RESEARCH PAPER

Global Bibliometric Trends in Technology-Enabled Flexible Learning in Higher Education (1983–2025)

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Abstract
The study maps the global evolution of technology-enabled flexible learning and identifies newly developing technological directions including artificial intelligence, learning analytics, immersive learning ecosystems, and intelligent digital learning processes. A total of 1,941 publications indexed in Scopus from 1983 to 2025 were analyzed, with a targeted subset of 1,326 papers from 2015 to 2025 investigated to identify recent trends in research. Bibliometric mapping was conducted using VOSviewer. The results reveal substantial growth in research activity, mainly after 2010 and during the COVID-19 period, highlighting the increasing importance of flexible learning ecosystems. Emerging themes include artificial intelligence–supported learning ecosystems, learning analytics, immersive technologies, modular credential systems, and digitally mediated assessment practices. The study highlights how these technologies are redefining the instructional design, assessment models, and student engagement while providing policy-relevant insights for institutions implementing flexible digital learning systems.

Keywords: Technology-enabled learning; Flexible learning; Online education; Learning analytics; Artificial intelligence in education; Bibliometric analysis
How to cite this article: Moza R, Nayyar V. Global Bibliometric Trends in Technology-Enabled Flexible Learning in Higher Education (1983–2025). Int J Drug Deliv Technol. 2026;16(47s): 108-120. DOI: 10.25258/ijddt.16.47s.13

1. Introduction

The previous four decades have witnessed a significant transformation in education driven by fast technological advancements and the increasing adoption of online and digital learning ecosystems. Technology-enabled flexible learning expands access and reshapes pedagogy (Selwyn, 2016; Bond et al., 2018). The COVID-19 pandemic accelerated this digital change, making online education a pivotal component of higher education systems globally (Bozkurt & Sharma, 2020; Soares et al., 2020). Despite growing research, the area remains fragmented and lacks longitudinal mapping.

Bibliometric analysis provides a rigorous and purposeful methodology for examining the intellectual structure, thematic evolution, and research trends (Zupic & Čater, 2015) on global evolution of research on technology-enabled flexible learning through detailed bibliometric analysis.

The study maps collaboration networks, thematic evolution, and emerging technological trends.

1.1 Background of the Study

Digital learning has evolved from early computer-assisted instruction to LMS-based systems, followed by interactive Web 2.0 ecosystems, and more recently, intelligent and adaptive learning environments (Bower, 2019; Kumar et al., 2022).

Although past studies have investigated online learning and educational technology adoption, detailed bibliometric mapping and a systematic international analysis that maps the intellectual evolution, collaboration networks, and new technological trajectories within technology-enabled flexible learning has not been explored. Addressing this gap is significant for knowing how digital learning environments are improving and for identifying future research directions. This study makes many significant contributions to literature on digital and flexible learning.

First, it provides a detailed longitudinal bibliometric mapping of technology-enabled flexible learning expanding more than four decades (1983–2025), offering one of the most comprehensive analyses of this research domain to date. Second, the study connects both historical and contemporary perspectives by joining long-term publication trend analysis with a targeted investigation of research developments from recent years (2015–2025). Third, the study identifies new technological trends—including artificial intelligence, learning analytics, immersive learning ecosystems, and digitally mediated evaluation systems. This study provides a strategic research roadmap for scholars, academicians, and policymakers related to the digital transformation of higher education.

1.2 Research Questions

The fast expansion of digital technologies has transformed higher education. The COVID-19 pandemic further accelerated the global adoption of the innovative models.

This study addresses this gap by analysing Scopus

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indexed research papers, to find out present day trends.
The objective of this study is to map international research trends, collaboration patterns, and emerging thematic areas in technology-enabled flexible learning using bibliometric methods.
This study provides a two-layered understanding of how flexible learning has changed from access-oriented systems to intelligent and adaptive digital learning environments.
The study is guided by the following research questions:
RQ1: What are the global publication patterns in technology-enabled flexible learning from 1983 to 2025?
RQ2: What are the collaboration trends among countries, authors, and institutions?
RQ3: What are the main thematic trends and emerging research areas in recent years?
RQ4: What inferences can be drawn regarding the future direction of technology-enabled flexible learning?

2. Literature Review

2.1 Evolution of Online and Distance Learning

Online and distance education have evolved from correspondence-based models (Kuse, 1996; Hlava, 1985) to online mediated ecosystems focused on flexibility, accessibility, and learner autonomy. This change reflects greater reliance on digital technologies to support scalable and inclusive education systems (Abrams & Haefner, 2002).

2.2 Technology-Enhanced and Blended Pedagogies

The penetration of technology in education has facilitated the emergence of blended and technology-enhanced learning models (Clarke & Hermens, 2001; Burbules & Callister, 2000). These methods combine digital tools with conventional pedagogies to improve engagement, networking, and learning outcomes (Naidu, 2008; Pan, 2009).

