

MAPPING THE LANDSCAPE OF E-LEARNING: A SCIENCE APPROACH TO GLOBAL RESEARCH TRENDS

Noor Syazwani Ishak¹
Mohd Firdaus Roslan^{2*}
Khairul Hafezad Abdullah³
Zahemi Azul Islami⁴

¹ General Studies Department, Sunway College, Kuala Lumpur, Malaysia

(E-mail: syazwanii@sunway.edu.my)

² Faculty of Engineering & Technology, Tunku Abdul Rahman University of Management and Technology, Kuala Lumpur, Malaysia (E-mail: mohdfirdaus@tarc.edu.my)

³ School of Business Management, Universiti Utara Malaysia, Kedah, Malaysia
(E-mail: hafezad@uum.edu.my)

⁴ Strategic Planning Division, MARA, Kuala Lumpur, Malaysia
(E-mail: zahemi.english@gmail.com)

*Corresponding author: mohdfirdaus@tarc.edu.my

Article history

Received date : 23-4-2026

Revised date : 24-4-2026

Accepted date : 3-6-2026

Published date : 29-6-2026

To cite this document:

Ishak, N. S., Roslan, M. F., Abdullah, K. H., & Islami, Z. A. (2026). Mapping the landscape of e-learning: A science approach to global research trends. *Jurnal Penyelidikan Sains Sosial (JOSSR)*, 9 (30), 11 - 29.

Abstract: *In an era characterised by rapid globalisation and digital interconnectedness, e-learning serves as a critical bridge for educational equity. E-learning has emerged not merely as a supplementary tool but as a transformative pedagogical framework that offers unprecedented flexibility and accessibility. Meanwhile, this study aims to explore research-related e-learning publishing patterns and trends using the most commonly used author keywords in the Scopus and Web of Science (WoS) databases. The eminent software, ScientoPy and VOSviewer, are used to analyse relevant publication data retrieved from Scopus and WoS. The results showed a positive trend in the growth of e-learning literature in both databases since 2005. The top three research areas that dominate this topic are “Education & Educational Research”, “Computer Science”, and “Engineering”. Based on a country analysis, the United States has become an active publisher, followed by China and the United Kingdom. Importantly, this study emphasised that the scholarly practices prevalent in e-learning research have been impressively propagated. The trends will assist researchers in acknowledging various fields by identifying their respective core areas, proactive institutions, and productive authors' respected publications in this field for supplementary investigation. By examining the most popular keywords, researchers will be able to develop further any potential research in areas, particularly concerning this study annual growth rates, which have been trending for the last five years.*

Keywords: *E-Learning, Online Learning, Digital Learning, Learning Platform, Blended Learning, Bibliometric Perspective*

Introduction

E-learning refers to the use of electronic technologies and the internet to deliver educational content and support interaction between teachers and learners across distances (Hamad et al., 2022). This e-learning can include fully online courses, blended formats that combine face-to-face and online activities, and a wide range of tools particularly in learning management systems (LMS), video conferencing, discussion forums, multimedia resources, and mobile apps. According to Conesa et al. (2023), e-learning has become a popular strategy in higher education, professional training, and lifelong learning due to its ability to overcome time and location constraints. With tremendous, profound accessibility in information and communication technologies, it will certainly provide an easier, faster and better learning experience for users, especially students.

Meanwhile, one of the most emphasised strengths of e-learning is its flexibility and accessibility (Rawashdeh et al., 2021). Students can access materials anytime and anywhere. They can also learn at their own pace, and often revisit recorded lectures or self-paced modules. This flexibility is particularly valuable for working adults, people in remote or conflict-affected areas, and those with disabilities, who may struggle to attend traditional classes (Lake & Maidment, 2023). Students appreciate the convenience, time savings, and the possibility of balancing study with work or family responsibilities. Besides that, in sectors such as nursing and healthcare, e-learning enables continuous professional development without requiring physical presence at training centres (Byungura et al., 2022).

Besides that, e-learning also offers pedagogical and technological advantages that can enhance engagement and learning outcomes (Wagino et al., 2024). Multimedia elements such as videos, animations, simulations, quizzes, and interactive cases can make content more engaging and support different learning styles. Learning management systems help organize content, track progress, and support assessment and feedback, which can improve quality and consistency of instruction (Veluvali & Suriseti, 2022). Emerging trends include artificial intelligence, adaptive learning, gamification, microlearning, mobile learning, and immersive technologies like virtual and augmented reality, all aimed at more personalized and interactive experiences. The results suggest that future e-learning research and practice will increasingly focus on learning algorithms, individual learning factors, and adaptive systems that tailor content to each learner (Benkhalfallah et al., 2024).

At the same time, e-learning poses significant challenges and disadvantages. Leal Filho et al. (2021) state that a lot of students and teachers express feelings of loneliness, a lack of direct social interaction, and fewer opportunities for informal peer learning. Participation can be severely hampered by technical issues like poor internet connectivity, a lack of devices, or platform unfamiliarity, particularly in environments with limited resources. Additionally, when there is a significant "digital divide" in access to stable networks and technology, e-learning may make inequality worse (Dyanty & Mkabile-Masebe, 2025). As a result, instructors face challenges when teaching practical skills solely online in practice-oriented fields such as laboratory-based courses or specific aspects of nursing and agriculture.

In light of this, the COVID-19 pandemic's quick transition to e-learning brought to light both its advantages and disadvantages. Universities worldwide have moved courses online to maintain continuity, resulting in an explosion of research on e-learning in higher and medical education. Students frequently valued continued access to learning, recorded lectures, and flexible schedules, but they also reported fatigue from excessive screen time, motivation issues,

and frustration with unstable internet access (Nordstokke et al., 2025). In addition, without sufficient institutional support, teachers had to quickly acquire new digital teaching techniques and revamp assessments. As a result, COVID-19 elevated e-learning to the forefront of education research and increased interest in hybrid or "hybrid/hyflex" models that combine online and in-person instruction for long-term use (Penrod, 2023).

