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Digital Innovation in Educational Management: A Bibliometric Analysis (2010-2024)

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ABSTRACT

The rapid advancement of digital technologies has reshaped the landscape of educational management, creating both opportunities and challenges in implementing effective digital strategies. Despite widespread digital adoption, many institutions still struggle with integration barriers, infrastructure gaps, and resistance to pedagogical transformation. This study addresses these issues by systematically analyzing how digital innovation in educational management has evolved over the past two decades. This research contributes by offering a comprehensive bibliometric mapping of digital education and management studies using Scopus data, revealing research hotspots, emerging themes, and key intellectual structures that guide future inquiry. It also demonstrates how bibliometric tools can be strategically employed to support institutional planning and policy formation. Methodologically, the study followed a four-stage process identification, screening, eligibility, and inclusion to extract 85 peer-reviewed documents from 2010 to 2024. Using VOSviewer, keyword co-occurrence and thematic clusters were visualized to highlight evolving research trajectories in the field. The results show a significant increase in publication output, especially after 2020, reflecting the global shift towards digital education due to the COVID-19 pandemic. Three dominant thematic clusters were identified: (1) Digital Education and Management Systems, (2) Human-Centered Research, and (3) Learning Process and Theory. Novel keywords such as teaching, learning, digital transformation, students, and LMS signal a growing focus on learner-centered, system-integrated educational models. Interdisciplinary contributions from sustainability, psychology, and information management journals underscore the complex, multifaceted nature of digital innovation in education. In conclusion, the findings provide actionable insights for researchers, educators, and policymakers, while offering a strategic roadmap for future research directions and digital transformation strategies in educational management.

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1. Introduction

The rapid growth of digital technology has significantly transformed the educational landscape worldwide, particularly in management, teaching, and institutional governance. However, integrating digital innovation into educational management remains a complex and challenging endeavor. Studies consistently highlight persistent gaps in digital readiness, infrastructure, and pedagogical strategies that hinder effective implementation [1], [2], [3], [4], [5]. Furthermore, educational institutions struggle with resistance to change, insufficient teacher training, and equity and access issues in digital education [6–10]. These challenges emphasize the urgent need for a systematic understanding of how digital innovation has evolved in educational management over the last two decades.

To address these problems, various solutions have been proposed and implemented. Strategic initiatives such as the development of e-learning platforms, digital transformation roadmaps, and learning management systems have been widely adopted [11], [12], [13], [14]. Moreover, capacity building programs focusing on digital competence for educators and administrators have been shown to enhance adaptability and institutional resilience [15]. Bibliometric and scientometric analyses also offer a methodological approach to map the evolution of research, identify knowledge gaps, and predict emerging trends that can guide future innovation in educational management [16], [17], [18], [19], [20], [21].

Existing bibliometric studies on digital education have concentrated on specific themes rather than providing a comprehensive picture of digital innovation in educational management. Mishra [22] mapped research on online learning adoption during the COVID-19 pandemic. Zawacki-De Nito E [23] reviewed research on e-learning systems over a decade, while Gao P [24] investigated trends in digital transformation in higher education. Studies by Song H [25] discussed policy and infrastructure challenges for digital education, and Tang K [26] examined emerging topics such as mobile learning and AI applications. However, despite these contributions, there is a lack of integrated bibliometric analysis focusing explicitly on the longitudinal evolution of digital innovation in educational management using a large dataset such as Scopus. This study fills this gap by analyzing research outputs from 2010 to 2024 and uncovering thematic clusters including digital education, information management systems, and organizational digital transformation.

This study offers several novel contributions. First, it fills this gap by providing a comprehensive bibliometric mapping of digital innovation in educational management based on 14 years of Scopus data. Second, it uniquely identifies three thematic clusters that demonstrate how digital education research has evolved beyond pedagogy to include information management systems and organizational digital transformation. Third, the study visualizes these clusters using VOSviewer and offers insights that can serve as a roadmap for policymakers, researchers, and institutional leaders. Unlike previous fragmented analyses, this work explicitly positions digital innovation as a multidisciplinary and socio-technical phenomenon.

