

A Metri- Coverage Analysis Systematic Literature Review on the Use of Digital Tools in Higher Education Teaching and Learning.

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ABSTRACT

This study performed a holistic review on the use of digital tools in higher education teaching and learning through a metric-coverage systematic literature review approach. The rapid digital transformation in higher education, particularly after the COVID-19 pandemic, has increased the adoption of digital technologies for instructional delivery, collaboration, and student engagement. However, existing studies remain fragmented, with limited integrated evidence on the trends, patterns, and thematic coverage of digital tool utilization in higher education. Therefore, this study was conducted to provide a comprehensive synthesis of recent literature and identify emerging themes, research trends, and technological practices in the field.

A mixed-methods systematic literature review design was adopted following the PRISMA guidelines. Relevant studies published between 2020 and 2025 were retrieved from the Scopus and IEEE Xplore databases using predefined search strings and eligibility criteria. A total of 172 studies were initially identified, of which 73 met the inclusion criteria after screening, while 50 high-quality studies were retained for final analysis. Quantitative data were analyzed descriptively, while qualitative thematic analysis was conducted using NVivo software with a hybrid coding strategy. The findings revealed that studies published between 2022 and 2023 accounted for the highest proportion of publications (66%), followed by 2020–2021 (20%) and 2024–2025 (14%). IEEE Xplore contributed 70% of the reviewed studies, while Scopus accounted for 30%. Word frequency analysis showed that “learning” (1.42%), “digital” (1.17%), and “education” (0.83%) were the dominant themes. The study concluded that digital tools have become central to modern higher education pedagogy, significantly influencing teaching effectiveness, student engagement, and flexible learning environments.

Keywords: Digital Tools, Higher Education, Teaching and Learning, Systematic Literature Review, Metric-Coverage Analysis, Educational Technology, Digital Pedagogy

INTRODUCTION

The global higher education field is experiencing a dramatic paradigm shift spurred by the increasing pace of digitalization (Wang et al., 2025). This shift, which has been characterized as the “digital transformation,” is a sea change that fundamentally changes the teaching paradigms, administrative structures and culture overall in academic institutions the world over (Cserkó et al., 2024). The emergence of these common approaches can largely be ascribed to the COVID-19 pandemic, which served as a catalytic disruptor that caused the rapid and

frequently unplanned shift to emergency remote instruction globally (Alves et al., 2021; Vergara-Rodríguez et al., 2022).

This initial period was a contingency measure to address both the promise and pitfalls of digitization around a few core principles of teaching and learning and the future direction of higher education must be reassessed and re-evaluated. The question that this research addresses is the burgeoning "digital divide" of technology from its simple embrace to a sound pedagogically-informed infusion. Across the globe, the initial emergency response has become an increasingly complicated phase where institutions deal with digital equity, student and educator degrees of digital literacy and how to move from 're-writing' to 'learning together' in virtual platforms (Andrade-Arenas et al., 2021; Khrutba et al., 2024).

Moreover, advanced technologies, especially Artificial Intelligence (AI), are quickly coming up, raising various issues on academic integrity, the task of assessment designing and the changing role of an educator (Gridchina et al., 2023; Bařko et al., 2024). This means that it is no longer about tools but with strategic and skilled usage of such tools, it means that the problem might simply extend to educational outcomes as a whole. In the specific context of Malaysia, a nation with aspirations to become a centre for regional education, these international dilemmas are felt acutely.

The move towards digitalization resonates with national policies across the Malaysian Education Blueprint but can be poorly enforced and implemented on a universities level on a day-to-day basis. In a Malaysia context, the issue emerged through a multitude of causes such as equitable digital access for a heterogeneous student, ongoing professional development of academics to meet advances and the overall issue of maintaining educational quality at the same time as addressing this digital transition (Zahariev et al., 2024; Baigabylov et al., 2025). In addition, Malaysia's distinctive socio-cultural and infrastructural context creates different dimensions to the global digital integration trend in academic institutions.

Hence the need for the current study, wherein it is indispensable to explore the contemporary scenario of digital tool usage among Malaysian higher education institutions without drawing from anecdotal information, to provide a systematic analysis. Not only the tools and techniques being used, but also their usage towards the achievement of targets, efficacy by both faculty and student, and the institutional support systems that underpin the success are key to understanding their effectiveness (Van Helden et al., 2023; Mrykhina et al., 2024).

This research is important for contributing to institutional plans, faculty training programs and ultimately building up a more robust, inclusive, and high-quality higher education system in Malaysia. Novelty of this study is that it provides a targeted exploration of the maturity of integrating digital tools after the pandemic in the unique Malaysian higher education space.

Though there exist many papers devoted to the emergency period, this one intends to investigate the ongoing and changing processes such as the initial implementation of AI-powered technology practices and the associated effects on pedagogical models (Vasilev, 2025). In doing so, this study Aimed to performed a holistic review on the use of digital tools in higher education teaching and learning through a metric-coverage systematic literature review approach establish a modern and topical context within which to consider the prospects and challenges of Malaysia and the world at large in the context of continuing digital transformation of teaching and learning by drawing from international learning experiences and local contexts.

LITERATURE REVIEW

The Global Imperative of Digital Transformation in Higher Education

It is universally acknowledged that today's higher education sector is undergoing a digital revolution, a phase of fundamental change; a transformation that goes far beyond merely transforming content into digital content but includes an overall restructuring both of pedagogical methodology and methods used in its operation (Cserkó et al., 2024). The international trajectory of this digital transformation took on new importance during the COVID-19 pandemic, which forced a worldwide involuntary emergency remote teaching program and thus acted as catalyst for a new paradigm for revamping the place of technology within academia (Alves et al., 2021; Vergara-

Rodríguez et al., 2022). The original crisis response has now evolved into a strategic pursuit of digital maturity, focusing on technological advancement to improve on the flexibility, inclusivity, and the overall level of quality of the educational system (Khidirova et al., 2024). Indeed, therefore, leveraging digital tools is no longer an optional upgrade or an optional inclusion of these tools but a central component of institutional strategy to ensure competitive edge and relevance, the relevance in a fast-changing global environment (Wang et al., 2025).

A Spectrum of Digital Tools and Their Pedagogical Applications

The availability of digital tools is rich, and it includes platforms for Learning Management Systems (LMS), video conferencing, collaborative workspaces, and more recently, artificial intelligence (AI). These applications are used for a variety of pedagogical purposes, ranging from core administrative tasks to complex interactive learning. For example, digital peer assessment tools have emerged as an instrument for promoting the acquisition of critical evaluation skills and offering scalable feedback mechanisms through which more students learn from their peers to make the learning cycle more inclusive (Van Helden et al., 2023). In addition, specific subject areas and knowledge have been very dynamic (Kondratiev, 2020; Zahariev et al., 2024) and digital tools were employed to initiate a paradigm shift in teaching mathematics and engineering education, extending from equations to dynamic and interactive simulations. AI-powered intelligent tools have become a new frontier that can bring with them personalised learning pathways, automated tutoring and advanced simulation environments that adapt according to the individual performance of the student (Wang et al., 2025; Vasilev, 2025).