Next, e-learning is now seen as both an opportunity and a responsibility in a variety of fields, including general higher education, nursing, medical education, and industry-specific fields like agriculture. In nursing and healthcare, e-learning can enhance access, strengthen clinical competencies through simulations and interactive cases, and promote continuous learning (Saboktakin, 2024). To create long-term e-learning ecosystems in developing countries, sustained investment, staff development, supportive policies, and equity must be prioritised over short-term projects.

Overall, e-learning has evolved from a supplementary option to a critical component of modern education, providing greater flexibility and reach. According to Spatioti et al. (2023), e-learning can be as effective as traditional methods if it is well-designed with high-quality content, interactivity, a clear structure, and strong support. However, its success is dependent on more than just technology: it necessitates thoughtful instructional design, dependable infrastructure, trained and motivated teachers, and strategies for preserving social connection and equity. End of word, e-learning will probably become even more integrated into regular education in the future, thanks to advancements in AI, personalisation, and immersive media, but long-term sustainability, privacy, and digital divides still need to be addressed (Salem, 2025).

However, there has been a lack of exploration conducted to analyse the research trends in the field of e-learning within challenges and opportunities, particularly in identifying specific domains within this field that have received limited attention. Hence, the present study employs bibliometric analysis to discern research trends within the realm of e-learning research. This focus remains strong despite increasing interest in this field of study (Iyer et al., 2020; Shankar et al., 2021). As a result, it has been noted that most research has focused on managing and delivering records, supporting materials and documentation (Farooq et al., 2021).

In order to address the issue of excessive information availability and the breadth of different research topics, bibliometric analysis assists scholars and researchers in gaining a broad or even microscopic view of the overall progress and steady and continuous flow status (Gazali et al., 2021). Information retrieval is crucial to the cross-disciplinary field; this process can analyse aspects of information science and publication trend analysis. The bibliometric technique visualises vast publishing outputs necessary for deriving valid conclusions, such as the evolution of publications, study fields, and influential authors (Sofyan & Abdullah, 2022).

Method And Data

Bibliometric analysis is a quantitative research technique that systematically analyses and evaluates scientific publications and their attributes, allowing the identification of patterns, trends, and relationships within a specific field of study (Leydesdorff & Vaughan, 2006). This analytical approach examines bibliographic data, including citations, to gain valuable insights into the scholarly communication process and the influence of scientific research (Waltman, 2016). Bibliometrics made it easier for researchers to identify research gaps, emerging research prospects, and significant research areas (Abdullah & Othman, 2022). It indirectly enables them

to summarize the significant trends of a particular study field. The current study's primary goal was to identify patterns in e-learning-focused publications.

In this study, two software programs were utilised: SciencioPy and VOSviewer, to accomplish bibliometric analysis. SciencioPy is a free and open-source scientometric analysis program built on Python software developed by Ruiz-Rosero et al. (2017) that sorts data according to the most well-liked, specific, and trending topics and subsequently tested for usability and effectiveness in later studies by Ruiz-Rosero et al. (2019). Pabon et al. (2020) demonstrated that this software helps detect and eliminate duplicate datasets and clean up non-standard data formats. SciencioPy, as demonstrated by Ruiz-Rosero et al. (2019), can automatically categorise and report on the top themes based on author or index keywords, as well as identify the most prolific authors and countries involved in the research, using bibliographical information. VOSviewer is another type of software used to map the co-occurrence of authors' keywords. VOSviewer is a software application that assists in constructing and visualising bibliometric networks (Abdullah et al., 2020; Roslan et al., 2023).

Figure 1 depicts the data processing sequence. This analysis consists of a systematic strategy divided into three primary parts. First, the title should be determined, and the datasets will be developed and gathered. The second phase involves integrating the databases and obtaining the SciencioPy-analysable parameters. In the final stage, SciencioPy and VOSviewer parameters are used to evaluate and analyse the results.

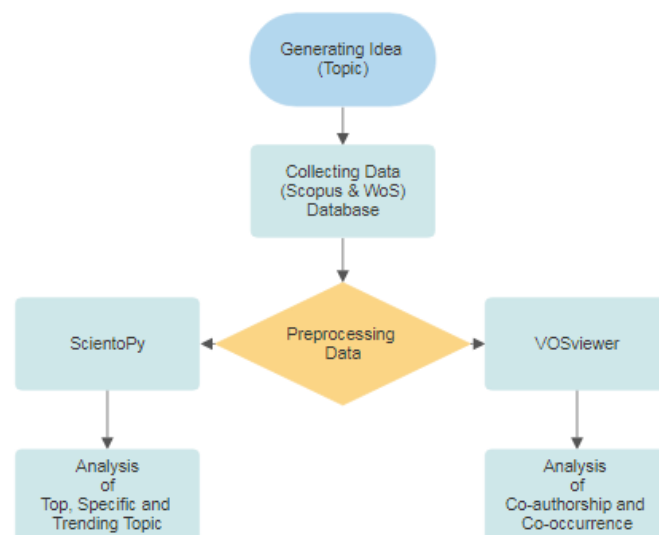


Figure 1: Selection Strategy and Research Protocol

Given the multifaceted nature of the studied topic, the literature on e-learning studies is spread across many different fields. As a result, it was necessary to use accessible and numerous bibliographic databases to search for and find pertinent material on this subject. Two primary databases, Scopus and Web of Science (WoS), were used to collect the data for this study. The Scopus and WoS databases are preferred since it is a multidisciplinary databases with more articles in social science, education-related journals, management and other documents in various academic disciplines (Sweileh, 2022; Visser et al., 2021). The Scopus and WoS databases also attract most scholars to obtain publications for their review purposes (Abdullah et al., 2023). These databases span multiple fields (Martín-Martín et al. 2021), and searching

them would aid researchers in locating the most significant number of citations on primary sources for bibliometric studies (Pranckutė, 2021).

