

Digital Learning Dynamics: A Bibliometric Exploration of Research Trends, Thematic Clusters and Collaborations

Yamini.P¹, Sunitha Guniganti²

¹Research Scholar, Department of Management Studies, National Institute of Technology Warangal,
yaminip@student.nitw.ac.in

²Associate Professor, Department of Management Studies, National Institute of Technology Warangal,
sunitha@nitw.ac.in

Abstract

This bibliometric study analyzes the dynamic landscape of digital learning research from 2013 to 2023, examining global trends, thematic clusters, intellectual structure, and collaborations. Using bibliometric techniques on 292 high-impact journal articles, the study revealed sustained research interest on digital learning, accelerated by COVID-19. Key trends include artificial intelligence, gamification, learning analytics, and personalized learning, indicating a shift towards learner-centered and data-driven approaches. Factorial analysis identified four thematic clusters: collaborative constructivist learning, learning analytics and data mining, learner motivation and engagement, and personalized virtual environments. Co-citation analysis further revealed the enduring influence of foundational frameworks like self-regulated learning, social constructivism, and technology acceptance. The study exposes disparities in research output and collaborations across world regions. The findings provide insights for researchers, educators, and policymakers navigating digital learning's future. Future research should prioritize inclusive global perspectives, ethical considerations, and empirical validation of emerging technologies. This study contributes a knowledge base to advance theory and practice in digital learning, emphasizing interdisciplinary and contextually-sensitive approaches to address evolving challenges and harness technological possibilities.

Keywords: Digital learning, Bibliometric analysis, Factorial analysis, Personalization

1. Introduction

Digital learning represents a paradigm shift in education, enriching learning experiences beyond traditional classrooms. The educational sector is at a digital turning point with massive growth of the e-learning market, from 200 billion US Dollars in 2019 to anticipated 400 billion US Dollars in 2026 (E-learning, 2024). Globally, the overall number of digital learners has risen and surpassed pre pandemic levels. Coursera, one of the biggest platforms for digital learning, highlights the rise in digital learners in their impact report (Learning Impact Report, 2021) with twenty million additional learners signing up, which is equivalent to the growth in three years prior to pandemic. This increasing trend of digital learners will deepen further with current increasing trend in the number of internet users (5.16 billion) and mobile phone users (5.44 billion) all over the world (Digital 2023.). The future of education is technology driven and it is vivid with the organization's investment on education and workforce development apps and platforms over next five years (Future of Jobs Report, 2024).

The multiple disruptions triggered by digitalization, COVID-19 and Industry 5.0 widened the skill gap and exacerbated unemployment (Ferreira et al., 2023), necessitating the acquisition of new skills through online learning, which is flexible and cost effective (Bahattab et al., 2022). The COVID-19 pandemic and Industry 5.0 were not the only factors driving the accelerated growth of e-learning. Other factors like the behavioural and psychographic traits of digital native students (Milutinović, 2022), the rising cost of higher education, and the emergence of disruptive technologies like Artificial Intelligence (AI) and gamification have also been important contributors to the growth of online learning.

The EdTech industry has seen many unprecedented digital disruptions like never before and some of the disruptive technologies that are revolutionizing include Artificial Intelligence (AI) (Benvenuti et al., 2023), Augmented Reality and Virtual Reality (AR & VR) (Bermejo et al., 2023), mobile learning, micro, nano-learning, gamification (Palaniappan & Noor, 2022), blended learning (Montgomery et al., 2019), learning analytics and collaborative learning (Zhang et al., 2019). These new learning disruptions have spawned a profusion of literature, and there is a need for academic syntheses covering all global learning interventions, their use, impact, and effective deployment. Conducting comprehensive studies on emerging areas like digital learning helps future researchers engage in thoughtful work and equips them with an understanding of innovative technologies and their practical applications.

This study provides a structured analysis of the digital learning landscape, guided by the following research questions: RQ1. What is the bibliometric landscape of leading digital learning publications in terms of productivity, scientific influence, and major contributors such as top journals, prominent authors, key countries, and most cited articles? RQ2. What are the trend topics in digital learning? RQ3. What are the main thematic clusters and research trends shaping the conceptual landscape of digital learning, as revealed by factorial analysis? RQ4. What are the core research themes and foundational knowledge bases shaping intellectual structure of digital learning? RQ5. How have international collaborations in digital learning research evolved and what is their impact across different world regions?

2. State of the art of digital learning and global learning disruptions

Digital learning might seem new, but it has a long history. In the early twentieth century long before inception of computers, digital learning took its birth with instruction of learning through technologies like television (Vyas & Kumar, 2002) and radio to work with more students (Aarreniemi-Jokipeltol et al., n.d.) and for remote teaching. Technology continued to advance and its use for instruction of learning continued from the use of radio and television to sophisticated intelligent tutoring systems and smart Learning Management Systems (LMS). Historically, the focus of utilization of digital technology has been more on instruction of learning rather than for knowledge creation. The edtech technologies, such as MOOCS, LMS, etc., have turned into basic content management systems and repositories of learning content because of their limited use as a medium for learning instruction and the absence of essential components like social interaction, content curation, and continuous feedback. Vygotsky (1997), argues that social interaction is essential for fostering learners' ability and development. Due to this lacuna in features of learning platforms, and with the perturbation of Industry 5.0 and

modern technologies such as AI, AR & VR and gamification, the emphasis has shifted to upgrading the digital learning environment to deliver immersive learning experiences. This resulted in the evolution of LMS into Learning Experience Platforms (LXPs) with transformative features like AI driven personalized content curation, interactive and gamified learning interfaces, on demand micro and nano learning modules, continuous dynamic feedback linked with other productivity and performance assessment tools, and seamless communication through messaging apps (slack, teams). Few such platforms include Udemy, Continu, Kahoot, Edu clipper, Ted-Ed, Zavvy etc. The current progression of events in digital learning is the result of technological advancements, COVID pandemic lockdowns, school closures, and adoption of digital learning. Examining these new research orientations in digital learning across an extensive literature calls for an essential bibliometric analysis.