This research makes several contributions. First, it provides a comprehensive bibliometric mapping of digital innovation in educational management using 14 years of Scopus data. Second, it identifies emerging research hotspots and evolving themes, offering a nuanced understanding of the field's intellectual structure. Third, by visualizing thematic clusters with VOSviewer, the study highlights the interconnections between digital education, information management, learning systems, and organizational transformation. Fourth, the findings offer a roadmap for researchers, policymakers, and institutional leaders to guide future digital transformation strategies. Finally, the paper contributes methodologically by demonstrating how bibliometric tools can be effectively used to analyze trends in complex, multidisciplinary domains.

2. Method

The research methodology for this study followed a structured four-stage process identification, screening, eligibility, and inclusion adapted from systematic review protocols. Each block in the flow diagram (Fig. 1) is explained below to ensure transparency and reproducibility.

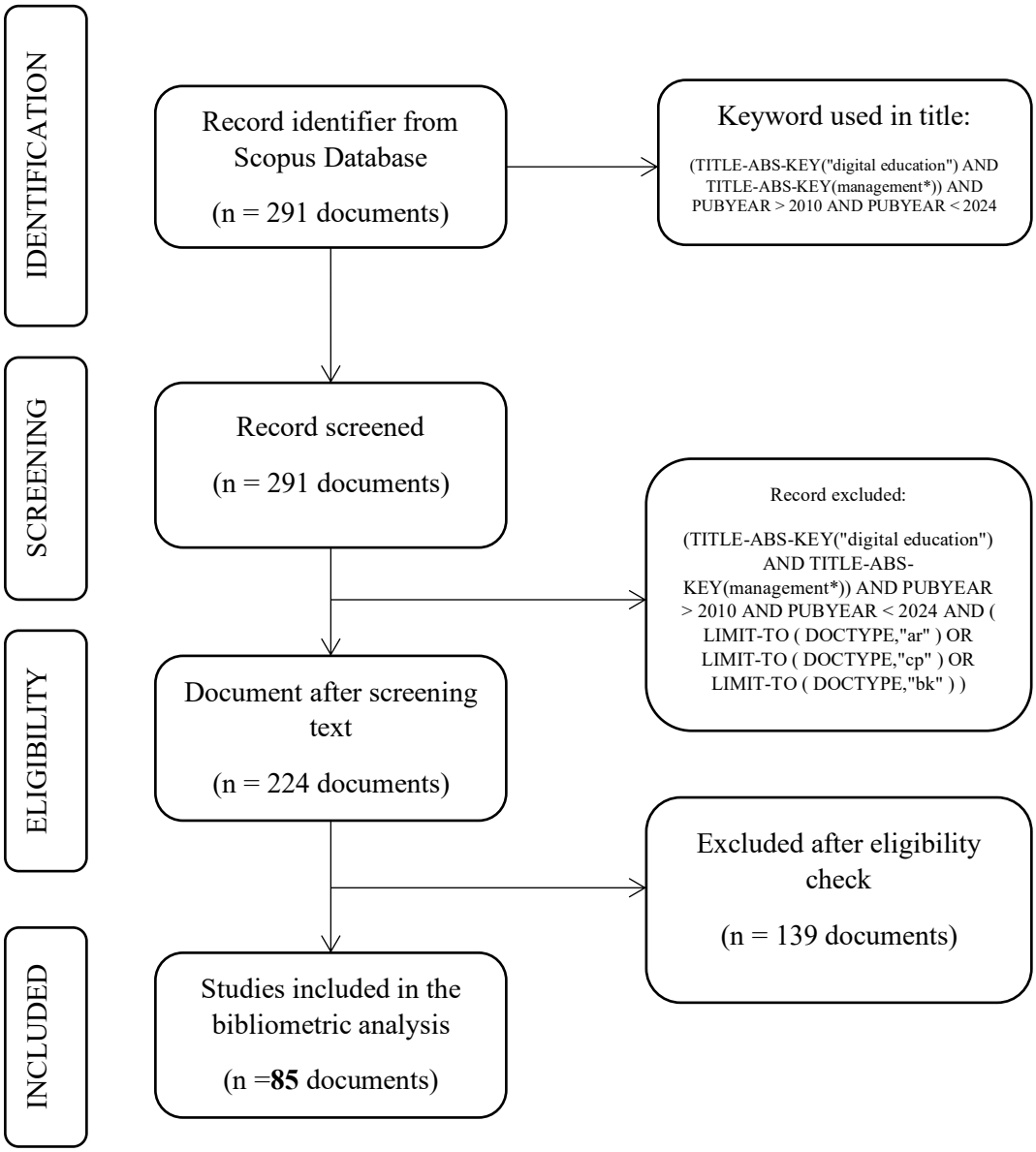

Fig. 1. Proposed of method

2.1. Identification Stage

The first block represents the initial search in the Scopus database, which was selected because it is one of the largest and most comprehensive sources of peer-reviewed literature in education, technology, and management. The search was conducted using the following Boolean query: *TITLE-ABS-KEY("digital education") AND TITLE-ABS-KEY(management) AND PUBYEAR > 2010 AND PUBYEAR < 2024.**. This search returned 291 documents. The combination of "digital education" and "management*" was used to capture research that links digital innovation with managerial aspects in education. The time frame (2010–2024) was chosen to reflect the rapid evolution of digital education practices during the last two decades.

2.2. Screening Stage

In the second block, all 291 records were screened by reading titles and abstracts. This step ensured that only studies directly addressing digital education in a management or organizational context were retained. Screening removed clearly irrelevant or duplicate documents. After this phase, 224 documents remained.

2.3. Eligibility Stage