After defining the databases, the search query "online learning" OR "digital learning" AND "learning platform" was chosen. The following fields were scanned for topic-related terms: article title, abstract and keywords for Scopus (4016 scripts) and title for WoS (9135 scripts). This inquiry was completed on January 26, 2026. The search time frame was set between 2000 and 2025

During the second stage, ScientoPy was used to preprocess the data. The secondary data set is then established for the following analysis stage. ScientoPy uses the following criteria during the pre-processing steps; (i) normalizing the author's name: it is replaced with a semicolon for metadata retrieved from the Scopus database, it is stripped of dots, commas, and special characters for metadata retrieved from both databases, and (ii) removing duplicate samples with the same title and authors (Ruiz-Rosero et al., 2019). The pre-processing information is recorded in Table 1. Based on Table 1, the ScientoPy pre-processing script has shown that WoS databases are more than Scopus, and after duplicate removal, there are also more papers in WoS than in Scopus. This study used a raw source dataset of 13151 papers from the WoS and Scopus databases. In this study, 969 of the 13151 loaded papers were eliminated due to ScientoPy's analysis. Following data reconciliation, this study examined 11739 papers from both databases, containing 8545 papers from WoS and 3637 papers from Scopus, after removing 385 from Scopus and 58 duplicate papers from WoS. Finally, the 11739-piece data set was analysed, and the necessary statistical reports, graphs, and tables were generated using bibliometric data visualisation tools, ScientoPy and VOSviewer.

Table 1: Information on Pre-processed Data Analysis

Information	Number	Percentage (%)
Loaded papers	13151	
Omitted papers by document type	969	7.40
Total papers after omitted papers removed	12182	
Loaded papers from WoS	8545	70.10
Loaded papers from Scopus	3637	29.90
Duplicated papers found	443	3.60
Removed duplicated papers from WoS	58	0.70
Removed duplicated papers from Scopus	385	10.60
Duplicated documents with different cited by	95	66.60
Total papers after duplicate removal	11739	
Papers from WoS	8487	72.30
Papers from Scopus	3252	27.70

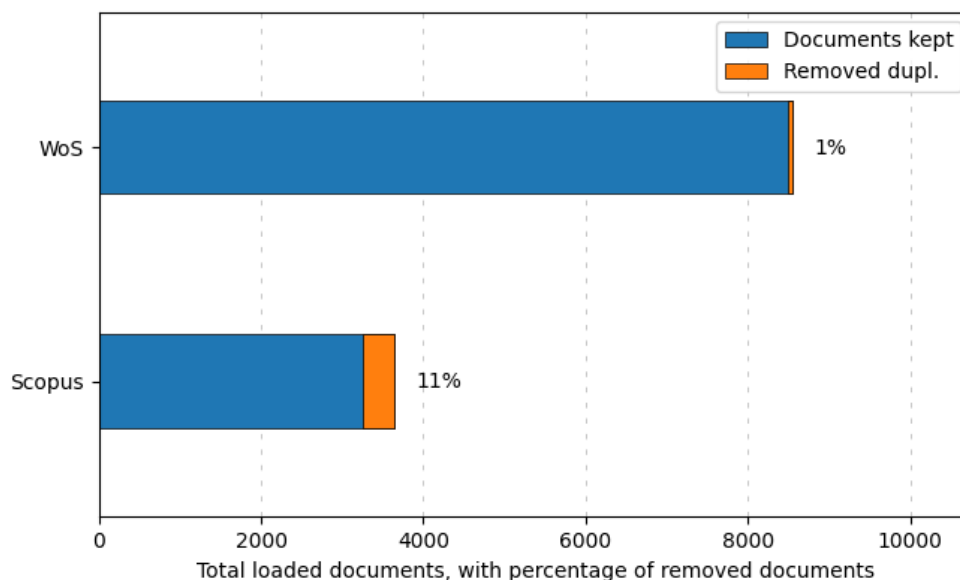


Figure 2: Pre-processing of Metadata from Scopus and WoS Databases

Scholars around the world use many bibliometric software programs, intending to provide information to readers with various interesting infographics and graphical visualisations (Ishak et al., 2024). Even if several software programs are available for conducting bibliometric analysis, choosing a solution that corresponds to the study's objectives and questions is essential. This emphasises assessing the research questions before selecting a software application. The success of software in bibliometric analysis ultimately depends on the researcher's capacity to answer the research questions posed in the studies (Abdullah et al., 2023; Roslan et al., 2023).

Results

Publication Growth

The number of peer-reviewed publications is an excellent indicator of a scientific topic's growth. Since 2005, Figure 3 demonstrates a significant increase in articles on e-learning research. Compared to Scopus, WoS publications have grown steadily, with a sharp rise after 2020 and have also taken the lead in terms of the overall number of documents compared to Scopus. Interestingly, according to this data, WoS publications began publishing in 1989, while Scopus publications began publishing in 2003.

