teaching-learning, evaluation or pedagogical management processes were included. In turn, articles focused on basic/secondary education, opinion texts without empirical support, and duplicate publications or publications with tangential scope (e.g., administrative management without an academic focus) were excluded.

METHODOLOGY

Regarding the analysis of the information: the selected texts were organized in an information extraction matrix, with variables such as: author, year, country, technology analyzed, main findings and limitations. Subsequently, a thematic analysis was applied that allowed the findings to be grouped into five axes: Artificial Intelligence and learning analytics, augmented reality, virtual reality and metaverse, digital platforms and virtual learning management environments (LMS), digital inclusion and accessibility, and pedagogical innovation and hybrid models. This methodological approach, although it does not use statistical meta-analysis, guarantees rigor and transparency, allowing a critical and updated synthesis of the university's digital transformation.

THEORETICAL REFERENCES

The theoretical references that underpin this study allow us to understand virtual mediation as the articulating axis of the university's digital transformation in the period 2020–2025, marked by the post-pandemic acceleration. From connectivism, learning is conceived in distributed networks that require new forms of interaction and digital curation (Siemens, 2005); added to this is the design proposal for the digital age that emphasizes pedagogical decisions – and not only technological ones – to integrate active methodologies and hybrid models with a formative sense (Bates, 2019). In this framework, hybrid synchronous and HyFlex formats expand the classroom and demand equivalence of results with

adequate teaching support (Beatty, 2019), while AI and learning analytics enable personalization and feedback with ethical governance requirements (Zawacki-Richter et al., 2019). Immersive technologies (AR/VR) enhance experiential learning, conditioned by infrastructure and didactic guides (Radianti et al., 2020). Finally, LMSs and accessibility standards (WCAG 2.2) become the backbone for quality with equity, in line with UNESCO's guidance on the responsible use of AI in education (UNESCO, 2023; W3C, 2023).1) Virtual mediation and online learning. The most accepted definition at the academic level of virtual mediation is taken as the set of pedagogical and organizational interactions supported by ICTs that articulate people, content and contexts in digital ecosystems. In this sense, connectivism maintains that learning emerges from distributed networks and that the key competence is to know how to connect and update knowledge in increasingly shorter life cycles (Siemens, 2005). This theoretical basis legitimizes the use of platforms, analytics, and digital curation as central mediations of learning in contemporary universities.

-Design for the digital age: from e-learning to the expanded classroom: Bates (2019) states that teaching in the digital age requires instructional design decisions –not just choice of tools–, combining active methodologies, continuous assessment, and hybrid models to maximize interaction, flexibility, and quality. Virtuality is effective when it is pedagogically integrated and not reduced to file repositories. On the other hand, the online learning tradition synthesized by the presences approach (teaching, social, and cognitive) provides criteria to guide the design of online courses and academic communities (Garrison, Anderson, & Archer, 2000).

- Hybrid models: hybrid synchronous and HyFlex: between 2020 and 2025, formats that expand the classroom are consolidated. The hybrid synchronous allows the simultaneous participation of remote and face-to-face students, increasing access and educational continuity; Its challenge lies in didactic orchestration and technological support. The HyFlex model offers multiple avenues of participation with equivalence of learning outcomes when there is adequate design and teaching support (Beatty, 2019).

- Artificial intelligence and learning analytics: In the period 2020–2025, artificial intelligence (AI) and learning analytics are used to personalize trajectories, predict risk, and improve feedback. Recent reviews show concrete progress in analytics-mediated feedback, but note gaps in socio-emotional dimensions of student engagement and in evidence for institutional scalability (Banihashem et al., 2022; Zawacki-Richter et al., 2019). It also highlights ethical challenges—privacy, bias, and explainability—that demand specific governance and institutional policies. In line with a humanistic approach, UNESCO's (2023) guide to AI in education recommends safe, equitable, and responsible use frameworks.

- Immersive technologies: AR/VR and the educational metaverse: Evidence suggests that augmented reality and virtual reality boost motivation, experiential learning, and retention, especially in practical disciplines. However, its impact depends on infrastructure, teacher training, and clear pedagogical frameworks, with a tendency to pilot projects and definitions still under development (Radianti, Majchrzak, Fromm, & Wohlgenannt, 2020).

- LMS platforms, accessibility and inclusion: learning management systems (LMS) continue as the backbone of virtuality when they are articulated with active methodologies and analytics, and not only as repositories. To ensure inclusion and quality, interfaces and content must comply with current web accessibility guidelines (W3C, 2023). After the pandemic, international organizations have insisted on closing connectivity gaps and developing digital capacities for teachers and students as a condition of quality and equity (UNESCO, 2023).

Integrative synthesis (2020–2025): together, the theoretical references converge on four ideas: (a) foundation: connecting people-resources-contexts and designing learning experiences in line with digital ecosystems (Siemens, 2005; Bates, 2019); (b) models: hybrids and HyFlex as ways for flexibility and educational continuity (Beatty, 2019); (c) technologies: AI/analytics for personalization and feedback with ethical governance, and AR/VR for experiential learning when there is didactic support and integration (Radianti et al., 2020; Zawacki-Richter et al., 2019); and (d) quality with equity: LMS accessible under international standards and institutional policies that close digital gaps (W3C, 2023;

UNESCO, 2023). Thus, virtual mediation is not a technical adjunct, but an organizing principle of contemporary university teaching.