2.3 AI, Gamification, Analytics

Recent research highlights the growing role of artificial intelligence, learning analytics, and gamification in enhancing personalized and adaptive learning environments (Dumitrache & Gheorghe, 2021; Li et al., 2024; Tempelaar et al., 2024). These technologies support intelligent data-driven educational systems and smart learning ecosystems (Hwang, 2014; Reginald, 2023; Suryanarayana et al., 2024). AI enables personalized and adaptive learning by analysing learner behaviour and performance (Zawacki-Richter et al., 2019).

2.4 Challenges and Digital Divide

Despite advancements, challenges such as digital divide, access inequality, and technological obstacles are still present in the system (Ali et al., 2024; Schuessler et al., 2024), mainly in developing regions (Huang et al., 2023; Gu, 2022). These issues continue to impact the equitable adoption of flexible learning systems.

Frameworks such as the Technology Acceptance Model, digital learning environments theory, and learner-centered pedagogical models indicate how technological infrastructure, institutional preparedness, and pedagogical innovation together structure the effectiveness of digital learning ecosystems.
Present studies only focus on specific technologies or short timeframes, limiting longitudinal understanding."

3. Methodology

Bibliometric analysis is used to identify research trajectories, structures, and collaborations.

3.1 Research Design

This study adopts a quantitative bibliometric research design to sequentially investigate the international research landscape of technology-enabled flexible learning. Bibliometric analysis facilitates the quantitative evaluation of scientific publications to identify trajectories, intellectual structure, collaborative networks, and thematic evolution within a research domain (Zupic & Čater, 2015). Unlike conventional narrative reviews, bibliometric methods provide purposeful, reproducible, and big-scale assessment of research productivity, citation influence, and knowledge diffusion patterns.
The study connects performance analysis and scientific mapping techniques to show a detailed overview of the evolution of technology-enabled flexible learning research.

3.2 Data Source and Database Selection

The Scopus database was identified as the main source for this study. Although, databases like Web of Science and ERIC give important coverage, Scopus offers broader coverage and high-quality metadata suitable for bibliometric analysis.
Scopus was selected for the following reasons:
• Extensive coverage of high-quality peer-reviewed interdisciplinary research
• Compatibility with bibliometric tools like VOSviewer

3.3 Search Strategy and Search Query

A structured search methodology was used to find publications related to technology-enabled flexible learning from Scopus.
The exact Boolean search string used was:
TITLE-ABS-KEY
(("online education" AND technology AND ("flexible learning" OR flexibility OR convenience))
OR ("online learning" AND technology AND ("flexible learning" OR flexibility OR convenience))
OR ("online technology" AND ("flexible learning" OR flexibility OR convenience))
OR ("e-learning" AND technology AND ("flexible learning" OR flexibility OR convenience)))
This specific search query resulted in the detailed coverage of literature related to online learning, educational technology, and flexible learning ecosystems.

3.4 Data Extraction and Retrieval Process

The bibliographic data were **extracted from Scopus in August 2025**. All available document types, which included research articles, conference papers, review articles, and book chapters, were included in the bibliometric dataset to give a detailed representation of the research area with following bibliographic information:

- Authors
- Title
- Year of publication
- Source title (journal or conference)
- Author keywords
- Abstract
- Affiliation and country
- Citation counts

3.5 Temporal Scope and Analytical Framework

The temporal scope of this study extends from 1983 to August 2025, showing the whole period for which important publications were indexed in Scopus. Two analytical timeframes were used:

Full historical analysis (1983–2025):

This period was used to classify:

- Publication growth trajectories
- Identification of the types of publication
- Long-term growth of the research field

Targeted contemporary analysis (2015–2025):

The immediate ten-year period was used to analyse:

- Leading journals
- Keyword co-occurrence patterns
- Country and institutional contributions
- Emerging research themes
- Collaborative networks

This twin-period approach has enabled both historical perspective and filtering out of the present research frontiers.

3.6 Inclusion and Exclusion Criteria

For bibliometric analysis, all 1941 publications extracted from Scopus were included without any exclusion to see that detailed mapping of the research areas. No limitations were imposed based on:

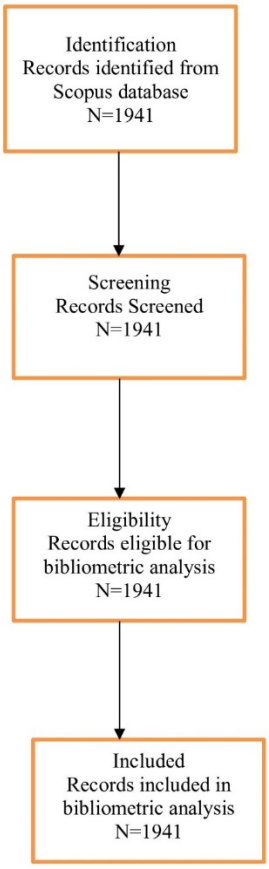
- Document type
- Country
- Language
- Publication source

This inclusive method ensures that global research activity is accurately represented.

3.7 PRISMA Framework and Screening Process

All 1,941 records extracted from Scopus were included for bibliometric analysis without any exclusion. As no filtering was applied, the PRISMA framework mainly serves to document the data identification and inclusion process (Figure 1).