3. Methodology

The scope of the review of this topic is broad and the dataset of 4126 articles from Scopus database is too unmanageable for manual review. Hence, for the efficient and comprehensive review, we used Bibliometrix (biblioshiny-4.3.2) for analysis. Bibliometrix is an R package offering quantitative tools for bibliometrics and Scientometrics (Aria & Cuccurullo, 2017)

3.1 Data collection and screening

3.1.1 Data search

Literature was collected from the SCOPUS database which has directory of over ninety million archives from various interdisciplinary areas. Scopus is a credible source of literature used by many experts (Donthu et al., 2021; N. Singh & Arora, 2023) for bibliometric analysis. To retrieve as many documents as possible with few irrelevant results, a valid and strong search query was framed by identifying relevant and exhaustive list of words of digital learning from prior studies and thorough brainstorming of keywords among authors, subject theme experts. A final search string was framed with appropriate words, Boolean operators, and wild characters. The search string along with entire process of data collection and screening is presented in table 2 below. The number of records initially retrieved by conducting a search through the title, keyword and abstract totalled 18,489 papers.

3.1.2 Data filtering

Articles are curated from the subject areas closely related to digital learning spanning across disciplines such as Business Management and Accounting, Computer Science, Social Sciences, Arts and Humanities, and Psychology resulting (12367 articles). Subsequently dataset was refined for articles and review papers that were finally published in journals (4312 articles) and in English language (4179 articles).

3.1.3 Data cleaning

Data cleaning was done by removing erroneous records i.e., articles with invalid author Id. (49), blank author names (1) and partial topic names (0). Further, DOI duplicates(0) and duplicates in Titles (3) were deleted. After data cleaning, 4126 articles remained for quality and content screening.

3.1.4 Quality and content screening

For quality screening of articles, we chose ABDC ranking criteria and selected A*(14), A(230) and B(48) category articles for content screening. 317 articles were screened manually to the

final corpus of 292 articles that are relevant and match the scope of the study. Table 1 below outlines the systematic search process, inclusion and exclusion criteria employed to select articles relevant to the scope of the study.

Table 1. Systematic search, article inclusion and exclusion criteria

Search Criteria and Filtering parameters	Reject	Accept
Database: Scopus		
Search Date: 23-08-2023		
Search query: TITLE-ABS-KEY (("Digital learning" OR " E-learning" OR "Online learning" OR " Computer Assisted Learning" OR " Remote Learning" OR " digi* learning" OR " Distance Learning" OR " Technology Assisted Learning" OR " MOOCS Learning" OR " Internet learning" AND "Learning disruptions" OR "learning interventions" OR " gamification" OR Microlearning" OR " Interactive learning" OR "Collaborative Learning" OR " personali?ed Learning" OR " Artificial intelligence" OR "Smart learning" OR " Intelligent Learning management systems" OR "on demand learning" OR "self-regulated learning" OR "lifelong learning" OR “experiential learning”))	-	18489
Period of publication: 2012-2023	4562	13927
Subject Area: “Business Management and Accounting, Computer science, Arts and Humanities, Psychology, Social Sciences”	1560	12367
Document type: “Articles” and “Reviews”	7831	4536
Publication stage: Final	224	4312
Article Selection		
Source Type: Journal		
Language Screening: Include articles in English language only	133	4179
Erroneous data screening	53	4126
Quality Assessment: Include articles from ABDC 2023 journals quality list with ratings of ‘A*’, ‘A’ and ‘B’	3809	317
Content Screening: Include articles that have Titles, Abstract and Keywords that align with focus of the study	25	292

This bibliometric analysis will present research trends, foundational works, thematic clusters, and social structure of digital learning research.

4. Results

4.1 Performance Analysis

According to the research productivity metrics (Figure 1), the field of digital learning demonstrated consistent research output in high-impact journals (A*, A, and B) from 2013 to 2023. A total of 292 documents were published across 70 sources, with an annual growth rate of 3.63%, indicating sustained interest in digital learning research. The publications showed strong collaboration, with only 24 single-authored documents and an average of 3.47 co-authors per document. International collaboration was significant, with 31.16 percent of the works involving international co-authorship. The research was impactful, averaging 39.02 citations per document.

The research corpus, comprising 890 unique author keywords, underscores its interdisciplinary nature. The 16,309 citations reflect deep scholarly engagement. With an average document age of 6.7 years, the collection encompasses both foundational and recent studies.