The third block involved applying more specific inclusion and exclusion criteria. Only peer reviewed journal articles and review papers were retained, while conference proceedings, book chapters, notes, and editorials were excluded. This criterion was chosen to ensure that the final dataset consisted of high-quality, rigorous research outputs. Following this filtering step, 139 documents were excluded, resulting in 85 eligible documents.

2.4. Inclusion Stage and Analysis

The final block shows the inclusion of 85 documents, which were used for bibliometric analysis. VOSviewer software was applied to these publications to generate co-occurrence maps and cluster visualizations. This allowed the study to identify research trends, emerging themes, and patterns of collaboration in the field of digital innovation in educational management. This structured approach balances comprehensiveness with quality control. The choice of Scopus ensured coverage of high-impact journals, the keywords aligned with the research focus, and the exclusion of non-journal materials guaranteed scientific rigor.

3. Results and Discussion

3.1. Documents by Type

The distribution of document types (Fig. 2) reveals that the majority of publications related to digital education and educational management appear in the form of journal articles (84.7%), while only 15.3% are published as conference papers. This indicates that most research in this field undergoes rigorous peer review processes and is documented as full-length studies, reflecting the maturity and growing academic interest in digital innovation within educational management. The predominance of journal articles also demonstrates that the field is well established, with a strong emphasis on high-quality empirical and theoretical contributions rather than preliminary findings usually presented in conferences.

This trend highlights the increasing consolidation of knowledge in digital education research. The lower proportion of conference papers suggests that, although conferences remain important venues for emerging ideas, significant advancements and validated findings are being reported in journals, which provides a stable knowledge base for policy development and practice. It also implies that researchers prefer long form, comprehensive studies to capture the complexity of digital transformation in education. For future research, this pattern encourages the continuation of high-impact journal publications while also leveraging conferences as spaces to explore innovative methodologies and pilot studies before expanding them into more extensive research outputs.