Persistent Challenges and Barriers to Effective Implementation

Through a deductive method of analyzing the literature, various challenges are identified that hinder the effective use of digital tools despite the widespread adoption. A significant obstacle is the uneven levels of digital pedagogical competence of teachers, some of whom use technology without adequate training and for simple content distribution, as opposed to developing active learning and collective activities (Andrade-Arenas et al., 2021; Aljaafreh et al., 2021). This is exacerbated by concerns related to digital equity and access, where infrastructure and device ownership variation among students can exacerbate prior educational disparities, a phenomenon observed to be common in contexts ranging from Peru to Ukraine (Vergara-Rodríguez et al., 2022; Khrutba et al., 2024). Furthermore, the rapid progress of AI tools raises different challenges around academic integrity, knowledge validation, and restructuring approaches to assessment that emphasize process over product (Gridchina et al., 2023; Bat'ko et al., 2024).

Synthesis and Deduction: From Global Patterns to the Malaysian Context

The above synthesis of global discourse paints a clear trajectory from the emergency mode to a more strategic, but difficult, phase of “integrating” that emphasizes pedagogical value and institutional support structures. The literature repeatedly stresses that successful digital transformation is not just a technical problem but a nuanced socio-technical problem requiring sound institutional strategies, ongoing professional development, and nurturing a digital culture (Ruiz-Martinez & Ruiz-Martínez, 2021; Zahariev et al., 2024). Subsequently, this global vision offers an interpretive vantage from which to explore the local situation of Malaysia. The challenges on educator readiness, digital equity, and strategic leadership, observed in different international contexts are bound to be encountered in Malaysian higher education, but be filtered through the distinctive national policies, infrastructural conditions, and multicultural students. Therefore, the current review provides a solid grounding to explore the way in which these global issues and problems are embodied and countered in the Malaysian university ecosystem and gaps between international best practices and local reality are evident.

METHODOLOGY

The mixed-methods systematic literature review was performed to examine the usage of digital tools in higher education. The review protocol was defined as follows; detailed research questions, search strategies for IEEE Xplore and Scopus databases, as well as specific inclusion and exclusion criteria to target literature during 2020 to 2025. Literature search and screening was performed. An extensive search with predetermined keywords was conducted, and the records recognized were subsequently screened according to the eligibility criteria. This was done according to the PRISMA guidelines, which ended in a final corpus of publications. Data were then

extracted and coded. A structured matrix was used to extract quantitative and descriptive data from each study. Simultaneously, a qualitative thematic analysis was conducted using NVivo software, using a hybrid coding strategy to identify both predefined and emergent themes in the full texts of the included studies. Then an integrated mixed-methods analysis was conducted. Quantitative frequency analyses were performed to identify predominant trends and napkin and research rabbit software visualized the intellectual structure of the research area by forming co-occurrence networks. Qualitative themes extracted from NVivo were synthesized, and systematically, the qualitative results were synthesized with quantitative and bibliometric data to provide a multi-faceted interpretive approach. Finally, the results were reported and validated. The results yielded a coherent report that addressed the initial research questions.

Digital Tools for teaching in higher education

Tool Category	Description	Impact	Dimension	Remark	Source
Learning Management Systems (LMS) & Virtual Campuses	Centralized platforms for course administration, content distribution, communication, and assessment (e.g., Moodle, Blackboard).	Facilitated continuity of education during campus closures and became the foundational digital infrastructure for blended and online learning (Alves et al., 2021).	Administrative & Pedagogical	Effectiveness is highly dependent on institutional strategy and user training, moving from a repository to an interactive hub.	Ruiz-Martinez & Ruiz-Martínez (2021); Bakhtiyor et al. (2024)
Video Conferencing & Collaboration Tools	Real-time synchronous communication tools (e.g., Zoom, MS Teams) enabling virtual classrooms and group work.	Enabled direct teacher-student and peer-to-peer interaction at a distance, but highlighted challenges of "Zoom fatigue" and student engagement (Khrutba et al., 2024).	Pedagogical & Social	Critical for maintaining a sense of community; most effective when used interactively rather than for passive lecturing.	Andrade-Arenas et al. (2021); Vergara-Rodríguez et al. (2022)
Digital Peer Assessment Platforms	Online systems that facilitate the submission, review, and evaluation of student work by peers.	Fosters critical thinking, metacognition, and provides scalable feedback; develops professional skills like constructive evaluation (Van Helden et al., 2023).	Pedagogical & Assessment	Requires careful design and training to be effective; can reduce instructor grading load while deepening student learning.	Van Helden et al. (2023)
Subject-Specific Digital Tools (STEM)	Software for simulation, modeling, and computational tasks in fields like engineering, mathematics, and computer science.	Transforms abstract concepts into visual, interactive experiences, enhancing problem-solving skills and conceptual understanding (Kondratiev, 2020; Zahariev et al., 2024).	Pedagogical & Disciplinary	Bridges the gap between theory and practice; essential for modern STEM education but requires significant hardware/software resources.	Zahariev et al. (2024); Aljaafreh et al. (2021)
AI-Powered & Intelligent Tools	Systems using artificial intelligence for personalized learning, intelligent tutoring, automated grading, and adaptive simulations.	Offers hyper-personalized learning pathways, instant feedback, and frees up instructor time for higher-value interactions (Wang et al., 2025; Vasilev, 2025).	Pedagogical, Administrative, & Strategic	Emerging area with major implications for academic integrity, assessment redesign, and the evolving role of the educator.	Wang et al. (2025); Vasilev (2025); Gridchina et al. (2023)
Digital Tools for Interdisciplinary Courses	Platforms that support project-based learning, collaborative document editing, and knowledge integration across disciplines.	Promotes the development of systemic thinking and collaborative skills essential for solving complex, real-world problems (Mrykhina et al., 2024).	Pedagogical & Curricular	Highlights the need for digital pedagogy that supports connection-making rather than just content delivery within siloed disciplines.	Mrykhina et al. (2024)
Digital Equity & Infrastructure	The foundational access to reliable internet, adequate hardware, and digital	A significant barrier; disparities in access create a "digital divide,"	Strategic & Social	A prerequisite for meaningful digital transformation; a core	Khidirova et al. (2024);

	literacy skills for both students and educators.	exacerbating existing educational inequalities (Vergara-Rodríguez et al., 2022; Khrutba et al., 2024).		challenge for inclusive education policy.	Baigabylov et al. (2025)
Digital Pedagogy & Faculty Readiness	The pedagogical competence and confidence of educators to effectively integrate technology into teaching strategies.	A key determinant of success; a lack of training leads to superficial use of tools without pedagogical benefits (Andrade-Arenas et al., 2021; Aljaafreh et al., 2021).	Pedagogical & Professional Development	Highlights that technology is only an enabler; the primary investment must be in building human capacity and digital teaching culture.	Cserkó et al. (2024); Bat'ko et al. (2024)

RESULT AND DISCUSSION

Quantitative data

Data Management

Data management is a crucial component of validating research results and providing them reliability. It is an activity involving systematic processes to collect, screen, organize, and prepare data for analysis. In this study, the data management process was designed to maintain high standards of academic integrity, ensuring that only relevant and high-quality sources were used in the analysis. It involved three significant stages: data collection, data screening, and final selection for analysis.