Figure 1. Research productivity metrics in the field of digital learning

4.1.1 Publication trends and research impact

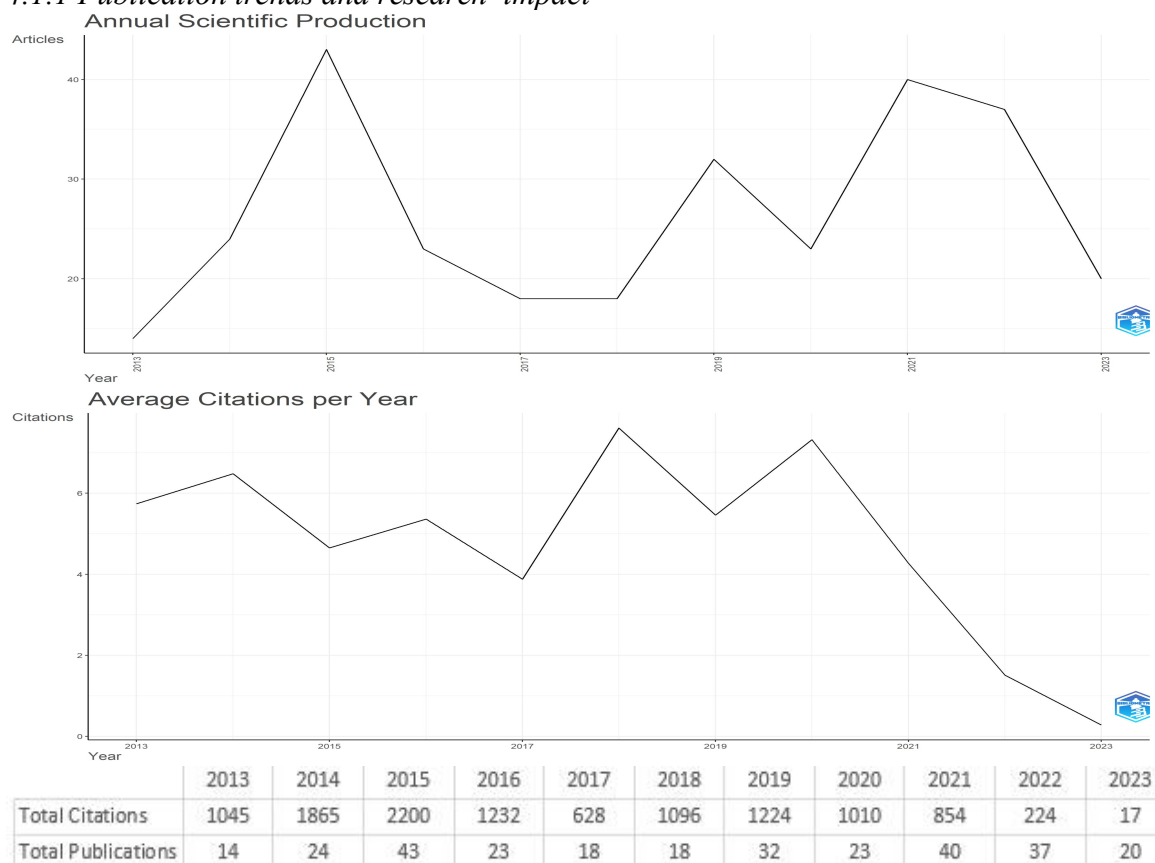


Figure 2. Publication and Citation trends of digital learning

Publication and citation trends (Figure 2) show an increase in digital learning research from 2013 to 2015, peaking at 43 publications in 2015 as focus shifted towards online learning. Publications fluctuated afterward but reached 40 in 2021, driven by COVID-19 pandemic related disruptions and interest in digital learning. Citations peaked at 2,200 in 2015, reflecting a typical time lag as citations accumulate. This pattern highlights evolving interest in digital learning and the pandemic's impact on research.

4.1.2 Most relevant sources in digital learning

Computers in human behavior is the most influential journal, with 100 publications and half of them concentrated between 2013-2015, establishing foundational research within digital learning. The British journal of educational technology follows with 69 publications showing significant growth during 2019-2021, reflecting rising prominence and growing contribution to the field. Behaviour and information technology and the International journal of human computer studies stand 3rd and 4th with steady research outputs, highlighting the interdisciplinary nature of digital learning by bridging human-computer interaction and information systems. Communications of the association for information systems and technological forecasting and social change have increased contributions recently indicating diversification of research outlets.

Table 2. Most relevant sources in digital learning

Sl.No	Journal	Category	TP	2013-2015	2016-2018	2019-2021	2022-2023
1	"Computers in Human Behaviour"	A	100	50	25	18	7
2	"British Journal of Educational Technology"	A	69	13	13	29	14
3	"Behaviour And Information Technology"	A	14	1	6	2	5
4	"International Journal of Human Computer Studies"	B	9		1	7	1
5	"Communications of the Association for Information Systems"	A	7		1	3	3
6	"Journal of Information Systems Education"	B	5	3	-	1	1
7	"Technological Forecasting and Social Change"	A	5	-	-	1	4
8	"International Journal of Human Computer Interaction"	B	4	-	1	2	1
9	"Journal of Cleaner Production"	A	4		1	2	1
10	"Knowledge-Based Systems"		4	1	1	1	1

Where "TP" is Total Publications

4.1.3. Prominent Authors based on productivity and impact

Table 3 presents list of prominent authors in digital learning research based on publication output and citation impact using h-index, g-index, and m-index. The h-index measures an author's productivity and citation impact by counting the number of papers (h) that have each received at least h citations. The g-index builds on h-index by giving more weight to highly cited papers, capturing author's top publications and m-index normalizes h-index by author's career length indicating consistent impact. Kurilovas.E leads with h-index and g-index of 5, with 235 citations

from 5 publications, reflecting significant scholarly influence. Li. X follows with strong impact and notable m-index (0.8), indicating consistent high-quality contributions relative to career length. Authors like Hwang. G. J, Baars. M, Paas. F, and Wong. J show balanced combination of high citations and moderate publication counts, advancing the field through impactful research. Al Samarraie. H and Bannert. M have lower indices but substantial citations.