Figure 1 PRISMA diagram



Note. Author's analysis using VOSviewer (2025)

3.8 Bibliometric Analysis Software

Bibliometric analysis and visualization were conducted using VOSviewer (version 1.6.20). VOSviewer is widely used for building and visualizing bibliometric networks, including keyword co-occurrence, citation networks, and collaboration patterns.

VOSviewer was used due to its:

- Strong network visualization qualities
- Capacity to handle large datasets
- Widely used in bibliometric research

3.9 Keyword Co-Occurrence Analysis and Parameter Settings

Keyword co-occurrence analysis was done using author-provided keywords to show major research themes and new areas. The following parameter settings were used:

Unit of analysis: Author keywords
Counting method: Full counting
Minimum occurrence threshold: 9
Number of keywords meeting threshold: 12
Normalization method: Association strength
Layout algorithm: VOS mapping technique

Generic and non-specific keywords such as "internet," "technology," and "online" were removed from the screened keywords to enhance thematic specificity and reduce noise in network visualization. Keyword normalization and synonym harmonization were performed with the help of thesaurus file to merge identical terms and ensure conceptual consistency.

3.10 Bibliometric Indicators and Analytical Techniques

The study engaged number of bibliometric indicators, including:

Performance indicators:

- Publication counts
- Citation counts
- Country productivity
- Institutional productivity
- Journal productivity

Science mapping indicators:

- Keyword co-occurrence networks
- Bibliographic coupling
- Co-authorship networks
- Network visualization

These indicators developed a detailed analysis of research productivity, collaboration trends, and thematic evolution (Sandström & Van den Besselaar, 2016).

4. Results

4.1 Publication Growth and Historical Evolution (1983–2025)

The longitudinal analysis indicates a clear and sustained increase in scholarly output over time (Table 1).

Table 1 Publication trends in technology-enabled flexible learning (1983–2025).

Year(s)	Papers published	Average papers published per year
1983-1999	20 papers	1.25
2000-2010	341	34.10
2011	56	56
2012	64	64
2013	55	55
2014	71	71
2015	86	86
2016	93	93
2017	95	95
2018	91	91
2019	116	116
2020	146	146
2021	186	186
2022	183	183
2023	178	178
2024	151	151

Note. Author's analysis using VOSviewer (2025)

4.2 Emergence of different Phases:

Three phases emerge: emergence (minimal early adoption), expansion (growth associated with LMS adoption and increased internet access), and acceleration fast adoption around COVID-19 (Bozkurt & Sharma, 2020).

4.3 Distribution of Publication Types

Analysis of publication types demonstrates that journal articles constitute the major form of scholarly output, followed by conference papers and review articles. The predominance of journal publications indicates enhanced scientific rigor and maturity of the research area.

4.4 Leading Journals and Knowledge Dissemination (2015–2025)

The analysis of journal productivity indicates

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concentration of research results in specialized educational technology and online learning journals (Table 2).

Rank	Source (Leading Journal)	Number of publications	Citations	Citations per paper
1	Education and Information Technologies	11	188	17.09
2	Sustainability (Switzerland)	8	323	40.38
3	Conference on Human Factors in Computing Systems – Proceedings	6	105	17.5
4	British Journal of Educational Technology	5	235	47
5	International Journal of Educational Technology in Higher Education	5	190	38
6	Heliyon	5	123	24.6
7	Australasian Journal of Educational Technology	5	121	24.2
8	Computers in Human Behaviour	4	132	33
9	Technology in Society	3	439	146.33
10	International Journal of Information Management	3	384	128
11	Information Communication and Society	3	239	79.67