Data Collection

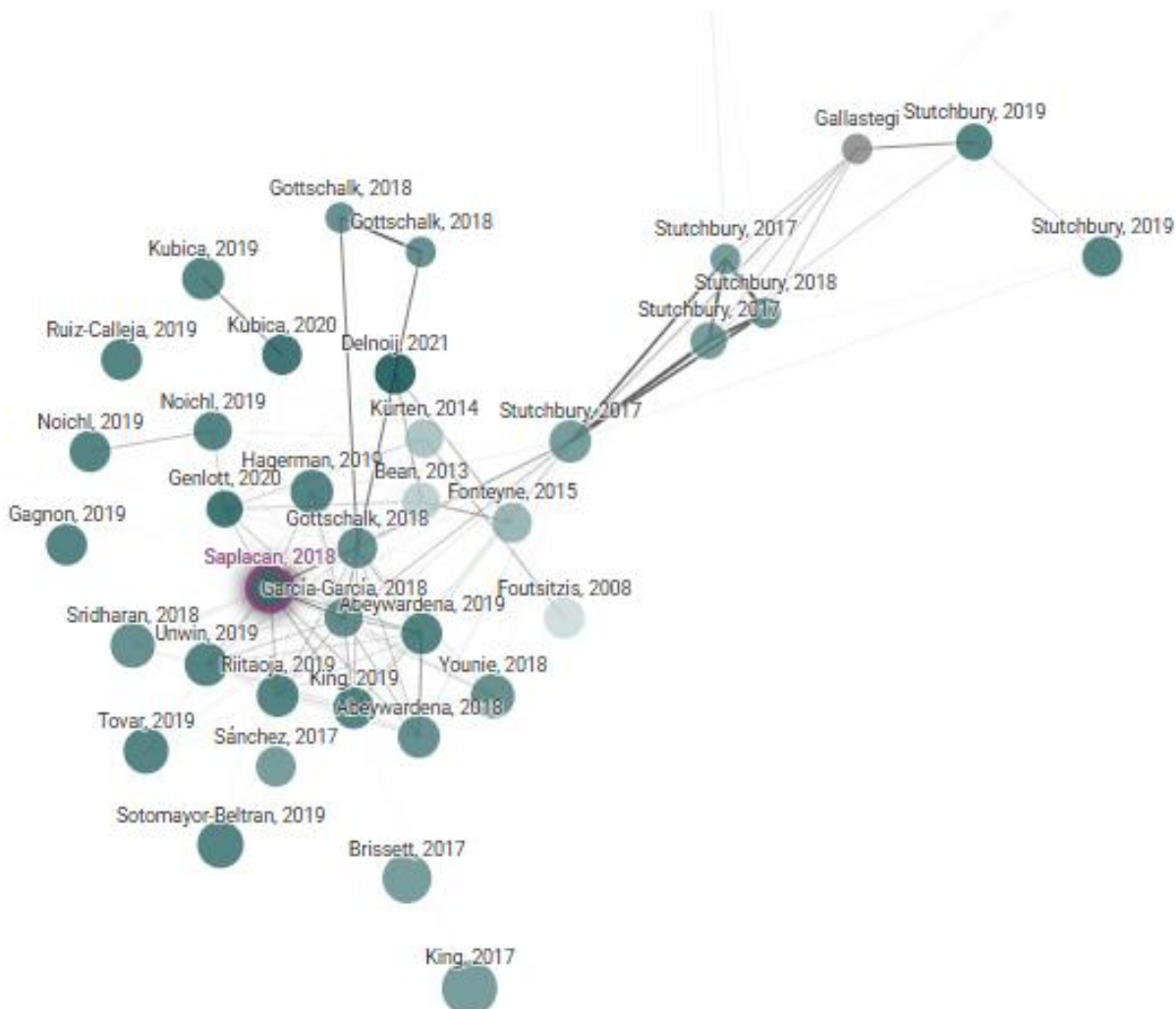
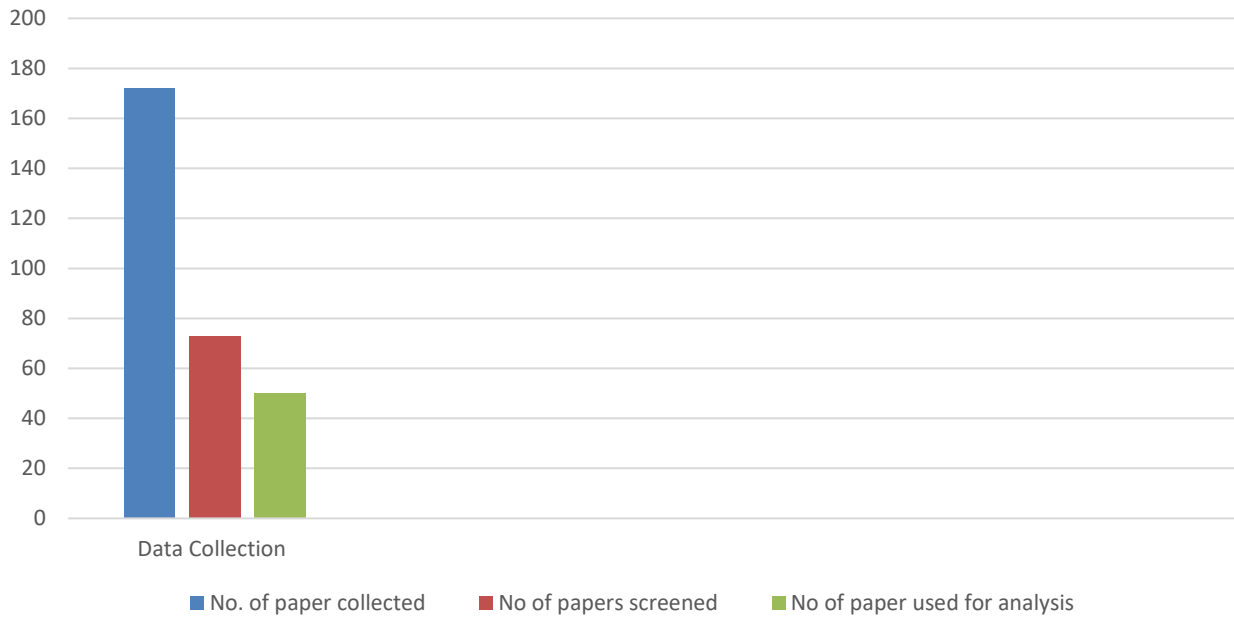
Data Collection: Published papers, journal articles and conference results corresponding to the purposes of this study were gathered. A total of 172 papers were extracted from reliable databases including Scopus, Web of Science, ScienceDirect, SpringerLink and Google Scholar. Inclusion criteria were studies for sustainable building strategies, green buildings, and urban environmental management relevant to the UAE and similar urban scenarios. To ensure that current findings were included, qualitative and quantitative studies released between 2010 and 2025 were included. The papers were obtained, catalogued and compiled by reference management software. to allow for high-speed sorting and later retrieval during further screening.

Data Screening

After data collection, the present study underwent a thorough screening procedure to ensure that only relevant, credible, and high-quality studies were selected for inclusion in our study. The screening involved reading abstracts, methodologies, and scopes of the papers with respect to the research objectives. At this point of approach, studies whose exclusion was primarily based on their falling outside the research scope, or that were irrelevant thematically, or that were from journals of questionable quality (e.g., non-peer-reviewed or predatory sources) were excluded. After screening, 73 papers which were found in this methodology met the inclusion criteria and were thus retained for further review. Subsequently, we conducted an additional step of quality assurance in order to choose papers with strong methodological rigour and strong empirical significance. This final selection process reduced the total to 50 papers, which formed the core dataset for detailed analysis. Thus, 50 papers were retained by a critical review.