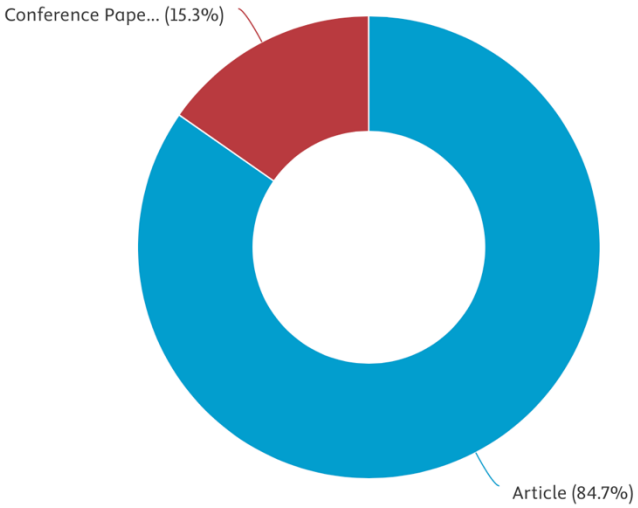

Fig. 2. Visualization of documents by type

3.2. Documents by Year

The annual distribution of publications (Fig. 3) shows a significant increase in research output on digital education and educational management over the last decade. From 2015 to 2018, the number of documents remained very low, indicating that digital innovation in educational management had not yet become a widely recognized area of study. A moderate increase began in 2019, followed by a noticeable jump in 2021, when the number of publications reached more than 20. This surge corresponds to the global shift in education caused by the COVID-19 pandemic, which accelerated the adoption of e-learning technologies and prompted scholars to explore digital transformation strategies in education more intensively.

Following the peak in 2021, there was a slight decline in 2022, but the upward trend resumed strongly in 2023, reaching the highest number of publications in the dataset. This pattern suggests that digital education research has transitioned from an emerging field into a mature and rapidly expanding area of academic inquiry. The post-pandemic period has also shown that research interest continues to grow, emphasizing the long-term importance of digital transformation in education rather than it being just a temporary response to a crisis. These results confirm that digital innovation in educational management is now firmly established as a significant focus of global research.

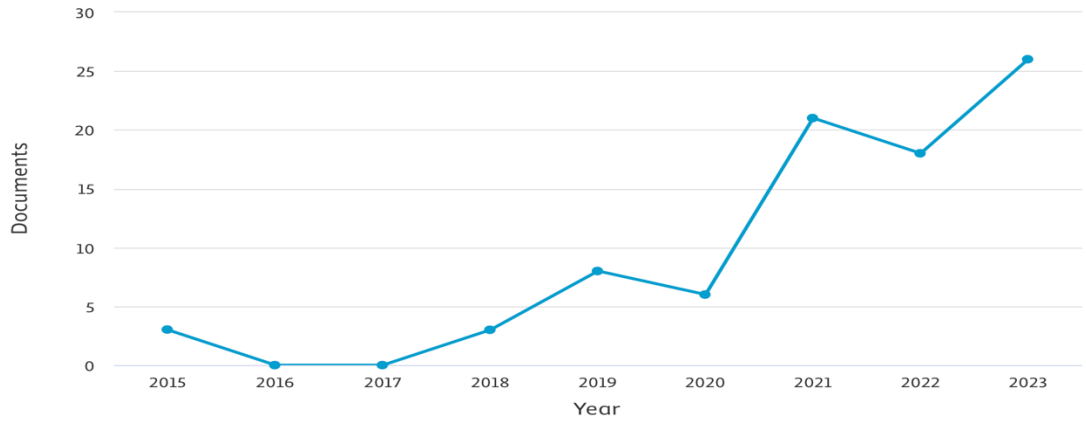

Fig. 3. Annual distribution of publications on digital education and educational management (2015–2023). The figure shows a steady increase in research outputs, with a sharp growth beginning in 2021 and peaking in 2023, reflecting the rising global focus on digital transformation in education.

3.3. Documents per Year by Source

The distribution of documents by source (Fig. 4) highlights a small set of journals and conference series that have consistently contributed to research on digital education and educational management from 2020 to 2023. Among them, Sustainability (Switzerland) shows the largest and most sustained output, with a peak of three publications in 2021 and a stable output of two documents in both 2022 and 2023. This reflects the growing emphasis on the intersection between sustainable educational practices and digital transformation. Meanwhile, the Journal of Physics Conference Series contributed three documents in 2021, which suggests that conference proceedings played an important role in disseminating early findings, particularly in the period immediately following the global transition to online education.