Table 2 Leading Journals by Publication Output

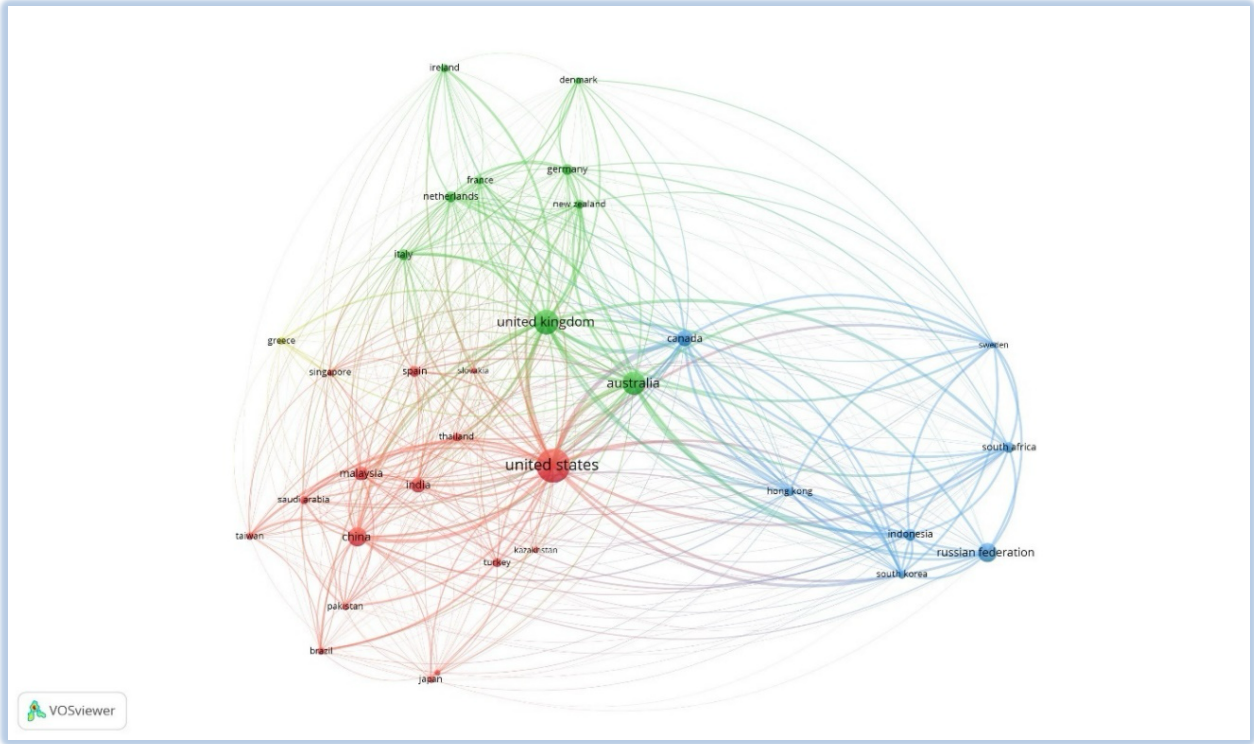
Note. Author's analysis using VOSviewer (2025)

This indicates that these journals act as main knowledge dissemination portals, showing the institutionalization of technology-enabled flexible learning as a different research domain. The presence of many different specialized journals highlights the emergence of well-explained expert communities emphasised on digital education research.

4.5 Geographic Distribution of Research Productivity (2015–2025)

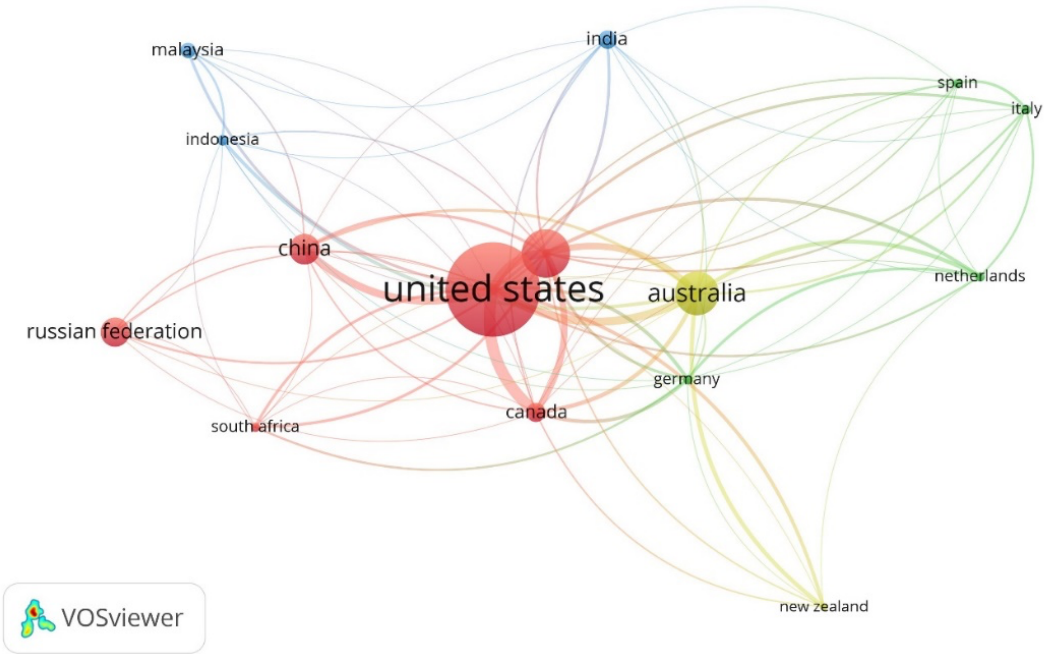
Country-level analysis indicates wide international participation in research related to technology-enabled flexible learning (Table A1). Table A1 (Appendix A) presents country-wise papers, citations, and link strength. The results show that countries with modern digital infrastructure and established higher education processes show higher productivity, strong research environments, technological preparedness, and institutional support for digital education initiatives. The analysis also shows enhanced contributions from developing economies, beyond conventional academic centres. Bibliographic coupling of countries (Figure 2 & 3) also indicates interconnected international research networks.