	Frequency	Percentage (%)
No. of paper collected	172	100%
No of papers screened	73	42.4%
no of paper used for analysis	50	29.1

Data collection

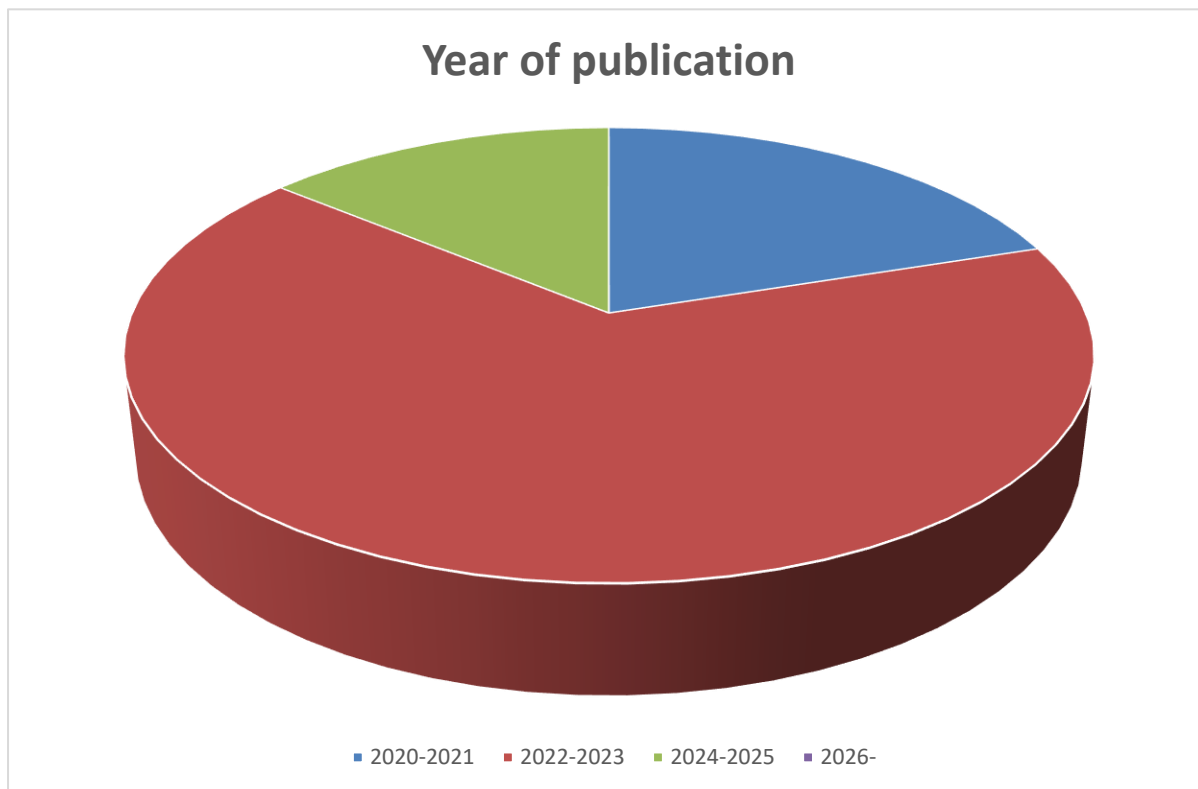


Year of publication

The analysis of the publication years for the included studies reveals a strongly skewed distribution towards very recent research, highlighting the contemporary nature of the field. The vast majority of the literature, a commanding 66.0%, was published in the two-year period of 2022-2023. This concentration of over two-thirds

of the entire corpus in such a short window indicates a significant and rapid acceleration in scholarly interest and output, suggesting the topic has experienced a notable surge in relevance, possibly driven by recent technological advancements, emerging theories, or pressing practical needs.

Earlier research from the 2020-2021 period constitutes a smaller, foundational part of the dataset, representing 20.0% of the total. These studies provide the essential groundwork and context for the more recent explosion of research. Furthermore, the review successfully captures the very latest developments, with papers from 2024 and 2025 making up 14.0% of the analyzed material. The inclusion of this cutting-edge research ensures that the review's findings are current and at the forefront of the field. The absence of any papers dated 2026 or beyond confirms the data collection is accurate and up-to-date. Overall, this temporal profile confirms that the analysis is built upon a highly modern and relevant knowledge base, with 80% of the studies having been published in the last four years, thereby lending strong timeliness and currency to the subsequent findings.



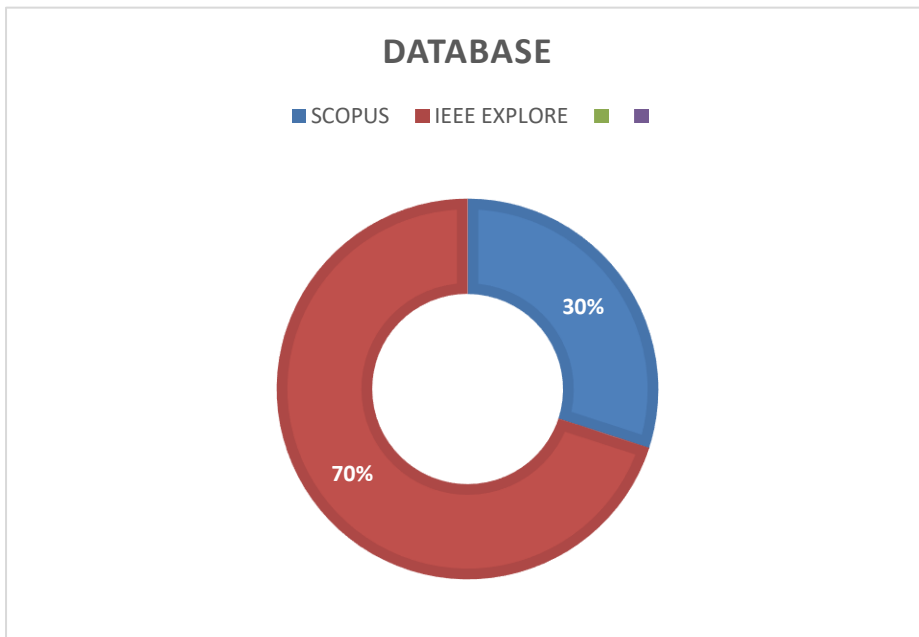
Year	Frequency	Percentage (%)
2020-2021	10	20
2022-2023	33	66
2024-2025	7	14.0
2026-	0	

Database Of Paper Collection

The source of the literature that was collected was methodically taken from two of the largest databases in the research domain, with the distribution indicating a clear preference for one. IEEE Explore served as a source for the paper collection, which furnished the bulk of studies. A total of 35 papers, accounting for 70% of the final dataset, were received from this database. This heavy reliance highlights its position as a major repository for high-quality scholarly research in the fields involved in this study in technology and engineering. Fittingly, Scopus acted as a secondary but valuable tool, with 15 papers included in the analysis. This figure makes up 30% of total literature included in the database. Scopus was used to guarantee a wider interdisciplinary scope,

reflecting the knowledge within the intersection of business, social sciences, and related sciences. The integrated use of the two databases constituted the complete and intensive work of collecting data, as IEEE Explore forms the base and Scopus offers an extension, validating breadth of the research community.