Table 3. Prominent authors in digital learning research

Sl.No.	Author	h index	g index	m index	TC	TP
1	Kurilovas E	5	5	0.416667	235	5
2	Li X	4	5	0.8	71	5
3	Baars M	3	3	0.428571	266	3
4	Dagiene V	3	3	0.25	189	3
5	Hwang G.J	3	3	0.3	100	3
6	Paas F	3	3	0.428571	266	3
7	Wong J	3	3	0.428571	266	3
8	Xing W	3	3	0.272727	239	3
9	Al-samarraie H	2	2	0.25	173	2
10	Bannert M	2	2	0.181818	94	2

Where TP is Total publications, TC is Total citations

4.1.4. Most global cited documents in digital learning research

Figure 3 presents top globally cited articles in digital learning. "A social gamification framework for a k-6 learning platform" leads with 490 citations, focusing on applying gamification in education to promote engagement. With 422 citations, "Impact of Covid-19 pandemic on information management research and practice: Transforming Education, Work, and Life" is the second most influential study. This expert-authored paper, written by 15 authors, collates insights on Covid-19's effects on online learning, AI, information management, interpersonal interactions, cybersecurity, digital strategy, blockchain, privacy, and mobile technology. The third most influential article is "Sentiment analysis in facebook and its application to e-learning," using sentiment analysis to offer insights for adaptive and personalized learning.

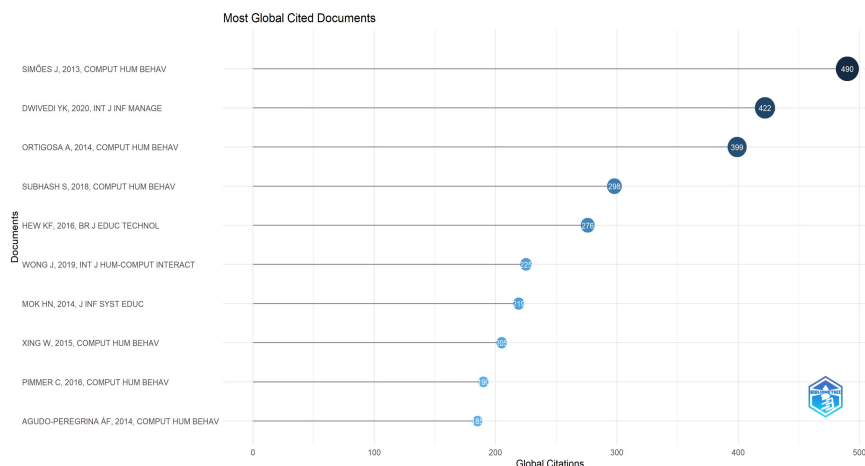


Figure 3. Top ten global cited articles in digital learning

4.1.5. Most cited countries in digital learning

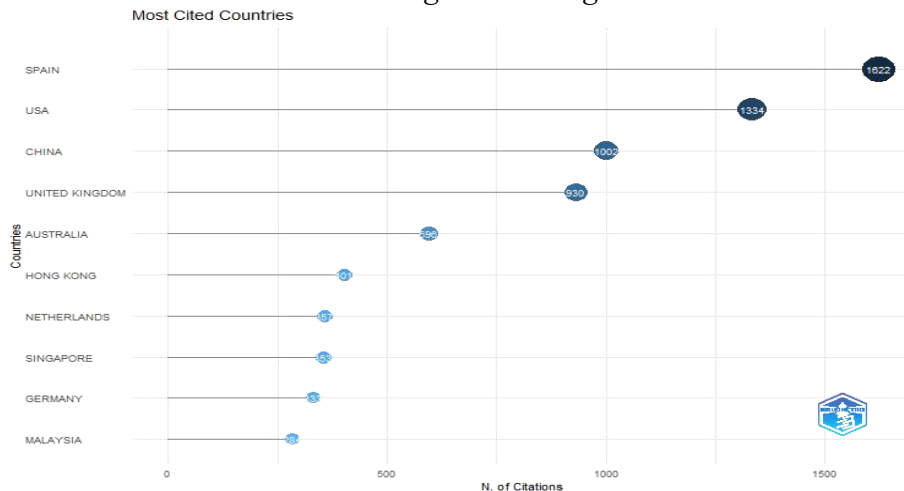


Figure 4. Top ten most cited countries

Spain leads digital learning research with 1622 citations followed by the USA with 1334 citations. China and the United Kingdom hold third and fourth positions with 1002 and 930 citations respectively. Australia (596 citations) and Hong Kong (401 citations) demonstrate active engagement from Asia-Pacific region. Netherlands (357 citations), Singapore (353 citations), Germany (333 citations), and Malaysia (284 citations) complete the list. The data shows European, American, and Asian countries lead digital learning research, with Spain and the USA as global leaders.

4.2 Trending topics in the field of digital learning over the decade (2013-2023)

Trend topic analysis (Figure 5) offers a broad perspective on the dynamics of topics, including their emergence over time, significance, and relative frequency, where the line indicates the duration of the trend, and the circle size represents relative frequency. Collaborative learning (CL) emerges as the most common keyword, appearing 35 times, followed by e-learning with 30 occurrences and self-regulated learning (SRL) with 23. Both CL and e-learning show sustained interest, underscoring their fundamental and ongoing relevance. There is a noticeable increase in interest in SRL and gamification, indicating a shift towards learner independence and engaging teaching methods. The persistent significance of online learning has been accelerated by the COVID-19 pandemic. Artificial intelligence and machine learning are newer, rapidly growing fields, highlighting the increasing incorporation of advanced technologies in education, while learning analytics emphasizes a growing focus on data-driven insights. Personalized learning shows moderate but potentially increasing interest alongside advancements in AI. Topics like active learning and blended learning are established trends, with initial interest possibly absorbed into broader concepts. COVID-19 underscores the pandemic's significant impact on accelerating digital learning research and its practical application. Higher education as a trend topic suggests that the integration of digital learning into online universities and distance education has experienced a resurgence due to the pandemic. Mobile learning maintains consistent interest, driven by the widespread use of devices.