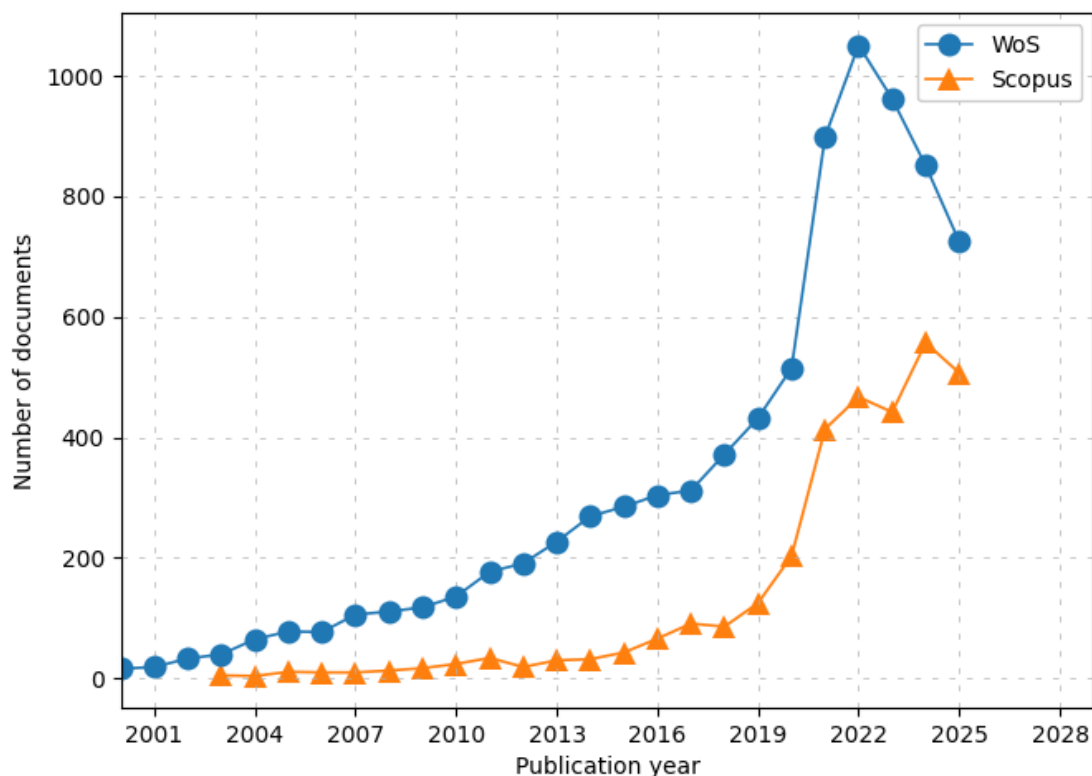


Figure 3: Timeline Graph

The data in Table 2 show the latest 5 years of publications in Scopus and WoS. From 2021 to 2025, Scopus produced 2387 publications, whereas WoS produced 4488. Scopus ranked the highest publications in 2024, with 557 in total; however, WoS published the largest number of publications in 2022 with 1051 in total. This resulted in WoS ranking Scopus up by the number of publications from 2021 to 2025.

Table 2: Five-Year Publication Trends

Year of Publication	Scopus	WoS
2021	414	899
2022	467	1051
2023	442	962
2024	557	851
2025	507	725
Total	2387	4488

This study also sought to determine where e-learning documents were published by analysing document types and language data. Table 3 shows the different types of e-learning documents published, and based on the results, articles ranked the highest in publications, with 7174 articles (59.8% of the total documents). Following the articles are a proceeding paper ($n = 2703$, 22.53%) and a conference paper ($n = 1525$, 12.71%). Review, book chapter and early access

represent the other 3 document categories, which are less than 10 percent of all document types combined.

Table 3: Document Type

Document Type	Total Publications	Percent (%)
Article	7174	59.80
Proceedings Paper	2703	22.53
Conference Paper	1525	12.71
Review	249	2.08
Book Chapter	233	1.94
Early Access	112	0.94
Total	11996	100.00

Subject Area

Likewise, it is critical to conduct a review of relevant research articles. This strategy enables the essential disciplines in which research on e-learning has been undertaken to be identified. Figure 4 depicts an evolution graph of the top ten subject areas that can be used to categorise e-learning research in the Scopus and WoS databases. Education & educational research have been identified as the most extensively investigated field, with over 3623 publications. Another fascinating subject is computer science, with 2878 publications, and the third-ranked subject area is engineering, with 1411 publications.

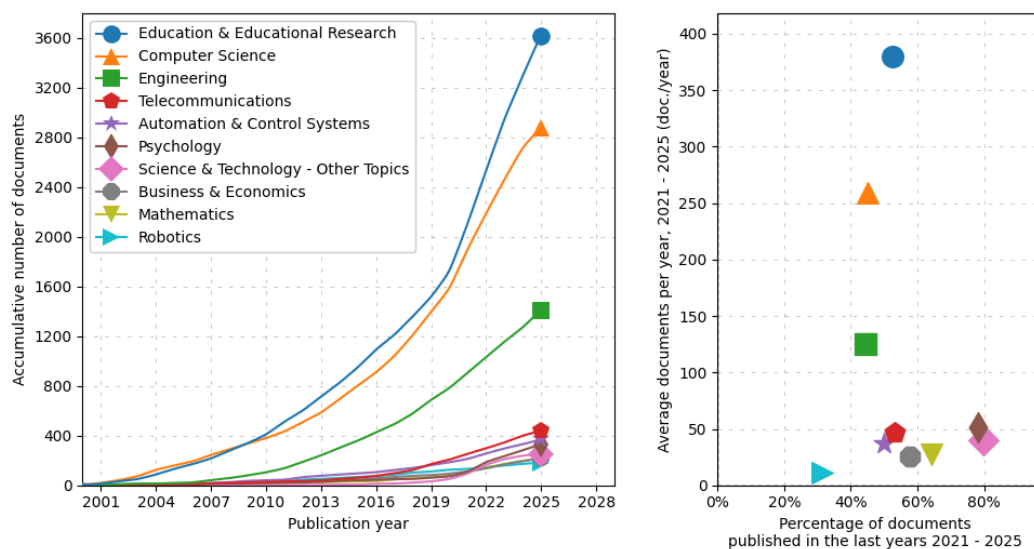


Figure 4: Subject Area Evolution Graph

From the data in Table 4, showing the latest five years for publication trends from 2021 to 2025, it was found that education & educational research is the most published subject in the last 5 years with an average of 380 publications, while for computer science subject it ranks second with an average of 258.8 publications produced, meanwhile the engineering subject, it was in third place with an average of 125.6 publications.