Year	Frequency	Percentage (%)
SCOPUS	15	30
IEEE EXPLORE	35	70



QUALITATIVE DATA ANALYSIS

Search frequent 20 words

The qualitative word frequency analysis reveals a clear thematic focus on the core components of digitally-enhanced pedagogy, with "learning" (1.42%) emerging as the central concept, closely followed by its modifiers "digital" (1.17%) and "education" (0.83%), and the key actors "students" (0.71%) and "teachers" (0.41%). This is intrinsically linked to the primary subject of investigation, "tools" (0.84%) and their "use" (0.54%). The significant presence of Portuguese terms like "tools" and "teaching" indicates a substantial contribution from Lusophone research to the global discourse. Furthermore, the context for this digital transformation is explicitly framed by the recent catalyst of the "pandemic" (0.36%) and the contemporary nature of the field, as evidenced by the high frequency of "2024" (0.35%), confirming the topic's ongoing relevance and rapid evolution.

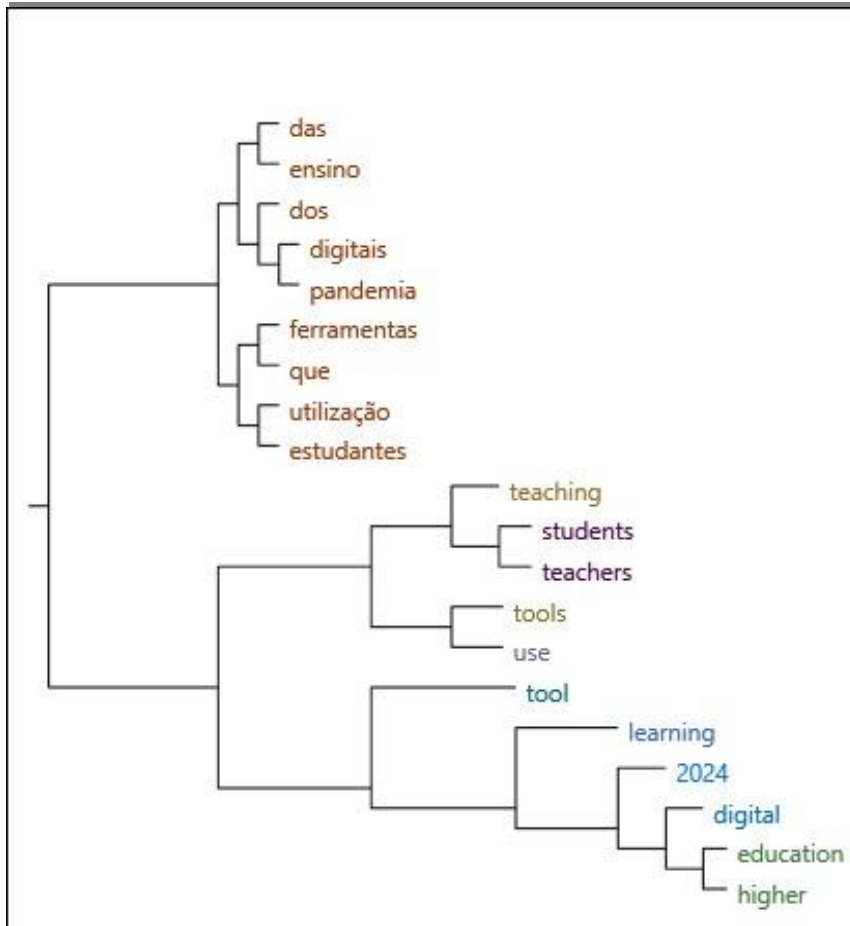
Word	Length	Count	Weighted Percentage (%)
learning	8	209	1.42
digital	7	172	1.17
tools	5	124	0.84
education	9	122	0.83
students	8	105	0.71
ferramentas	11	93	0.63

que	3	86	0.58
use	3	80	0.54
teaching	8	77	0.52
utilização	10	75	0.51
higher	6	71	0.48
estudantes	10	63	0.43
teachers	8	60	0.41
das	3	56	0.38
ensino	6	55	0.37
tool	4	54	0.37
digitais	8	53	0.36
pandemia	8	53	0.36
dos	3	52	0.35
2024	4	51	0.35