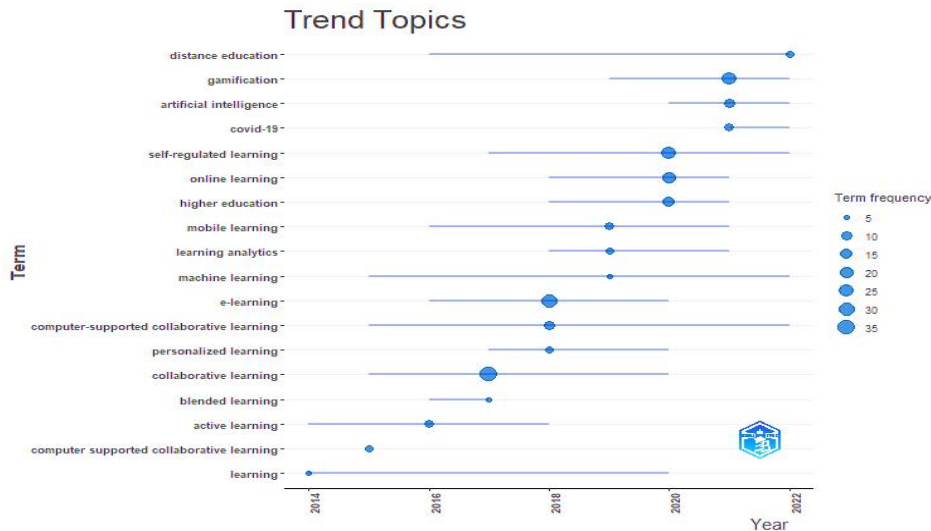


Figure 5. Trending topics in digital learning and disruptions over the decade (2013-2023)

4.2. Conceptual structure of digital learning research through factorial analysis

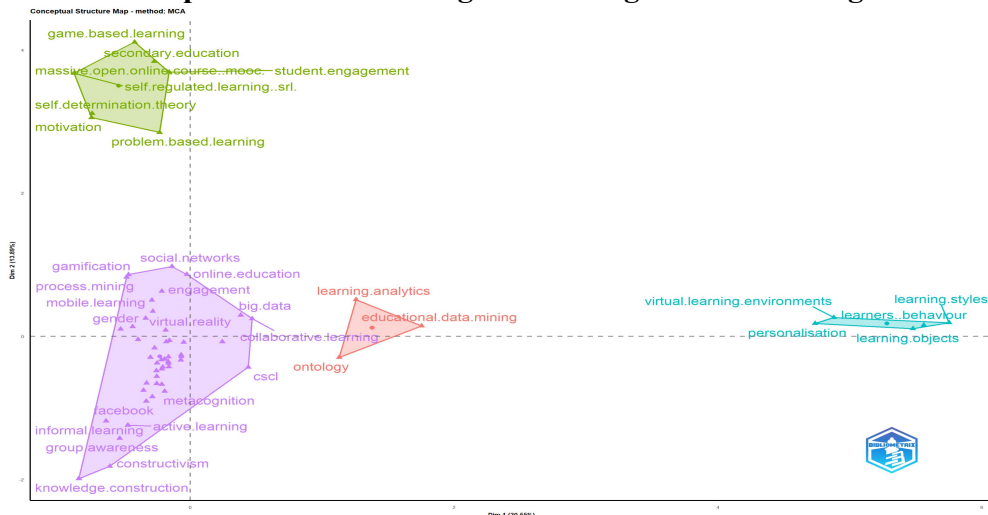


Figure 6. Factorial Map of Digital Learning Themes from Multiple Correspondence Analysis
Factorial analysis uncovers the conceptual landscape and evolution of scientific fields (Iman et al., 2023). The factorial analysis map through multiple correspondence analysis (Figure 6) generated four latent thematic clusters. The axes of factorial map represent conceptual dimensions that differentiate research themes within the field by explaining the variance in the data.

Dimension 1 (Horizontal Axis): Pedagogical—Technical continuum

Dimension 1 (horizontal axis) delineates the spectrum from Pedagogical foundations to technical dimension. On the left, the map is dominated by social and technology enhanced learning ecosystems focusing on collaborative pedagogies and general learning processes. As we move rightwards, the orientation shifts to data driven analytics, educational data mining, adaptive personalization and learner centric environments which are highly technological and platform-

based research strategies focused on data analytics, artificial intelligence (AI), adaptive content delivery and virtual environments. Dimension 1 captures *how* learning and teaching are approached pedagogically, to *what* technologies and analytic tools are used to optimize learning experiences.

Dimension 2 (vertical Axis): Methodological—psychological focus

Dimension 2 (vertical axis) separates research literature focused on methodological innovation from psychological and affective factors. The lower segment contains work on instructional designs such as blended learning, active learning, and process mining emphasizing delivery mechanisms. The upper region focuses on learner motivation, engagement, and psycho-pedagogical innovation, examining cognitive, motivational, and behavioral dynamics like engagement, self-regulation, and intrinsic motivation. Dimension 2 highlights the division between education delivery and how learners experience it psychologically.