Figure 2 Bibliographic Coupling of Countries – Network Visualization



Note. Author's analysis using VOSviewer (2025)

Figure 3 Bibliographic coupling of countries – Overlay visualization



Note. Author's analysis using VOSviewer (2025)

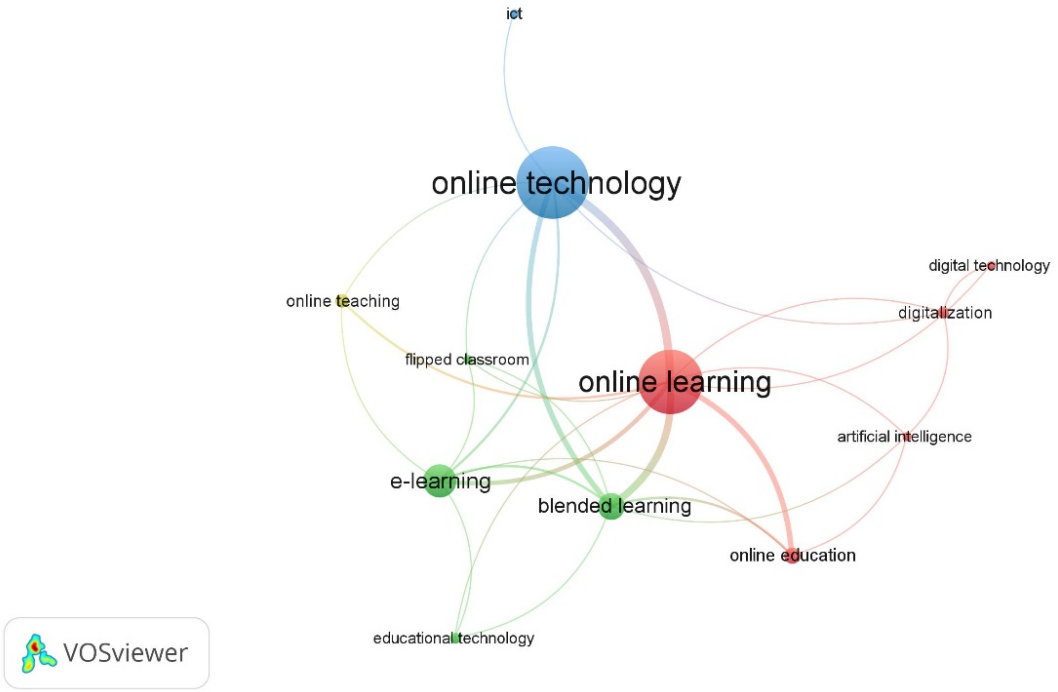
Enhanced degree of collaboration indicates need for interdisciplinary specialisation in addressing educational technology challenges.

4.6 Keyword Co-Occurrence Analysis and Thematic Structure (2015–2025)

Keyword co-occurrence analysis was conducted using VOSviewer to screen significant research themes and intellectual structure of the field (Figure 4), supported by trending topics (Figure 5) & (Figure 6).

Figure 4 presents the keyword co-occurrence explained through network visualization and thematic clusters.

Figure 4 Trending Topics – Keyword Network Visualization

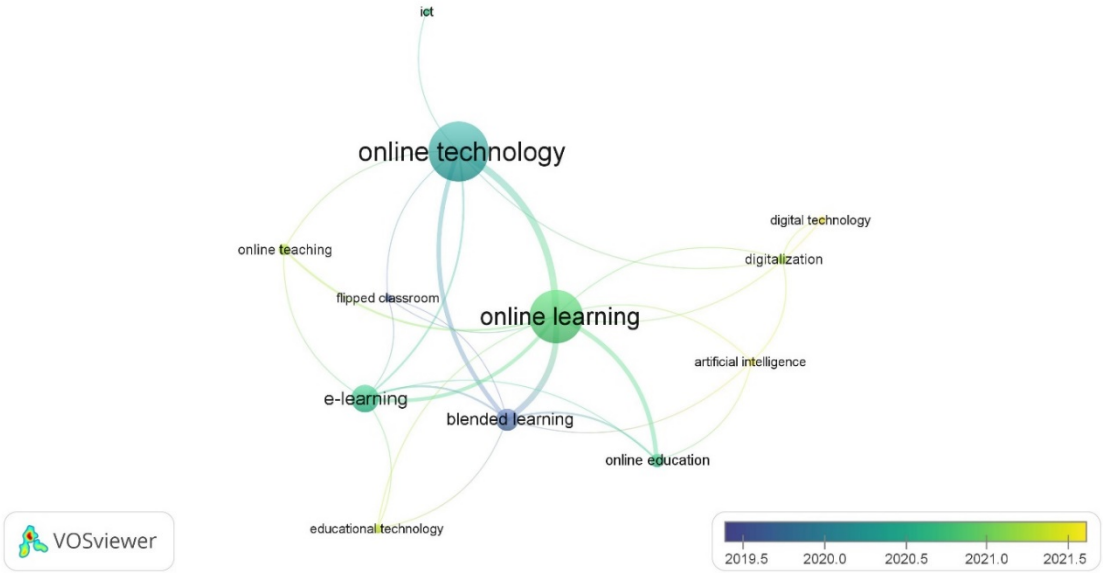


Note. Author's analysis using VOSviewer (2025)