Table 4: Five Years on Top Ten Subject Area

Subject Area	Total Publications (5 years)	Average
Education & Educational Research	1900	380.0
Computer Science	1294	258.8
Engineering	628	125.6
Psychology	259	51.8
Telecommunications	233	46.6
Science & Technology - Other Topics	201	40.2
Automation & Control Systems	185	37
Mathematics	138	27.6
Business & Economics	128	25.6
Environmental Sciences & Ecology	121	24.2
Total	5087	1017.4

Publishing Countries

Figure 5 shows the country network visualisation of e-learning research. Since 1989, research on e-learning has been conducted in various countries and based on Figure 5, China indicates that it has the most connections among other countries, followed by India and the United States. Next, in Figure 6, the United States and China were identified as the top two publishing countries in e-learning research, with more than 2400 publications. Malaysia, Canada and Taiwan, on the other hand, are ranked the three lowest. The United States tops the chart in the e-learning study due to its major role in this field. However, research also shows that there are still many more countries that do not contribute towards the publication of e-learning research. Consequently, the studies of e-learning should be explored further in many countries.

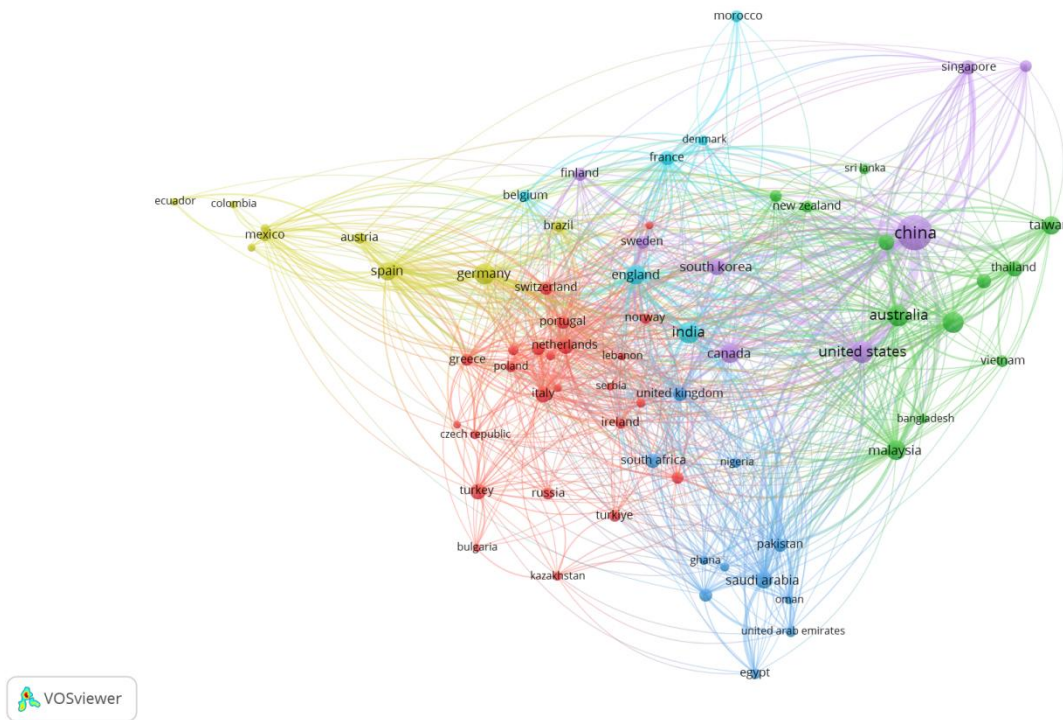


Figure 5: Network Visualisation for Publishing Countries

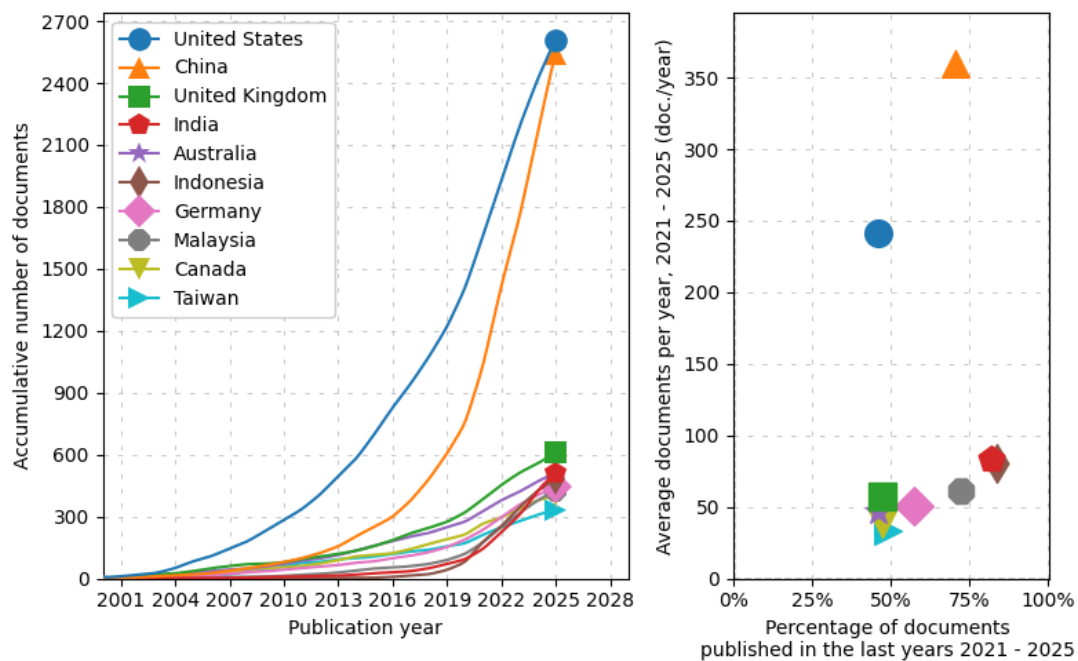


Figure 6: Country Evolution Graph

Productive Authors

The information in Figure 7 pertains to the most productive authors in e-learning research, who are ranked according to the number of publications. A list of ten authors is included, along with the 25-year and the last five years' trending percentages.