Cluster 1: Collaborative, Constructivist, and Technology-enhanced Learning (purple)

Cluster 1 (purple) forms the largest thematic group, encompassing collaborative learning, constructivism, active learning, e-learning, mobile learning, online learning, lifelong learning, artificial intelligence, blended learning, and digital learning approaches. It focuses on the convergence of social and constructivist pedagogies with technology, representing environments where learning is co-created, supported by digital platforms, and occurs in group contexts or informal networks.

Cluster 2: Learning analytics and educational data mining

Cluster 2 (Red) is a compact cluster embodying the methodological core of contemporary digital learning research, distinguished by its focus on learning analytics, educational data mining, and ontology. This cluster captures learning science as an empirical, computational field where data-driven methods, big data analytics, and semantic technologies analyze learning processes and behaviors to improve digital learning environments. This cluster shows the growing field of learning science where data-driven methodologies, big data applications, and knowledge graphs analyze outcomes and behaviors to model student behavior, generate intelligence, optimize instructional processes, and improve digital learning environments.

This cluster represents use of data science to support adaptive instruction, enriching digital learning experiences and evidence-based decision-making for organizations and educational institutions.

Cluster 3: Learner Motivation, Engagement, and Pedagogical Psychology

Cluster 3(green) brings together motivation, student engagement, self-determination theory, self-regulated learning, problem-based learning, game-based learning, secondary education, and MOOCs. This theme unifies psychological and motivational constructs in digital and innovative pedagogies. Research focuses on how cognitive, emotional, and motivational factors drive effective learning and engagement through gamification, problem-based strategies, and massive open online courses. and student-centered strategies

Cluster 4: Personalization, Learner Behavior, and Virtual Learning Environments

Cluster 4 (Blue) include virtual learning environments, personalisation, learning styles, learners' behaviour, and learning objects. This cluster centers on theories and practices of personalized, adaptive, and learner-centric education. It explores the tailoring of instruction and digital content to individual preferences, behaviors, and learning profiles, aiming to maximize each learner's potential through personalization, and continuous adaptation of the virtual educational experience.

4.3. Intellectual structure of digital learning research through co-citation analysis

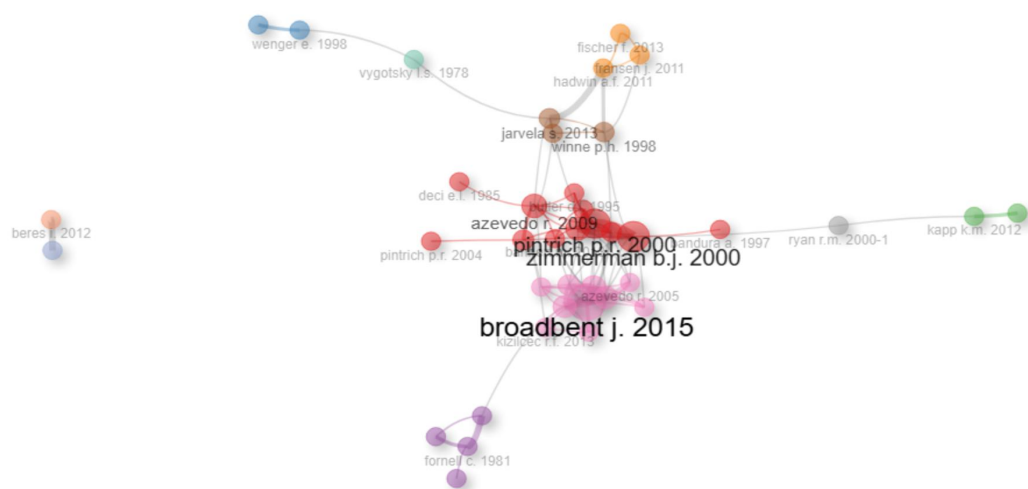


Figure 7. Intellectual structure and knowledge foundations using co-citation analysis

The cocitation analysis visually maps how foundational studies and thematic communities are intellectually interconnected within the field. The cocitation network (Figure 7) reveals seven distinct clusters shaping educational research. Cluster 1 (red) anchors the field with foundational self-regulated learning, motivation, and metacognition theories, featuring (Pintrich, 2000; Zimmerman, 2002; Azevedo, 2009; Ryan & Deci, 1985; Bandura, 1997; Winne, 2010), who provide the definitive models and frameworks for SRL and motivational processes. Cluster 2 (blue) encompasses (Wenger, 1998; Lave, 1991) social constructivism and communities of practice, emphasizing learning as participation. Cluster 3 (green) focuses on gamification (De-Marcos et al., 2016; Kapp, 2012) in learning and how to use game elements to boost motivation and engagement. Cluster 4 (purple) contains methodological classics (Fornell & Larcker, 1981; Nunnally, 1978; Venkatesh, Morris, Davis, & Davis, 2003) central for measurement and technology acceptance models. Clusters 5 and 6 chart collaborative cognition and group learning (Hadwin, Järvelä, & Miller, 2011; Bannert, Reimann, & Sonnenberg, 2014) while Cluster 7 (pink) highlights empirical research on MOOCs, learning analytics, and digital SRL (Broadbent & Poon, 2015; Kizilcec, Pérez-Sanagustin, & Maldonado-Mahauad, 2017)