Figure 5 presents the trending research topics explained through Overlay visualization

Figure 5

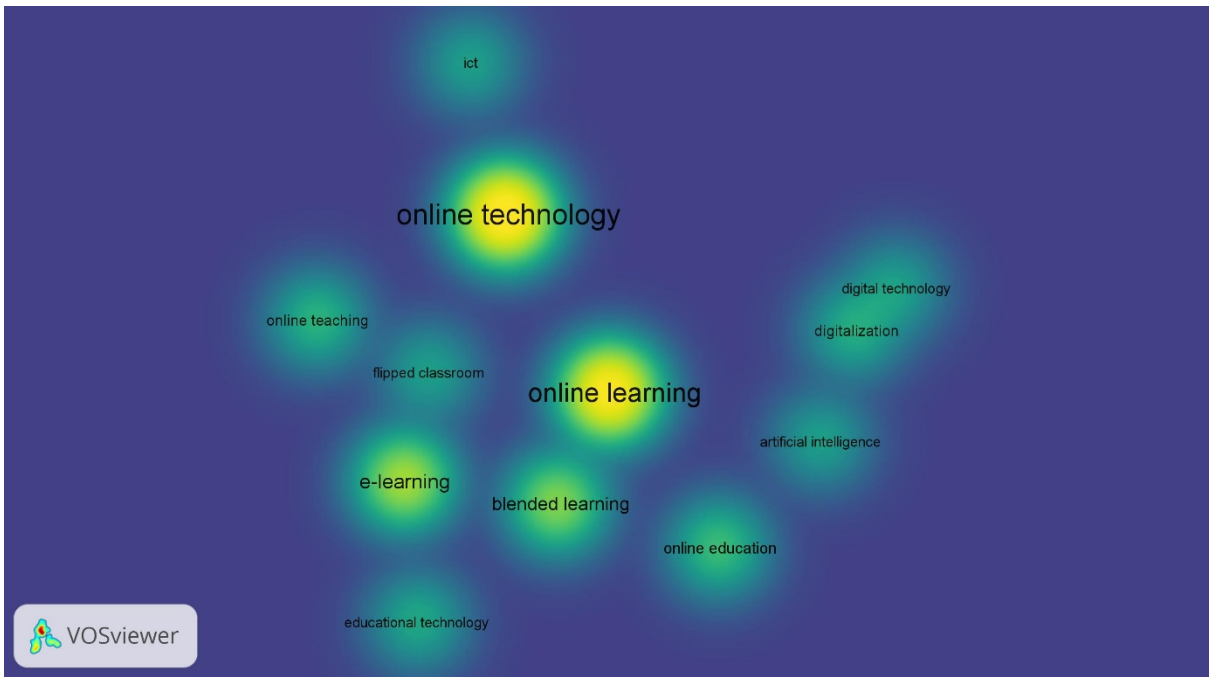
Overlay visualization of trending research topics (2015–2025).



Note. Author's analysis using VOSviewer (2025)

Figure 6 presents the author keywords explained through Density visualization.

Figure 6 Density visualization of author keywords



Note. Author's analysis using VOSviewer (2025)

As shown in Figure 4, the network visualization highlights major thematic clusters.

Core research cluster: Three groups emerge: core learning processes, technological innovations, and pedagogical models. Overlay visualization highlights research focus in recent years in Figure 5 and Figure 6. These results show the transition of the research field from basic online learning implementation toward modern intelligent educational systems.

4.7 Intellectual Structure and Research Maturity

The bibliometric results together show that technology-enabled flexible learning has evolved into a mature and fast expanding research domain featured by:

- Persistent growth in publication output
- International research participation
- Strong institutional research leadership
- Enhanced partnership in research networks
- Emergence of varied thematic research groups (Van Eck & Waltman, 2019)

Recent research directions increasingly put emphasis on modern technological penetration, into learning systems. These results suggest that technology-enabled flexible learning will continue to remain a critical research domain, pushed by ongoing technological innovation and digital transformation.

5. Discussion

The discussion interprets above bibliometric findings in relation to the present literature and theoretical perspectives. These findings highlight the structural and thematic evolution of the area.

5.1 Evolution and Growth of Research Activity

Three phases—emergence, expansion, and acceleration—highlight increasing maturity driven by technological advancement and disruption due to COVID-19.

The expansion period observed between 2006 and 2019 goes parallel with international improvements in internet accessibility, growth of learning management systems, and enhanced institutional adoption of online learning platforms.

The most important increase in research results occurred after 2020, showing the global transition to online education (Bozkurt & Sharma, 2020). This fast growth indicates the responsiveness of the research community to international educational disruption and the critical role of technology-enabled flexible learning in bringing continuity to the education system (Selwyn, 2016; Bond et al., 2018).

Technology-enabled flexible learning is a critical part of the modern educational systems rather than ad hoc technological adaptation.

5.2 Global Distribution and Institutional Research Leadership

The geographic distribution of publications indicates wide international participation in technology-enabled flexible learning research, with strong contributions from technologically advanced countries as well as enhancing participation from developing economies. The expansion of research contributions from new economies highlights increased global accessibility of digital learning technologies. These institutions operate as innovation hubs, contributing importantly to the advancement of flexible learning systems.