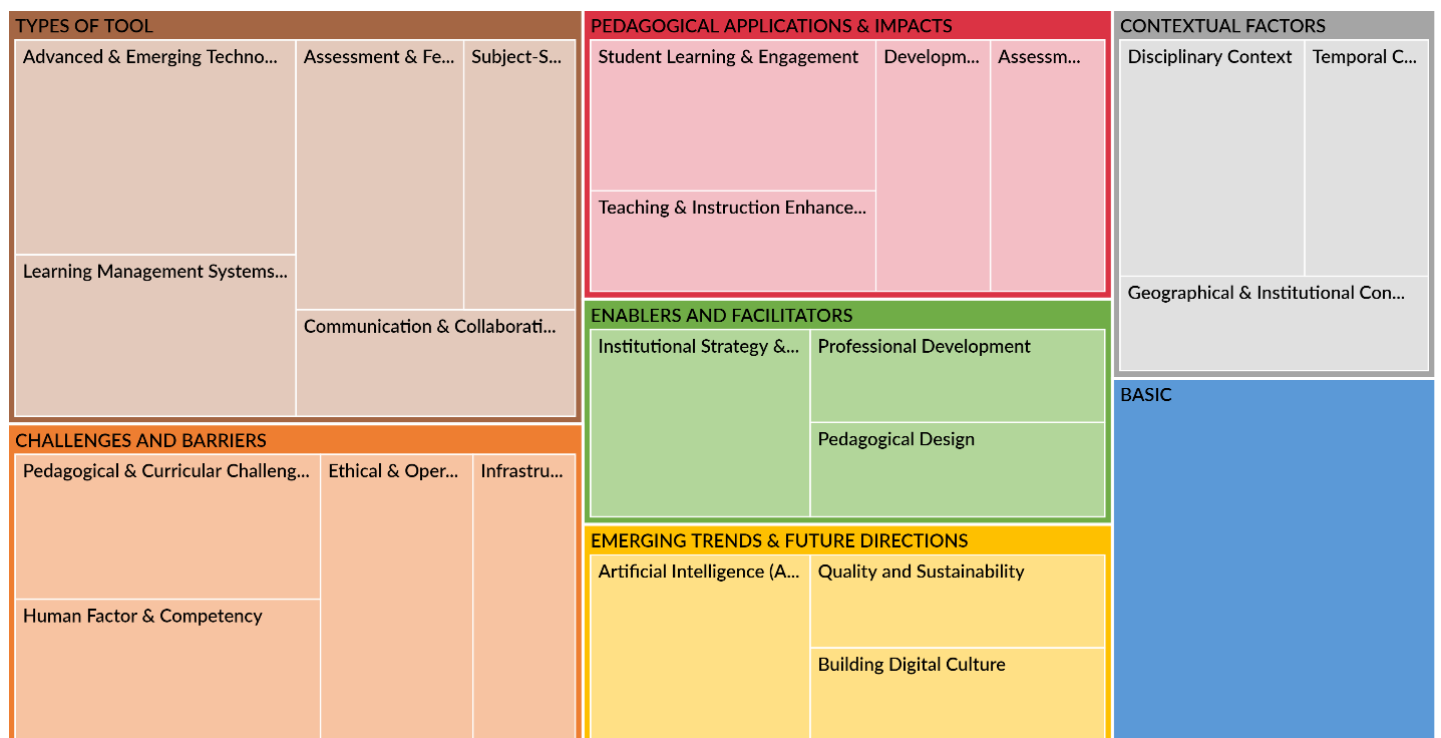
Cluster analysis

Based on cluster analysis, three distinct thematic clusters emerged from their respective groups and helped to outline the research landscape well. The first, consisting of Lusophone terms such as “ferramentas” (tools), “utilização” (use), and “estudantes” (students), constitutes a specific Lusophone research stream on the problem of applying digital tools to learning. The second, pedagogical cluster groups “teaching,” “students,” and “teachers” with “tools” and “use,” showing that there are many papers out there providing a practical sense of the use of technology for learners' and teachers' work. Yet many questions remain unanswered on how technology can be used in education. Last but not least, a central and overarching cluster connects the temporal markers of "learning," "digital," "education," and "higher" with the top temporal marker "2024," which represents the preminent, ongoing discursive discourse related to digital transformation in higher education industry today.



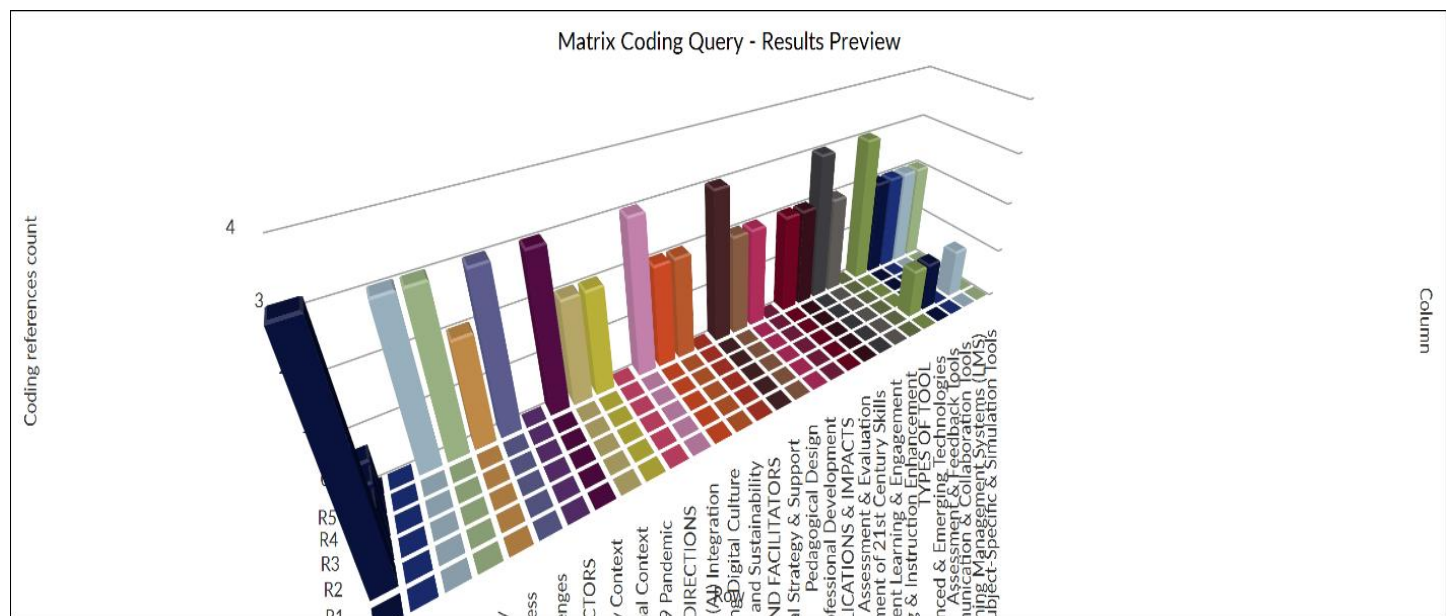
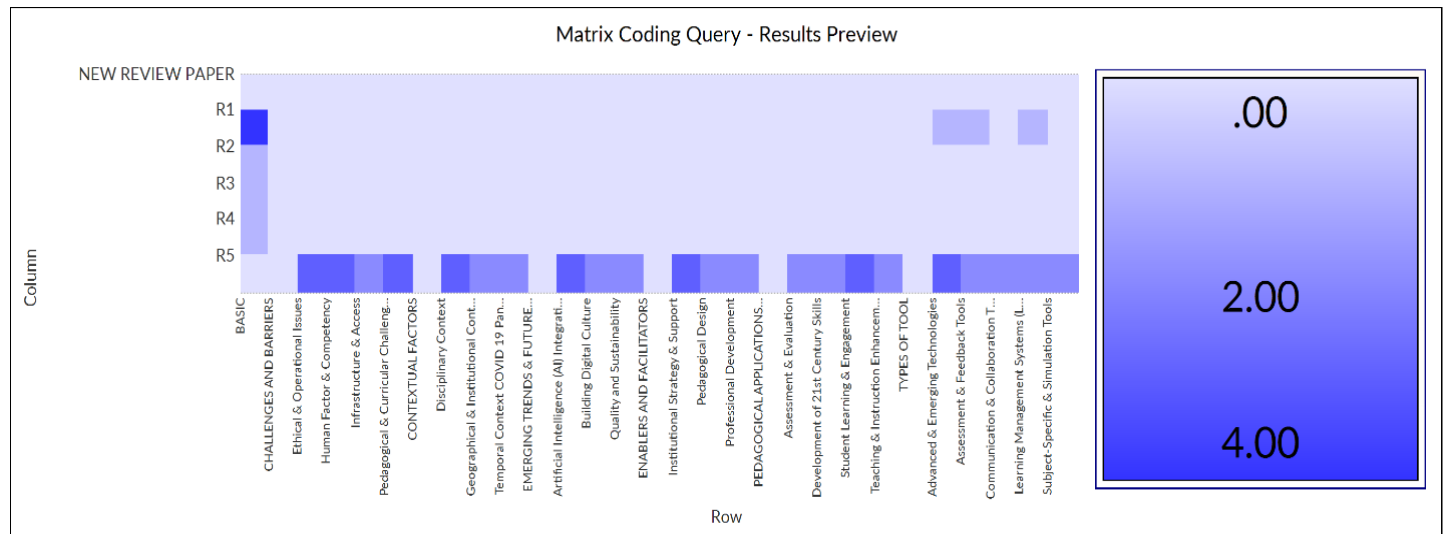
Coding reference

This analysis of coding references indicates that the literature focus is squarely on the one hand on "Pedagogical Applications & Impacts" of digital tools, particularly concerning "Student Learning & Engagement," while simultaneously grappling with the significant "Challenges and Barriers" to implementation, especially those related to human competency and pedagogy. Conversely, themes of "Enablers and Facilitators" and forward-looking "Emerging Trends" received comparatively less focus, indicating the current discourse is more occupied with immediate practicalities and hurdles than with strategic support systems or future directions.