Social structure of digital learning research

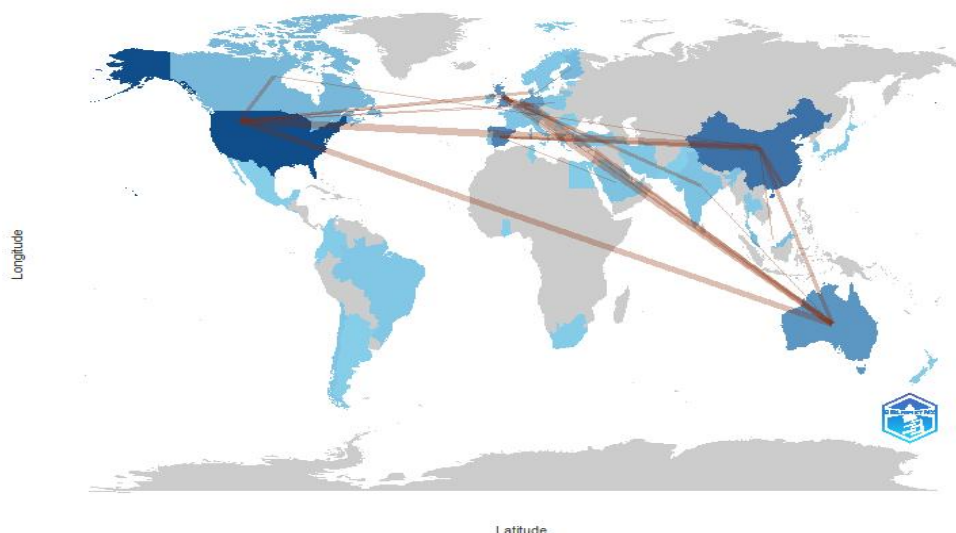


Figure 8. Country collaboration map of digital learning research

Figure 8 visualizes the global landscape of digital learning depicting research output by country color (dark blue: highest, light blue: lowest), and collaboration through lines where the number indicates breadth (partnerships) and thickness represents strength (shared publication frequency). The United States leads significantly in publication collaboration (19 partners), followed by China and the UK (14 partners each). Strong collaborations include USA-China (6 shared publications) and several involving Australia (e.g., with Netherlands, UK, USA, Germany). A clear regional disparity exists, with North America, Europe, Asia and Australia forming a dominant collaborative core, while South America shows medium to low engagement and African countries significantly lag in both output and partnerships, highlighting uneven global research in this domain.

5. Limitations

The study relied on Scopus database alone and included publications in English language only which may have excluded relevant works from other sources and languages. Additionally, bibliometric methods primarily map research trends and structures, they do not fully elucidate underlying causal relationships, highlighting the need for complementary qualitative analyses. Additionally, the rapid evolution of digital learning technologies means some emerging themes may still be under-represented in the dataset. Despite these limitations, the research provides valuable insights that contribute to advancing the field and shaping future investigations.

6. Discussion

The bibliometric analysis highlights significant and sustained scholarly interest in digital learning, especially marked by the surge during the COVID-19 pandemic, which accelerated research as education globally adapted to unprecedented disruptions (Li et al., 2021). The interdisciplinary character of the field emerges clearly, integrating insights from education, psychology, computer science, and information systems to address complex dimensions of digital learning. Key emerging trends such as artificial intelligence (AI), gamification, learning

analytics, and personalized learning signal a shift toward more learner-centered and data-driven approaches that enhance engagement and optimize learning outcomes. The transformation of traditional learning management systems into sophisticated Learning experience platforms further reflects ongoing pedagogical innovations. Despite these advances, the study reveals marked disparities in research output and collaborations, with developed regions dominating while Africa and South America remain underrepresented, underscoring the critical need for more inclusive and equitable development globally.

The factorial and co-citation analyses illuminate the thematic organization of the field, identifying clusters that span collaborative constructivist approaches, learning analytics and data mining, motivational and psychological factors, and personalized virtual learning environments. Foundational intellectual frameworks, including self-regulated learning, social constructivism, gamification, and technology acceptance, continue to shape research trajectories. However, important gaps remain. There is a need for enhanced representation from underexplored regions to diversify perspectives and contextual challenges. Additionally, the long-term impact, ethics, and equity concerns associated with AI-driven personalization warrant deeper empirical investigation. Immersive technologies like augmented and virtual reality (AR/VR) hold promise but require further study on their effectiveness across diverse learner populations. Moreover, combining bibliometric mapping with qualitative and longitudinal research could uncover underlying causal mechanisms and richer understandings of learner outcomes and technology integration.

Future research should address these gaps by extending bibliometric and empirical studies to include underrepresented geographies, fostering interdisciplinary collaborations among educators, technologists, psychologists, and policymakers, and focusing on longitudinal and mixed-method designs. Ethical implications of emerging technologies must be prioritized (Yang & Beil, 2024), along with exploration of accessibility and social inclusion in digital learning. Integrative approaches that combine quantitative bibliometric techniques with qualitative literature reviews will deepen insights into conceptual and intellectual structures, advancing both theory and practice in the field.

7. Conclusion

In conclusion, this comprehensive bibliometric review sketches the dynamic evolution of digital learning research over the past decade, emphasizing rapid adoption of AI and data-driven methods, enduring emphasis on collaboration and learner motivation, and growing attention to personalized and immersive environments. While technological advancements offer exciting opportunities to enhance education, addressing global disparities and conducting extended empirical validations remain imperative for equitable progress. This study provides a foundational knowledge base that can inform researchers, educators, and policymakers seeking to navigate and shape the future of digital learning in line with emerging global challenges and technological possibilities (Iman et al., 2023).