Digital platforms help students in remote and far-flung regions to access global academic resources without physical relocation (Gulati, 2008; Huang et al., 2023).

The dominance of developed nations and the minimal or no representation of African and Latin American regions highlight disparities in technological adoption and research capacity (Ali et al., 2024; Gu, 2022). This shows the need for focused strategies to increase global participation in digital education research.

5.3 Collaboration Networks and Knowledge Exchange

The development of collaborative research networks shows the complex and multidisciplinary nature of educational technology research, which needs specialisation in education, information technology, psychology, and instructional design.

Strong collaboration networks help in exchange of knowledge, increase in scientific innovations, and enhancement in the quality and influence of research, highlighting the maturity of the research field and the growth of structured scholarly communities (Isfandyari-Moghaddam et al., 2023). The rise of global collaboration networks among the USA, China, India, and Australia (Figures 2–3) indicates a shared pursuit of scalable, persistent education systems capable of filling the physical divides (Whitehouse et al., 2001; Clarke & Hermens, 2001).

These findings show that technology-enabled flexible learning research has developed from isolated research efforts into interconnected international research environments.

5.4 Thematic Structure and Research Focus

Keyword co-occurrence analysis indicates a well-defined intellectual structure with a distinct thematic cluster representing fundamental research themes. Core keywords such as online learning, e-learning, and online technology represent the fundamental concepts of the research area, reflecting the pivotal role of digital learning ecosystems in present education. These themes form the foundation upon which future technological and pedagogical innovations will be built.

This transition reflects more emphasis on personalization, scalability, and data-driven educational practices.

5.5 Temporal Evolution and Emerging Research Trends

Past research focused on fundamental technological implementation, while more recent research has put enhanced emphasis on modern technological connection and pedagogical optimization. The emergence of artificial intelligence, digital transformation, and modern digital learning technologies indicates the enhanced sophistication of educational technology systems (Li et al., 2024; Tempelaar et al., 2024). These technologies support automated evaluation systems, and increased student engagement, evolving beyond basic digital content delivery (Selwyn, 2016; Bond et al., 2018). The convergence of artificial intelligence, learning analytics, and immersive technologies is shifting learning from content delivery models to intelligent, adaptive learning environments.

5.6 Research Maturity and Intellectual Consolidation

The overall bibliometric results highlight that technology-enabled flexible learning has brought significant research maturity. The consolidation of research themes and development of structured intellectual networks indicate that the area has evolved into a fundamental academic area. The presence of niche journals and research communities further endorse the institutionalization of technology-enabled flexible learning research.

5.7 Implications for Future Research

The penetration of emerging technologies (Suryanarayana et al., 2024) is expected to increase accessibility, improve learning outcomes, and enable flexible participation, including remote access to global educational resources. Artificial intelligence, learning analytics, and immersive technologies are emerging as transformative forces in education (Holmes et al., 2019; Siemens & Baker, 2012; Radianti et al., 2020).

The connection of these technologies contributes to the growth of intelligent digital learning environments based on continuous data generation and interaction between learners, digital platforms, and technological systems, thereby supporting advanced learning analytics, adaptive teaching, and evidence-based educational decision-making (Almufarreh & Arshad, 2023; Mendoza et al., 2024). These technologies support personalized teaching, real-time feedback, and enhanced student engagement (Sofi-Karim et al., 2023)

The growth of flexible learning systems facilitates institutions to expand educational access beyond conventional classroom settings. Educational institutions must therefore develop technological infrastructure and faculty ability necessary to effectively implement flexible learning ecosystems.

The results of this study have many implications for educators, teaching designers, educational policy and institutional strategy in finding new technological trajectories and linking with their educational strategies.

Implications for Open and Distributed Learning: The findings are mainly relevant for open and distributed learning systems, indicating how digital technologies enable scalable, flexible, and inclusive education models across geographical boundaries.

6. Conclusion and Future Direction

The findings highlight a transition toward intelligent, data-driven, and immersive learning processes. Publication growth, mainly after 2010 and during the COVID-19 period, indicates the accelerated institutional adoption of digital learning models. The results reveal a change from technology as a mechanism of access to technology as an active pedagogical collaborator. In addition, technology-enabled flexible learning is facilitating access to digital education by helping students in remote or resource-constrained regions to access modern academic knowledge and programmes offered by leading institutions globally without need for relocation. Emerging themes highlight a framework for reconfiguration of teaching and learning practices. In classroom contexts, intelligent systems may support adaptive feedback, differentiated teaching, and real-time monitoring of learner connection with the online learning (Li et al., 2024).

Emerging technologies like AI, learning analytics, and immersive systems are expected to fundamentally restructure educational delivery and learner engagement (Siemens & Baker, 2012; Radianti et al., 2020).

Technology also enables safe and secure remote examinations for all including geographically dispersed learners (Gulati, 2008).

Despite these advancements, the bibliometric patterns show persistent geographical concentration of research results within most advanced regions.