RESULTS

The documentary review analyzed 130 articles published between 2020 and 2025, from various regions of the world. The findings were organized into five axes and are complemented by cross-cutting trends that explain success conditions and bottlenecks of the university's digital transformation. These are:

a) Artificial intelligence and learning analytics (LA): AI and LA are consolidated as levers for personalization, early risk detection and formative feedback at scale. Reviews show positive effects when models are integrated with clear pedagogical objectives and actionable feedback (Banihashem et al., 2022; Crompton, Bernacki, & Greene, 2023; Pardo et al., 2019; Zawacki-Richter et al., 2019). The need for ethical governance – privacy, bias, explainability – and targeted teacher development persists (UNESCO, 2023; Williamson, Bayne, & Shay, 2020).

b) Immersive technologies (AR/VR) and metaverse: evidence points to improvements in motivation, experiential learning, and conceptual retention, especially in practical disciplines (health, engineering, arts) (Radianti et al., 2020; Makransky & Petersen, 2021; Wang & Wu, 2022; Lee & Jeong, 2023). Its impact depends on infrastructure, teacher training and mature didactic designs; otherwise, they remain as pilots without escalation.

c) Hybrid models (hybrid synchronous, HyFlex): hybrid models increase access and flexibility and can sustain equivalence of results if there is a coherent course architecture (teacher presence, continuous assessment, participation guides) (Beatty, 2019; Raes et al., 2020; Martin, Borup, & Dennen, 2022). The main challenges are associated with teaching load, technological orchestration and coherence between modalities.

d) LMS and online university teaching: LMSs remain the backbone of digital ecosystems when integrated with active methodologies and analytics, and are not used only as repositories (Bates, 2019). The distinction between emergency remote teaching and quality online learning clarifies the expected standard after the pandemic (Hodges et al., 2020); performance studies confirm that instructional design and teacher/social/cognitive presence are determinants (Iglesias-Pradas et al., 2021; Garrison, Anderson, & Archer, 2000).

e) Inclusion, accessibility, and public policies: to ensure quality with equity, content and platforms must comply with WCAG 2.2, promote universal design for learning, and align with digital transformation agendas (W3C, 2023; Al-Azawei, Serenelli, & Lundqvist, 2016; European Commission, 2020; OECD, 2021). Multilateral reports insist on closing connectivity and capacity gaps as a condition for the sustainability of change (UNESCO, 2021; UNICEF, UNESCO, & World Bank, 2021).

Cross-sectional findings

The evidence converges on four vectors that condition the effectiveness of the university's digital transformation. First, teacher professional development operates as a decisive lever: when teachers master instructional design, continuous assessment, and technological mediations, AI, AR/VR, and hybrid models unfold their true potential (Bates, 2019; Martin et al., 2022). Second, data governance and AI ethics—with privacy policies, bias mitigation, and explainability—are a requirement for scaling with responsibility and social legitimacy (UNESCO, 2023; Williamson, Bayne, & Shay, 2020). Third, assessment and monitoring systems supported by analytics strengthen timely feedback, persistence, and personalization, as long as they are integrated into formative assessment practices and clear pedagogical objectives (Pardo et al., 2019; Banihashem et al., 2022). Finally, infrastructure is an enabling condition: without robust connectivity, technical support, and guaranteed accessibility, innovation is not sustained or democratized, limiting its institutional impact (Wang & Wu, 2022; European Commission, 2020).

CONCLUSIONS

1. Effective digital transformation is explained less by technology and more by design decisions that articulate active methodologies, continuous assessment, and teaching/social/cognitive presence (Bates, 2019; Garrison et al., 2000).
 2. AI/LA personalizes trajectories and strengthens feedback, but requires ethical frameworks and institutional capacities for its responsible use (Banihashem et al., 2022; UNESCO, 2023; Zawacki-Richter et al., 2019).
 3. AR/VR and the metaverse improve experiential learning if there is infrastructure and pedagogical script; otherwise, its effect is diluted (Radianti et al., 2020; Makransky & Petersen, 2021; Lee & Jeong, 2023).
 4. Hybrid synchronous and HyFlex expand access and flexibility and achieve equivalence when there is design and teaching support; the implementation burden is the main challenge (Beatty, 2019; Raes et al., 2020; Martin et al., 2022).
 5. LMSs are the scaffolding of the ecosystem; to translate into quality with inclusion, they must comply with accessibility (WCAG 2.2) and be articulated with policies that close digital divides (W3C, 2023; European Commission, 2020; UNESCO, 2021).
- As a general conclusion, it can be stated that between 2020 and 2025, virtual mediation is consolidated as an organizing principle of university teaching. The leap in scale depends on four keys: teacher development, data/AI governance, infrastructure and accessibility, and formative assessment with analytics (Bates, 2019; Pardo et al., 2019; Williamson et al., 2020; UNESCO, 2023).

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