References

1. Aarreniemi-Jokipeltol, P., Tuominen, J., Kalli, S., & Riikonen, T. (n.d.). Experimenting with digital television learning environments.
2. Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959-975.
3. Azevedo, R. (2009). Theoretical, conceptual, methodological, and instructional issues in research on metacognition and self-regulated learning: A discussion. *Metacognition and Learning*, 4(1), 87–95.
4. Bahattab, A. A. S., Linty, M., Trentin, M., Truppa, C., Hubloue, I., Della Corte, F., & Ragazzoni, L. (2022). Availability and characteristics of humanitarian health education and training programs: A web-based review. *Prehospital and Disaster Medicine*, 37(1), 132–138.
5. Bandura, A. (1997). *Self-efficacy: The exercise of control*. W H Freeman/Times Books/Henry Holt & Co.
6. Bannert, M., Reimann, P., & Sonnenberg, C. (2014). Process mining techniques for analysing patterns and strategies in students' self-regulated learning. *Metacognition and Learning*, 9(2), 161–185.
7. Benvenuti, M., Cangelosi, A., Weinberger, A., Mazzoni, E., Benassi, M., Barbaresi, M., & Orsoni, M. (2023). Artificial intelligence and human behavioral development: A perspective on new skills and competences acquisition for the educational context. *Computers in Human Behavior*, 148, Article 107903.
8. Bermejo, B., Juiz, C., Cortes, D., Oskam, J., Moilanen, T., Loijas, J., Govender, P., Hussey, J., Schmidt, A. L., Burbach, R., King, D., O'Connor, C., & Dunlea, D. (2023). AR/VR teaching-learning experiences in higher education institutions (HEI): A systematic literature review. *Informatics*, 10(2), 45.
9. Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, 27, 1–13.
10. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–339.
11. De-Marcos, L., García-López, E., García-Cabot, A., Medina-Merodio, J. A., Domínguez, A., Martínez-Herraíz, J. J., & Díez-Folledo, T. (2016). Social network analysis of a gamified e-learning course: Small-world phenomenon and network metrics as predictors of academic performance. *Computers in Human Behavior*, 60, 312–321.
12. Digital 2023. (n.d.). Datareportal.
13. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021a). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296.
14. Ferreira, C., Robertson, J., & Pitt, L. (2023). Business (un)usual: Critical skills for the next normal. *Thunderbird International Business Review*, 65(1), 39–47.
15. Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50.

16. Iman, B., Yuadi, I., Sukoco, B. M., Purwono, R., & Hu, C.-C. (2023). Mapping research trends with factorial analysis in organizational politics. *SAGE Open*, 13(4).
17. Kapp, K. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. Pfeiffer.
18. Kizilcec, R. F., Pérez-Sanagustín, M., Maldonado-Mahauad, J., Kizilcec, R., Pérez-Sanagustín, M., & Maldonado, J. J. (2017). Self-regulated learning strategies predict learner behavior and goal attainment in massive open online courses. *Computers & Education*, 104, 18–33.
19. Lave, J. (1991). Situating learning in communities of practice. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 63–82). American Psychological Association.
20. Li, Z. M., & coauthors. (2021). A hybrid learning pedagogy for surmounting the challenges of the COVID-19 pandemic in the performing arts education. *Education and Information Technologies*, 26(6), 7635–7655.
21. Milutinović, V. (2022). Examining the influence of pre-service teachers' digital native traits on their technology acceptance: A Serbian perspective. *Education and Information Technologies*, 27(5), 6483–6511.
22. Montgomery, A. P., Mousavi, A., Carbonaro, M., Hayward, D. V., & Dunn, W. (2019). Using learning analytics to explore self-regulated learning in flipped blended learning music teacher education. *British Journal of Educational Technology*, 50(1), 114–127.
23. New Directions for Higher Education. (2024). *Artificial Intelligence in Higher Education: Issues and Implications* (Vol. 2024, No. 207). Wiley.
24. Nunnally, J. C. (1978). An overview of psychological measurement. In B. B. Wolman (Ed.), *Clinical diagnosis of mental disorders*.
25. Palaniappan, K., & Noor, N. M. (2022). Gamification strategy to support self-directed learning in an online learning environment. *International Journal of Emerging Technologies in Learning*, 17(3), 104–116.
26. Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts & M. Niemivirta (Eds.), *Theory into Practice* (Vol. 41, Issue 2, pp. 64–70). Ohio State University Press.
27. PHILIP H. WINNE (2010). Improving measurements of self-regulated learning. *Educational Psychologist*, 45(4), 267–276.
28. Ryan, R. M., & Deci, E. L. (1985). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being.
29. Serving the world through learning impact report. (2021). Coursera.
30. Singh, N., & Arora, S. (2023). Recognizing the legacy of the TQM journal: A bibliometric analysis of Scopus indexed publications (2008–2021). *TQM Journal*, 35(4), 946–963.
31. Vyas, P. V., & Kumar, A. (2002). Educational television in India. *Turkish Online Journal of Distance Education*.
32. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). Unified theory of acceptance and use of technology (UTAUT) [Database record]. APA PsycTests.
33. Vygotsky, L. S. (1997). *The collected works of L. S. Vygotsky, Vol. 4: The history of the development of higher mental functions* (R. W. Rieber & M. J. Hall, Eds.). Plenum Press.

34. Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.
35. Zhang, X., Meng, Y., Ordóñez de Pablos, P., & Sun, Y. (2019). Learning analytics in collaborative learning supported by Slack: From the perspective of engagement. *Computers in Human Behavior*, 92, 625–633.
36. Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice*, 41(2), 64–70.
37. WEF-Future of jobs-2023. (2020). World Economic Forum.