Matrix Coding Analysis of Digital Education Themes

The matrix coding query indicates a unified thematic framework for the analysis of digital tools in higher education with sub-coding in the following category: Pedagogical Applications & Impacts, which has more detailed sub-coding in terms of "Student Learning & Engagement" and "Teaching & Instruction Enhancement," and thus, a major focus of research. At the same time, "Challenges and Barriers" receives full attention, with "Human Factors & Competency" and "Pedagogical & Curricular Challenges" being highlighted as important sub-themes, indicating substantial research challenges. This helps cover a huge amount of coverage around the two concepts mentioned earlier under the domain which is "Enablers and Facilitators," "Emerging Trends" while overall "Types of Tools" is given more coverage without being particularly granular in the way, while also covering the technology dimension, thus bringing a holistic analytical approach covering the fields of technological, pedagogical, human, and institutional dimensions of digital education integration.



LEARNING TOOLS

Respondent 1 (R1) contributed the greatest amount of detailed information, 4 coded references with a sum of 2.30% (references). Their view underscored the controversial, yet critical role of digital tools during the pandemic (0.40% total coverage), focused on the positive effects of technology such as WhatsApp for communication and videoconferencing (0.62% total coverage). A large part of this response (0.67% total coverage) emphasized that successful application of tool depends on the quality of teacher and student training and a well-structured design. They further highlighted the role of evaluation tools that facilitate student involvement and teacher feedback to guarantee educational quality (0.62% coverage). The remainder provided narrower, singularly theme insights.

Respondent 2 (R2) 0.44% coverage provided a framing for the whole of the discussion by locating the COVID-19 pandemic as the major disruption force that compelled institutions of higher education to urgently seek new implementation strategies for teaching and learning. Respondent 3 (R3) also scored stronger (0.91% coverage) on the "Generation gap" argument: traditional approaches are not effective for a "touchscreen generation" for whom digital is part of their identity and how they live. In contrast, Respondent 4 (R4) (0.80%) described the technological frontier - an advanced, AI-powered tool that uses a customized large language model to provide dynamic simulations and personalized learning feedback.

Query results exclude project stop words. Add or remove stop words in project properties.

⊕ Name	▲ In Folder	References	Coverage
NEW REVIEW PAPER	Files	31	1.04%
R1	Files	28	0.50%
R2	Files	13	0.14%
R3	Files	104	1.60%
R4	Files	80	0.92%
R5	Files	7	0.87%

1. TYPES OF DIGITAL TOOLS

Learning Management Systems (LMS)

There is a marked functional contrast in the two respondents in the tool usage, according to the information. Input as indicated by R1 (0.99% coverage) suggests the implementation of communication tools for managing real-time classroom logistics, student inclusion, and addressing emergent technical difficulties. R5 (0.78% coverage) has been on foundational institutional infrastructure, namely core Learning Management Systems including Moodle, Blackboard, and Canvas (0.40%) and more general Virtual Campus Platforms (0.37%)

1.2. Communication & Collaboration Tools

Respondent 5 also highlights priorities in communication and collaboration tools (covering 1.31%). Although Video Conferencing tools like Zoom and MS Teams were accounted for (0.54% coverage), an even larger amount of coverage was given to Collaborative Workspaces (0.76% coverage), including Google Workspace and Miro. This suggests that one could argue that to this respondent, sustained, asynchronous collaboration platforms form a more important part of the digital toolset than synchronous communication tools

1.3. Assessment & Feedback Tools

the results reveal a significant differentiation in perceptions of digital assessment tools. Respondent 1 (R1) with 0.78% coverage highlighted the teacher's role in virtual education, calling for pedagogical didactics and the use of specific interactive tools, like Padlet and Mentimeter to promote student and teacher expositions during the pandemic. On the contrary, Respondent 5 (R5), who had a total of 1.04% coverage between two references, considered automated assessment technologies as important mechanisms that relied on Digital Peer Assessment Platforms (0.51%) and Automated Grading & Quizzing Tools (0.53%). This dichotomy illustrates a core division between a human-centered pedagogical paradigm in tool use and an efficiency and scalability approach with automation.

1.4. Subject-Specific & Simulation Tools

This data suggests a functional clarity in tool utilisation between the two respondents. R1 with 0.99% coverage emphasizes the use of communication tools to manage real-time classroom logistics, student inclusion, and respond to emergent technical difficulties. In contrast, R5 (0.78% coverage) focuses on foundational institutional infrastructure, naming core Learning Management Systems: Moodle, Blackboard, Canvas (0.40%) plus more

generally Virtual Campus Platforms (0.37%)

1.5. Advanced & Emerging Technologies

There is a very distinct theme divergence in the exploration of "Types of Digital Tools" where R1's solitary reference (0.62% coverage) addresses the specific, functional use of visual organizers such as FreeMind, a tool for student research and group work, and R5's three references (1.38% total coverage) focus explicitly on advanced, AI-driven educational technologies such as the following: Artificial Intelligence Tools (0.53%), Intelligent Tutoring Systems (0.44%) and Adaptive Learning Platforms (0.42%).

2. PEDAGOGICAL APPLICATIONS & IMPACTS

2.1. Teaching & Instruction Enhancement

In order to assess the enhancement of teaching and instruction, Respondent 5 had an equal and significant focus (1.12% overall coverage) on two transformative applications for digital tools. The data indicates a balanced attention on Content Delivery & Flipped Classroom models (0.56% coverage) and Facilitation of Interactive Lectures (0.56% coverage). This point, however, implies that using digital tools is not only used to reorder the temporal structure of learning through flipped methodologies, but also to transform traditional lecture formats to be more dynamic and participatory.

2.2. Student Learning & Engagement

The impact analysis of student learning and engagement found that Respondent 5 was one of the more involved respondents, as he provided very important input as a whole (total coverage of 1.99%) in three areas. Development of Critical Thinking & Metacognition (0.75% coverage) showed the highest emphasis, as that is noted as the top value of digital tools. Also important were Increased Student Engagement & Motivation (0.64% coverage) and Fostering Collaboration & Peer Learning (0.61% coverage). This distribution indicates that digital tools are most effective when they move beyond simple engagement to actively cultivate higher-order cognitive capabilities and collaborative social learning.

2.3. Assessment & Evaluation

Discussion on assessment and evaluation strategies in response also indicated that Respondent 5 (R5) focused substantially (1.24% total coverage) on the two pillars of modern educational measurement. The predominant focus on that of Formative Assessment & Continuous Feedback (0.65% coverage) illustrated that ongoing, developmental evaluation is critical to progress toward the success of teaching. Summative Assessment & Exam Proctoring received a slightly lower, yet substantial (0.59% coverage), suggesting concurrent concern for final assessment and the integrity of high-stakes examinations in digital learning settings. Such a balanced coverage indicates that effective implementation of digital tools requires attention to the supportive, iterative nature of assessment and the logistical challenges that accompany formal, summative testing.