Other sources, such as E3S Web of Conferences, Frontiers in Psychology, and Education Sciences, appear with smaller but noteworthy contributions, each publishing one document per year during the observed period. These findings indicate that the research output is dispersed across interdisciplinary sources, combining perspectives from education, psychology, sustainability, and technology. However, the relatively low concentration of studies in high-impact educational management journals suggests that there is still room to consolidate a specialized publication outlet for this topic. This trend also underlines the interdisciplinary nature of digital education research, which draws insights from multiple fields rather than a single dominant source.

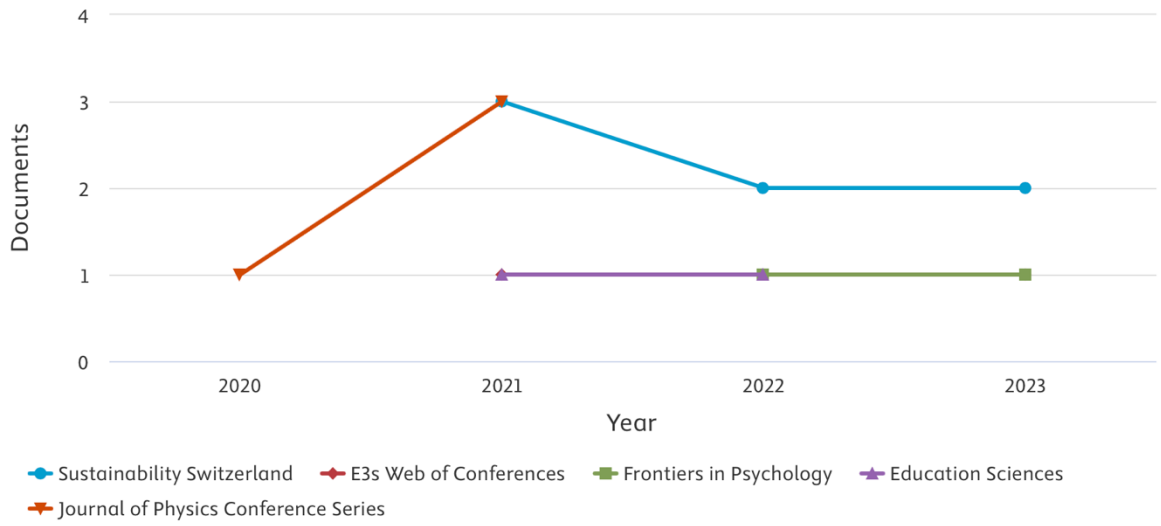

Fig. 4. Distribution of publications on digital education and educational management by source (2020–2023). Sustainability (Switzerland) shows the highest and most stable contribution, followed by conference series such as the Journal of Physics Conference Series and E3S Web of Conferences, illustrating the interdisciplinary and emerging nature of this research area.

3.4. Focus Research

The keyword co-occurrence map (Fig. 5) identifies three main clusters (Table 1) that illustrate the thematic structure of research on digital education and educational management. The red cluster represents Digital Education and Management Systems, focusing on digital transformation, e-learning, teaching, higher education, and learning management systems. This cluster highlights how technology integration and systems management are central to discussions in modern educational contexts. The green cluster emphasizes Human Centered Research, reflecting studies concerned with the role of humans, demographics (male, female, adult), internet use, and patient education. Lastly, the blue cluster focuses on Learning Process and Theory, which stands as a smaller yet essential area that connects digital technologies with fundamental theories of learning.

Compared with previous bibliometric studies, these findings are consistent with research by Ruark T [27] and Su Y [28] who also reported that digital education research has become interdisciplinary, blending pedagogy, management, and technology. However, this study expands on their work by showing that management systems and human factors are becoming dominant themes, whereas earlier research placed more emphasis on pedagogical innovation alone. The presence of a distinct cluster related to human centered research is especially significant because it reflects how post-pandemic studies have begun to explore psychological, demographic, and behavioral factors influencing the success of digital education.