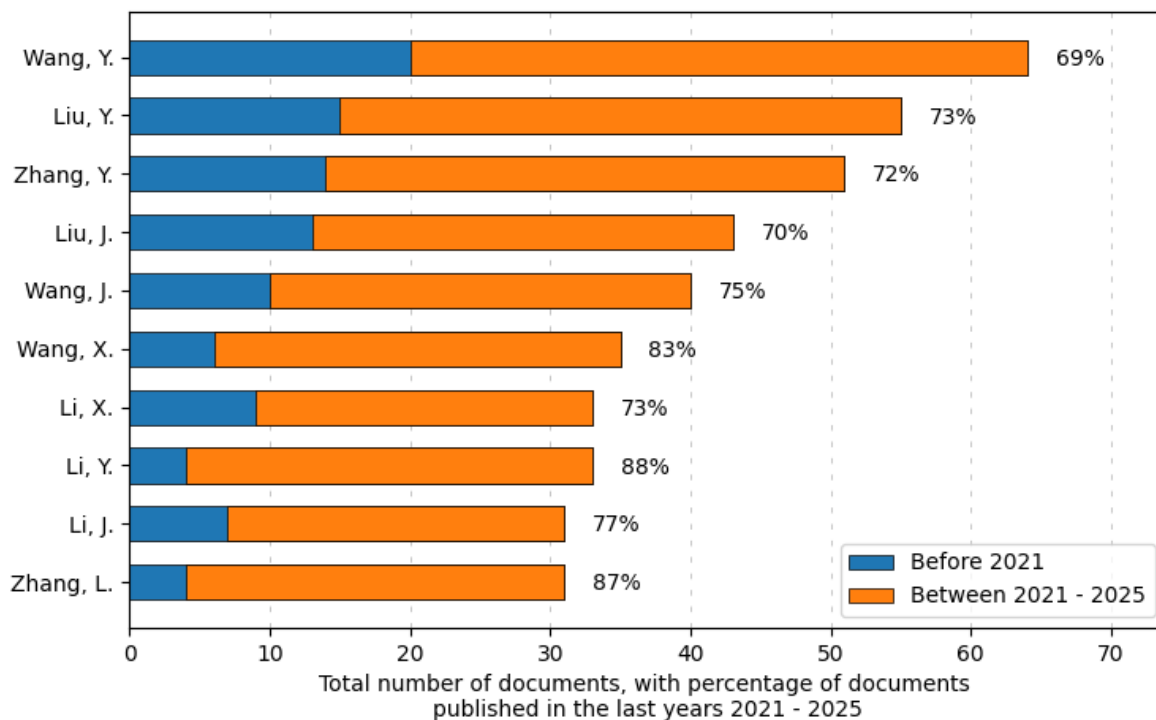


Figure 7: Productive Authors Bar Trends

According to Figure 7, Wang, Y. was ranked first with 64 publications, followed by Liu, Y. with 55 publications and Zhang, Y. with 51 publications. All three authors were the most productive in writing journals and remained the most influential in e-learning research, with possible plans to maintain further future publications. Remarkably, Li, Y. has been a proactive author in the last five years, with 88% of publications released from 2021 to 2025. Also, the compelling authors in the previous five years are Zhang, L., with 87% of publications and Wang, J., with 83% of publications. These authors' data is the most up-to-date information for future readers and researchers who want to know which authors are most active in this study of e-learning research.

Institutional Analysis

Figure 8 shows an intriguing result where, in the span of 25 years, 7 out of 10 institutions have come from China, with Tsinghua University being the most active, with 83% of publications in e-learning for the last 5 years, and the Chinese Academy of Sciences, China being the lowest, with only 38% of publications of the same period. Therefore, this indicates that e-learning research publications are still an ongoing process with potential growth.