The future growth of technology-enabled flexible learning will rest on inclusive policy structure, institutional capacity building, ethical governance of data-driven mechanisms, and equitable online infrastructure.

Overall, technology-enabled flexible learning is no longer restricted to flexibility of access but increasingly represents a change of teaching design, evaluation systems, and learner engagement models. Future research must therefore move beyond descriptive adoption patterns to focus on intelligent systems, ethical AI integration, and data-informed pedagogies (Holmes et al., 2019; Zawacki-Richter et al., 2019).

7. Limitations and Scope for Future Research

This study is limited by its reliance on the Scopus database, which may exclude important publications indexed in other repositories, or in other languages or available as grey literature. Although the complete dataset covered 1983–2025, comprehensive thematic mapping focused on the 2015–2025 subset to indicate present research trends. Further, citation counts are time-sensitive and may help as newer research gains visibility. In addition, bibliometric analysis focuses mainly on patterns of publication, citation, and partnerships, and so, it cannot completely capture the pedagogical depth, methodological strength, or contextual effectiveness of individual studies. The study does not contain citation normalization metrics like field-weighted citation impact. Future, research may complement bibliometric methods with systematic qualitative reviews or meta-analyses to develop deeper insights.

8. Declarations

Conflict of interest

The authors declare that there is no conflict of interest.

Use of AI

The author used an AI-assisted language tool (ChatGPT) solely for language refinement and clarity. The author takes full responsibility for all the intellectual content, analysis and conclusions.

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Appendix A

Supplementary Tables

This appendix provides comprehensive bibliometric data supporting the findings presented in the main text.

Table A1 Country-wise publications, citations, and total link strength in technology-enabled flexible learning research (1983–2025)

Rank	Country	No. of Publications	Citations	Region	Link Strength
1	USA	304	4540	North America	92
2	UK	157	3958	Europe	67
3	Australia	141	2468	Australia	61
4	China	99	1274	Asia	31
5	Russian Federation	94	236	Asia	11
6	Canada	63	861	North America	53
7	India	60	289	Asia	18
8	Malaysia	51	475	Asia	12
9	Indonesia	35	106	Asia	16
10	Germany	32	383	Europe	29

Note. Author's analysis using VOSviewer (2025)

Table A2 Top authors by productivity, citations, and total link strength in technology-enabled flexible learning research (1983–2025)

Rank	Author	No of Publications	Citations	Average citation per paper	Link Strength
1	Tuapawa, Kimberley	8	30	3.75	0
2	Bouchrika, Imed	5	27	5.40	0
3	Harrati, Nouzha	5	27	5.40	0
4	Mahfouf, Zohra	5	27	5.40	0
5	Zhang, Hongfeng	4	17	4.25	0
6	Alam, Gazi Mahabubul	3	141	47	0
7	Brennan, David J.	3	34	11.34	0
8	Chen, Ru-Si	3	13	4.34	0
9	Dermentzi, Eleni	3	75	25	2
10	Feng, Xue-Song	3	24	8.0	0
11	Gena, Cristina	3	11	3.67	0
12	Kuflik, Tsvi	3	11	3.67	0
13	Origlia, Antonio	3	11	3.67	0
14	Papagiannidis, Savvas	3	59	19.67	2
15	Singh, Gaurav	3	5	1.67	0
16	Zhang, Yuan	3	24	8	0
17	Zhou, Yu	3	24	8	0
18	Andreassen, Cecilie Schou	1	1109	1109	0
19	Billieux, Joël	1	1109	1109	0
20	Demetrovics, Zsolt	1	1109	1109	0
21	Kuss, Daria J.	1	1109	1109	0
22	Mazzoni, Elvis	1	1109	1109	0

23	Pallesen, Ståle	1	1109	1109	0

Note. Author's analysis using VOSviewer (2025)

Table A3 Highly cited collaborative publications in technology-enabled flexible learning research

Rank	Authors	Title	Year	Source title	Cited by
1	Andreassen C.S.; Billieux J.; Griffiths M.D.; Kuss D.J.; Demetrovics Z.; Mazzoni E.; Pallesen S.	The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study	2016	Psychology of Addictive Behaviors	1109
2	Szymkowiak A.; Melović B.; Dabić M.; Jeganathan K.; Kundi G.S.	Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people	2021	Technology in Society	355

Note. Author's analysis using VOSviewer (2025)
Note: Highly cited multi-author papers contribute disproportionately to citation counts, reflecting influential interdisciplinary studies.

Table A4 Most prolific universities by number of publications in technology-enabled flexible learning research (1983–2025)

Rank	Organisation	No of Publications	Citations
1	University of Michigan, USA	4	48
2	University of Melbourne, Australia	4	20
3	Georgia Institute of Technology, Atlanta, USA	3	37
4	Newcastle University, Newcastle, United Kingdom	3	19
5	De La Salle University, Philippines	3	4
6	University of Newcastle, Australia	3	4
7	Lomonosov Moscow State University, Moscow, Russian Federation	3	2

Note. Author's analysis using VOSviewer (2025)