This visualization also suggests that digital education research is evolving into a socio-technical field, where technology (systems and platforms), human interaction (students, teachers, demographics), and pedagogical theory intersect. Unlike some previous studies that highlighted isolated themes, our results show the growing integration between these clusters, as evidenced by the overlapping linkages between them. This integrated approach is essential for future work that aims to enhance educational outcomes while addressing management efficiency and human needs in digital environments.

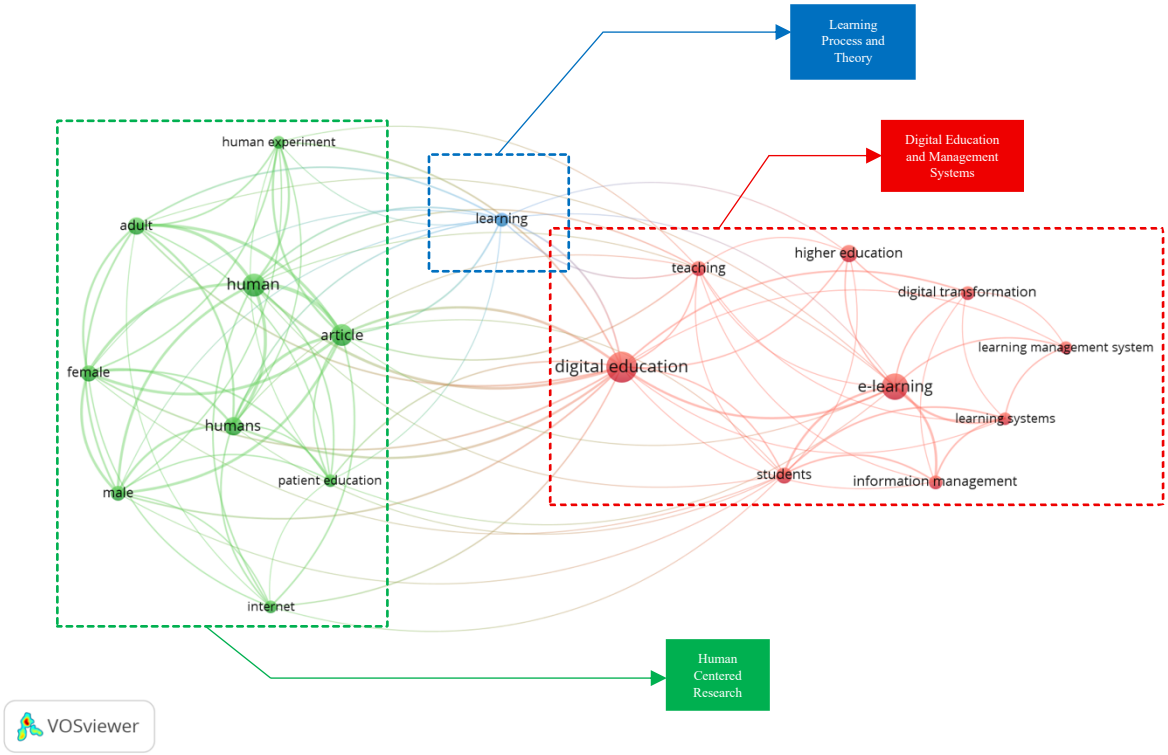

Fig. 5. Keyword co-occurrence network identifying three thematic clusters in digital education and educational management research: Digital Education and Management Systems (red), Human-Centered Research (green), and Learning Process and Theory (blue).

Table 1. Clusters of Research Focus in Digital Education and Educational Management

Cluster	Main Themes / Keywords	Key Implications
Digital Education and Management Systems	Digital education, e-learning, teaching, higher education, digital transformation, learning management system, learning systems, information management	Focus on how digital tools and platforms transform educational management processes. Emphasizes system integration, efficiency, and strategic use of digital technologies in educational institutions.
Human Centered Research	Human, humans, male, female, adult, internet, patient education, human experiment	Explores demographic, behavioral, and psychological factors affecting digital education. Highlights the importance of inclusivity, accessibility, and understanding human interaction with technology.
Learning Process and Theory	Learning, learning processes, pedagogical theory	Concentrates on the theoretical foundations of learning in digital contexts. Connects educational psychology and cognitive theories with digital delivery models and instructional design.