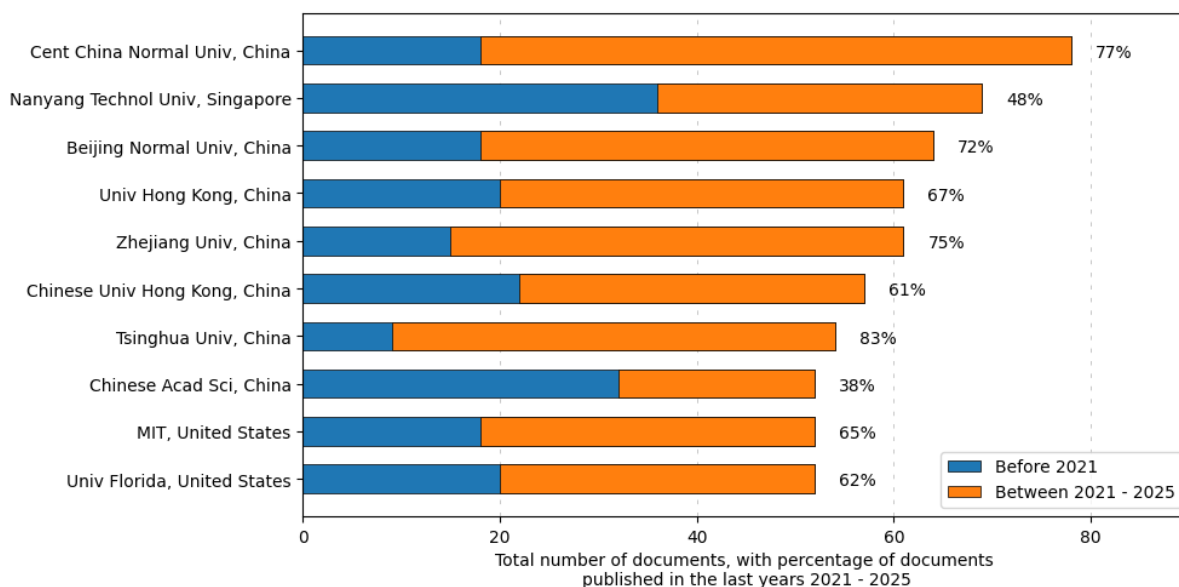


Figure 8: Institutional Bar Trends

Author Keywords

Analysis Author keywords refer to the terms used by authors to represent the content of their documents accurately. Most authors mention their study's topic as a keyword in their document. The authors' keywords aided readers and future researchers in identifying the publications' significant ideas and arguments (Roslan et al., 2024). Numerous electronic search engines, databases, and journal websites use author keywords to identify and deliver relevant articles to prospective readers. Readers need to understand that keywords produce links to other relevant publications (Abdullah et al., 2022). In this case, Scientopy might track the evolution or trends of a study's topic or search argument using the authors' keywords. This section analyses the authors' top keywords in previous research on e-learning. For the purpose of completing the procedure, the authors' keywords were used to determine research trends. It has been suggested to use an appropriate term, such as "online learning" OR "digital learning" AND "learning platform". These manual tasks assist in organising data and eliminating term duplication, resulting in more robust results.

Figure 9 exhibits 10 previously researched keywords. As illustrated in Figure 9, the top three used terms are "online learning", followed by "COVID-19" and "e-learning". Data processing was given importance in this broad phrase, directly related to the subject. Important keywords are made available to assist readers and future researchers in determining which ones to employ while conducting document analysis (Abdullah et al., 2022). While Figure 9 illustrates the first 10 keywords, ScientoPy enables us to view an infinite number of keywords (Ruiz-Rosero et al., 2019). Also, Figure 9 displays the percentage of documents published in the preceding five years (2021– 2025) to illustrate a relative increase. We can observe from this indicator that the "COVID-19 pandemic" has the highest proportion, with 95% publication between 2021 and 2025. It is self-evident that the issue has increased significantly over the last five years compared to other keywords. Additionally, "COVID-19" and "machine learning" have been among the most-searched topics, with 94% and 80% publications from 2021 to 2025. Thus, these studies depicted that "COVID-19" and "machine learning" have sparked scholars' curiosity.

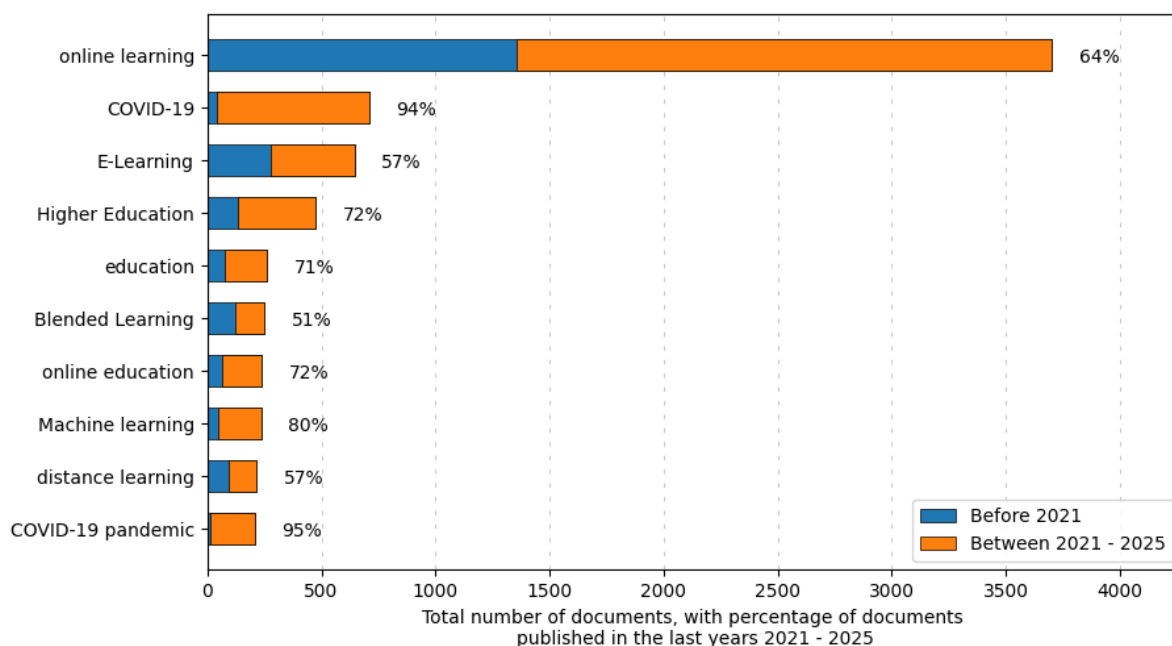


Figure 9: Author Keywords Bar Trends

Furthermore, this study used cluster mapping to ascertain the co-occurrence of the authors' keywords to denote themes or issues relevant to e-learning research (see Figure 10). Before using the VOSViewer to generate a network map, the dataset was pre-processed with SientoPy (a combination of Scopus and WoS metadata). Additionally, this study used a thesaurus file to map the co-occurrence of the authors' terms before mapping them. Concatenating related terms, spelling variants, and singular or plural terms requires the use of the thesaurus file.