2.4. Development of 21st Century Skills

The 21st-century skill development analysis shows the focused perspective of Respondent 5 (0.70% total coverage). Collaborative Problem-Solving was the most strongly valued domain (0.45% coverage) compared to Digital Literacy (0.25% coverage). This weighting indicates that the inherent benefit of digital tools in education is not so much based on how it trains those technical skills, but how it uses those skills to grow higher-order thinking and social skills that are required to face complex, real-world problems.

3. CHALLENGES AND BARRIERS

3.1. Infrastructure & Access

Analysis of infrastructure and access Challenges The analysis of the infrastructure and access challenges reveals that Respondent 5 placed greater emphasis on the fundamental issue of Unreliable Internet & Hardware Access

(0.58% coverage) than on the broader social concern of the Digital Divide & Equity Issues (0.47% coverage), with a total coverage of 1.04%. This point reflects an approach rooted in the importance of real-world proximal barriers to connectivity and availability of devices as the principal infrastructural gaps and the central drivers of the broader digital equity Divide in higher education

3.2. Human Factor & Competency

The human factor challenge analysis identifies this as a central and critically significant category with Respondent 5 contributing significant input (1.73% total coverage). The concerns were highly balanced, with Resistance to Change from faculty and administration receiving the strongest coverage (0.59% coverage). This was closely followed by nearly equal challenges in Educator Digital Literacy & Readiness (0.58% coverage) and Student Digital Literacy & Readiness (0.56% coverage). This indicates that the human dimension of digital transformation is perceived as a complex barrier involving not just skill deficits across the educational spectrum, but also deep-seated cultural and attitudinal resistance to change

3.3. Pedagogical & Curricular Challenges

This also leads into a serious pedagogical and curricular challenge, which Respondent 5 made a valuable input towards (1.65% of the total coverage). The largest challenge identified was for lack of effective pedagogical integration (0.64% coverage); it suggests technology only in a limited form leads to a lack in teaching and it needs good and good teaching methods at all times. Closely following was the challenge of Designing for Interdisciplinary Courses (0.61% coverage), identifying a distinct curricular complexity. The problem of Overwhelm & "Zoom Fatigue" (0.40% coverage) was also observed, indicating human cost of poor digital implementation.

3.4. Ethical & Operational Issues

Analysis of ethical and operational challenges indicates that in this arena, the main concern found by Respondent 5 is Cost and Sustainability of Tools (0.50% coverage), followed closely by Academic Integrity & Cheating (0.45% coverage), and Data Privacy and Security (0.39% coverage), in total covering 1.34%. This implies although ethical concerns about cheating and data are serious, the long-term financial viability and operational sustainability of the introduction and maintenance of the use of these digital tools are seen as the most pressing issues for institutions.

4. ENABLERS AND FACILITATORS

4.1. Institutional Strategy & Support

In reflecting on institutional enablers, it was observed that Respondent 5 identified three critical, interconnected components to support digital tool integration, with a total coverage of 1.28%. Digital Transformation Strategy was identified as the most foundational requirement (0.48% coverage). Direct Investment in Infrastructure (0.44% coverage) and strong Technical Support Teams (0.36% coverage) were closely aligned with this. It underscores a hierarchy that the successful realization first relies on clear strategic direction, which in turn justifies and enables necessary financial investments and human resource support structures.

4.2. Professional Development

A detailed examination of professional development as an enabler reveals that Respondent 5 emphasized a balanced (0.75% total coverage) component of professional development by covering two complementary support structures. A bit more emphasis was placed on formal Faculty Training Programs, which offer essential technical and pedagogical skills (0.39% coverage). This was further bolstered by Communities of Practice (0.36% coverage), showing peer-to-peer learning and collaborative support networks among educators to be of great value. This dual perspective highlights that successful professional development demands both structured instruction and recurring, community-led knowledge-sharing for the sustainable use of digital integration strategies.

4.3. Pedagogical Design

The assessment of pedagogical design as a key contributor shows that Respondent 5 focused on the need (0.75% overall coverage) for foundational changes to curriculum and instructional planning. The data displays that there is a balanced focus on Curriculum Re-engineering (0.39% coverage) and Learning Design Support (0.36% coverage). This reflects an acknowledgement that successful integration of digital tools encompasses not only the expertise of course designers but also the overhaul of the curriculum itself for the maximum effectiveness of new technologies and pedagogies

5. CONTEXTUAL FACTORS

5.1. Temporal Context: COVID-19 Pandemic

The temporal analysis indicates that Respondent 5 showed a stronger emphasis on the importance of Emergency Remote Teaching as a Catalyst for digital adoption (0.58% coverage) than on the subsequent phase of Post-Pandemic Consolidation (0.42% coverage), with the actual overall coverage being 1.00%. This shows an approach which regards the pandemic mainly as a disruptive, transformative event that forced the adoption of digital instruments into the system at a rapid rate of implementation, with the ongoing effort to integrate and mainstream these practices into routine practice as an important, though secondary, thematic concern

5.2. Geographical & Institutional Context

By examining geographic and institutional conditions, it appears that Respondent 5 placed greater emphasis on macro-level National Policies, such as the Malaysia Blueprint (0.67% coverage), than on micro-level University-specific Initiatives (0.48% coverage), with overall coverage of 1.15%. This weighting reflects a mindset that believes that high-level national strategy and policy frameworks are the key enablers and drivers of digital transformation of higher education, within which the work of the institution in specific is positioned and implemented

5.3. Disciplinary Context

Disciplinary context analysis showed that the response provided by Respondent 5 was relatively important and balanced to a certain degree in three academic areas, with a slightly stronger emphasis on Engineering & STEM Education (0.44%) and Humanities & Social Sciences (0.44%) than on Interdisciplinary Programs (0.40%). The distribution illustrates the comprehensive viewpoint given to consider the value and special needs of digital application in technical and nontechnical knowledge and also the importance of cross-disciplinary perspectives in higher education today

6. EMERGING TRENDS & FUTURE DIRECTIONS

6.1. Artificial Intelligence (AI) Integration

According to the analysis of emerging trends, Respondent 5 gave considerable and well-balanced coverage (1.31% total coverage) to three key dimensions of AI in education. Intelligent Simulation Tools (0.44%), AI in Educational Management (0.44%), and the Ethical Considerations of AI (0.44%) have equal coverage. This tripartite focus indicates a comprehensive view of AI's future role, recognizing its potential to transform practical learning through simulations, optimize institutional operations, and acknowledging that its adoption must be guided by a concurrent and critical examination of the associated ethical implications from the outset.

6.2. Building Digital Culture

Based on digital culture shaping, the analysis of digital culture development shows a greater emphasis for Respondent 5 on institutional transformation to a "Digital University" (0.47% coverage)—than on the individual Shift in Learning Habits (0.37% coverage) for a total coverage of 0.84%. This suggests a view that cultivating a digital culture is seen as a top-down, strategic institutional rearrangement that re-imagines the educational environment, not just a bottom-up transformation of how students and teachers behave

6.3. Quality and Sustainability

Quality and sustainability analysis shows that Respondent 5 gave more importance to Building Flexible & Inclusive Systems (coverage = 0.58% against 0.45% for General Impact on Educational Quality) with a total coverage = 1.03%. Its future focus is that the long-term sustainability of digital education can only be achieved through adaptable and equitable learning infrastructures; one that sees flexibility and inclusion as a central pillar of educational quality itself.

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