3.5. Keyword Novelty

Fig. 6 reveals "digital education" as the most dominant keyword, central to a wide array of related terms such as "learning," "teaching," "e-learning," and "students." This centrality illustrates its pivotal role as a thematic hub in the field. Closely related concepts like "higher education," "digital transformation," and "learning management system" cluster around this node, suggesting a technological shift in instructional delivery. The color gradient shows a clear trend toward newer research (yellow hues) involving “teaching” and “learning,” indicating a focus on pedagogical strategies in digital education during the most recent years.

The presence of terms like “human,” “female,” “male,” and “adult” highlights the demographic focus of many studies, especially in medical or health education contexts. Interestingly, terms such as

"internet" and "information management" are less recent (blue tones), indicating they were prominent earlier in the digital education discourse but are now being replaced by more advanced topics like "digital transformation." This trend aligns with findings by XIa X [29], who noted a post pandemic shift from infrastructure concerns toward learner experience and adaptive pedagogy. Compared to earlier studies, this visualization shows a greater thematic diversity and newer research interests focused on the integration of digital tools in formal education settings.

This network visualization underlines the evolution of digital education research from generic ICT usage to more sophisticated implementations such as e-learning systems and personalized learning environments. The increased focus on "students," "learning systems," and "digital transformation" reflects a growing emphasis on user-centered design and system-level change. These findings echo trends observed by Aramburuzabala [30] who emphasized that digital education is increasingly seen not just as a delivery method but as a transformative force. Therefore, future research should continue exploring the implications of this transformation, particularly in emerging areas such as AI-assisted instruction, immersive learning, and inclusive access strategies.