Based on Figure 10, it can be deduced that the most frequently used keywords were “online learning”, “e-learning”, “higher education”, “COVID-19”, and “COVID-19 pandemic”. These keywords are inextricably linked. The keyword “e-learning” was grouped in the same clusters (purple colours) with “deep learning” and “learning analytics”. “E-learning” is also closely linked to “online learning”.



From 2000 to 2025, e-learning has evolved from a niche topic to a major, highly diversified research field, a trajectory clearly visible through bibliometric analysis (Muhamad Yusof et al., 2024). Bibliometric mapping also reveals clear thematic evolution and explains keywords that are significantly related to e-learning. Early 2000s research focused on effectiveness, course design, and basic learner satisfaction. However, by the 2010s, topics had expanded to include learning assessment, e-learning systems, and learning factors. According to Gurcan et al. (2021), important topics were identified, with "learning assessment" and "e-learning systems" being consistently high-volume areas. Four phases of dominant themes, culminating in a recent shift toward hybrid/blended learning as a reframed concept of e-learning. Therefore, more recent bibliometric analysis documents subfields around artificial intelligence, mobile learning, gamification, virtual and augmented reality, and adaptive/personalised systems as emerging hotspots.

In the meantime, geographically and institutionally, e-learning research is strongly global but unevenly distributed. Bibliometric analysis consistently identifies the USA, UK/England, Spain, and China as leading producers of e-learning publications, with high productivity and citation impact (Tonbuloglu, 2023). In major global datasets, the USA and UK contribute more than half of e-learning research, while Canada and some European countries achieve high citations per paper in health and medical e-learning (Djeki et al., 2022). Top institutional and journal hubs include the University of London, highly ranked universities in the USA, UK, China, and Taiwan, and journals such as *Computers & Education*, *Computers in Human Behavior*, and other leading educational technology outlets (Huang, 2011). At the same time, multiple studies highlight low levels of collaboration across authors, institutions, and countries, and particularly weak contributions from Africa and parts of Asia and the Global South.

Furthermore, the COVID-19 pandemic marks a clear inflexion point in e-learning. From 2020 onward, nearly all large-scale analyses report a sharp spike in publication counts, both in general e-learning and in specific sectors such as higher education and health professions (Xiong et al., 2021). Keyword co-occurrence networks show “COVID-19,” “online learning,” “distance learning,” “flipped classroom,” “mobile learning,” and “blended learning” becoming central nodes, reflecting urgent research on emergency remote teaching, student readiness, digital equity, and instructional strategies under crisis conditions (Shen et al., 2022). Post-2020 bibliometric studies in Asian and global contexts similarly identify pandemic-driven expansion, new collaboration networks, and a lasting focus on digital transformation and educational resilience. Evidence suggests that publication trends will remain elevated even after the immediate pandemic period, as e-learning becomes embedded in mainstream educational systems.

Looking toward 2025, bibliometric evidence converges on several future directions. Topic-model and trend analyses project growing emphasis on learning factors, algorithms, and adaptive/personalised platforms, setting the stage for the next generation of individualised, mobile, and AI-enhanced e-learning environments. At the same time, cross-cutting themes include student readiness, engagement, and higher-order thinking skills; integration of AI, machine learning, VR/AR, and interactive media; and attention to ethics, equity, and access, especially in low- and middle-income regions. Finally, from a bibliometric perspective, 2000–2025 can be characterised as a progression from proving e-learning’s feasibility to optimising complex, data-driven, and hybrid digital learning ecologies on a global scale.

Conclusion

In conclusion, e-learning is an ongoing development of the educational landscape rather than merely a fad in the digital world. By combining technological innovation and sound pedagogical practices, we can build a more resilient and adaptable learning environment that prepares students for a digital-first world. The value of e-learning lies in its potential to democratize education. Digital platforms allow a wide range of learners to pursue knowledge at their own pace by removing time and location constraints. As we advance, the emphasis must continue to ensure that these instruments are applied to reduce rather than increase the educational divide. Therefore, it is crucial to understand and recognise the trends in this study and the importance of using e-learning by learning intensively about it as a whole.

This research looks at how often specific articles are published and how often they use certain keywords to determine e-learning research. In the meantime, this study can yield some results from its analysis. The results indicated that publications on e-learning research have increased significantly since 2005. Notably, WoS publications have expanded consistently compared to Scopus, with a sharp increase following 2020. With over 3000 publications, “Education & Educational Research” has been identified as the most thoroughly explored research area. The United States, China and the United Kingdom have been designated as the research area’s top three publishing countries. Wang, Y. was the most productive author and often published in e-learning research, followed by Liu, Y. and Zhang, Y. with 78 publications, scholars from Central China Normal University in China were credited with the most active institution. The keyword “online learning” is the most frequently used by previous researchers, followed by “COVID-19” and “E-Learning”. E-learning was clustered in the same group with “deep learning” and “learning analytics”. Remarkably, “E-learning” and “online learning” are inextricably intertwined.

Certain limitations of this study may help direct future studies. Publications in the Scopus and WoS databases were analysed and mapped for this research. As a result, the findings of this study were limited to deducing the most critical themes or keywords associated with e-learning research found in those databases. Therefore, if future research wishes to further expand on the foundation or address broader subjects, a systematic literature review or meta-analysis is recommended to provide the most relevant evidence synthesis possible. Nonetheless, scholarly dissemination in the e-learning research field is provided to potential readers and future researchers to work on this topic.

This study provides a new perspective by showing that research on e-learning is not limited to learning through online resources only, but has attracted scholars to explore the importance of making this resource a meaningful online learning experience and identifying challenges and opportunities from these research results. Therefore, the study will aid researchers from various fields in identifying essential publication trend factors for systematically disseminating e-learning research. In addition, this study's findings motivate researchers to collaborate and develop new research paradigms for evaluating e-learning research by analysing the most often-used terms through empirical studies.

Acknowledgements

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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