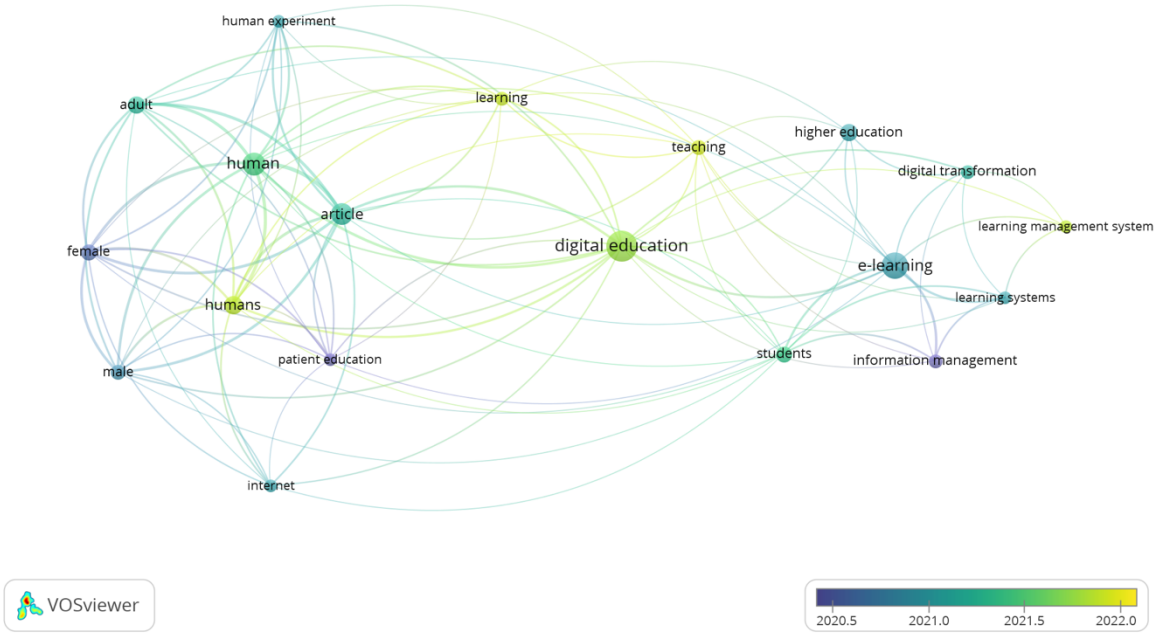

Fig. 6. Keyword novelty

The emergence of keywords such as teaching, learning, digital transformation, learning management system (LMS), higher education, and students in recent literature underscores a paradigmatic shift in digital education research. The prominence of teaching and learning indicates a renewed emphasis on core pedagogical interactions, now recontextualized in digital and hybrid environments. Scholars such as Salas-Pilco S and Spaho E [31], [32] emphasize that effective online teaching requires new instructional models that prioritize interaction, engagement, and feedback. These findings suggest that digital education is no longer limited to content delivery but has evolved into a dynamic space for rethinking instructional strategies.

The increased visibility of digital transformation and LMS signals a structural change in how institutions manage learning environments. As highlighted by Jung Y [33] LMSs are now pivotal not just for content delivery but also for tracking student engagement, performance analytics, and fostering adaptive learning. Digital transformation extends beyond adopting new technologies it involves strategic reconfiguration of institutional processes, teacher training, and learner support systems. This evolution calls for more agile and scalable digital infrastructures in educational institutions, particularly in higher education contexts where flexibility and personalization are increasingly demanded.

Implications for future practice are substantial. Policymakers must prioritize investment in digital infrastructure and establish regulatory frameworks that support equitable access to digital education across demographics. In pedagogical terms, instructors should be equipped with competencies for designing learner-centered online experiences, such as flipped classrooms, project-based learning, and formative digital assessments. Curriculum designers should consider embedding digital competencies, critical thinking, and collaborative learning within course outcomes to prepare students for a tech driven world. Additionally, universities should explore the integration of AI and analytics into LMS platforms to personalize learning pathways. In sum, these findings not only reflect current research trends but also offer a concrete roadmap for shaping a more resilient, inclusive, and effective digital education ecosystem.

4. Conclusion

This study set out to examine how digital innovation has evolved within the domain of educational management by conducting a comprehensive bibliometric analysis of Scopus-indexed literature from 2010 to 2024. As anticipated in the introduction, the findings confirmed a significant and accelerating transformation in the field, particularly following the COVID-19 pandemic. The results demonstrate that research has shifted from foundational concerns about digital infrastructure and access toward more sophisticated themes such as learning management systems, digital transformation strategies, and human-centered pedagogical innovations.

The analysis identified three major thematic clusters Digital Education and Management Systems, Human-Centered Research, and Learning Process and Theory revealing an increasingly integrated socio-technical landscape in education. These findings align with and expand upon prior studies by offering a broader longitudinal view and identifying novel keywords such as teaching, learning, students, and digital transformation, which are increasingly central in recent publications. This reflects the growing importance of learner-centered design, institutional adaptability, and the systemic use of digital tools.

Looking forward, future research should delve deeper into how artificial intelligence, immersive technologies, and predictive analytics can further personalize and optimize digital education. Policymakers are encouraged to establish adaptive regulatory frameworks that support equitable access and digital capacity building. Educators must be empowered with training and tools to implement interactive, student centered learning environments, while curriculum designers should embed digital literacy and transversal skills into educational programs. The insights generated from this study can thus serve as a roadmap for strategic planning, innovation, and capacity building in educational management, ensuring that institutions remain resilient and relevant in a rapidly changing digital era.

Declarations

Supplementary Materials: Supplementary materials of this study include the full dataset retrieved from Scopus and visualizations generated using VOSviewer.

Author Contributions: MFR & ILK: Conceptualization; RNG: Writing-Initial Draft, Editing and Visualization, Methodology and Review & Editing, Conceptualization, Formal analysis, Methodology and Review & Editing; PN: Validation and Monitoring. All authors have read and approved the published version of the manuscript.

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