

v1: 2 December 2024

Review Article

From Theory to Practice: The Impact of E-Learning on Student Performance, Trends, and Educational Horizons

Peer-approved: 2 December 2024

© The Author(s) 2024. This is an Open Access article under the CC BY 4.0 license.

Qeios, Vol. 6 (2024)
ISSN: 2632-3834

Hassan Abuhassna¹

1. School of education, Faculty of social science and humanities, Universiti Teknologi Malaysia, Malaysia

Background: Following the global outbreak of COVID-19, conventional classrooms have been supplanted by e-learning platforms, which have assumed a critical role in ensuring educational continuity.

Objective: The purpose of this review is to examine the interplay between e-learning platforms and student performance in the age after the COVID-19 pandemic.

Methods: This bibliometric analysis uses PRISMA to summarise studies linking e-learning platforms to student performance. Scopus was selected for its broad coverage and reputation as a scientific article analysis resource. A complete keyword search yielded 8060 publications in the database. Applying inclusion and exclusion criteria narrowed the findings to 1420 relevant articles.

Results: Since 2019, papers on e-learning and student performance have increased, suggesting a greater focus on research. The list of major publications, governments, and organizations that contribute to this issue shows a global effect. The study emphasizes the most prolific authors and main research keywords, reflecting the multidisciplinary nature of e-learning research.

Conclusion: E-learning is becoming more important in education, as shown by an increasing number of publications, a diverse variety of writers, and a focus on numerous subject areas and keywords. This shows how collaborative and diversified this sector's research is.

Recommendation: The paper recommends greater study to improve digital education and student learning. Understanding and improving the impact of e-learning platforms on student performance requires creating strategies and expanding the corpus of knowledge.

Corresponding author: Hassan Abuhassna,
mahassan@utm.my

1. Introduction

Following the COVID-19 epidemic, there was a significant transformation in the educational scene, whereby e-learning platforms emerged as critical

instruments for maintaining educational continuity. With the swift substitution of conventional classrooms with digital interfaces, these platforms not only facilitated continuous learning but also ushered in an unprecedented age of educational delivery [1]. The global health crisis triggered an unparalleled surge in the use of e-learning platforms, underscoring their

capacity to provide adaptable, readily available, and varied educational encounters. The transition to digital, which began as a reaction to a worldwide emergency, has now become a standard educational methodology, signifying a substantial transformation in the manner in which information is transmitted and acquired in the twenty-first century [2][3].

The shift towards e-learning platforms has emphasised the critical nature of student performance in these virtual settings [4]. The evaluation of e-learning's efficacy often hinges on students' academic performance and degree of involvement, which prompts inquiries into the influence of online learning approaches on educational results. Numerous students demonstrate exceptional performance in the technology-infused, self-directed setting, but others face challenges arising from the lack of in-person interaction and technological impediments, according to research. It is of the utmost importance to comprehend the ways in which different students

navigate and benefit from these virtual learning environments, given that the wide range of academic performance raises significant concerns regarding the efficacy, inclusiveness, and educational worth of e-learning platforms [5].

1.1. Integration of Learning Theories in E-Learning Design

Effective e-learning platforms typically integrate multiple learning theories to create a robust educational experience that caters to diverse learning styles and needs. For instance, an e-learning course might include behaviorist elements such as scoring systems, cognitive tasks involving critical thinking, constructivist activities requiring learners to create a project based on their understanding, and connectivist opportunities through online discussions with a global community. Table 1 discusses key learning theories that explain how digital technologies support or enhance learning processes and outcomes.

Theory	Description	Application in E-Learning
Behaviorism	Focuses on observable behavior changes and emphasizes practice and reinforcement.	Utilizes quizzes and interactive exercises for repetitive practice and immediate feedback to reinforce learning materials.
Cognitivism	Concentrates on the mental processes involved in learning, such as understanding, memory, and problem-solving.	Features simulations and problem-solving tasks that require the application of cognitive skills, aiming to build upon existing knowledge and promote deeper understanding.
Constructivism	Suggests that learners construct new knowledge based on their experiences.	Offers interactive, learner-centered activities that allow for exploration and experimentation, fostering collaborative and reflective knowledge construction.
Social Learning	Emphasizes learning through observation, imitation, and modeling, as per Albert Bandura's theories.	Incorporates video demonstrations, peer collaboration, and discussion boards to facilitate learning through observation and imitation of peer behaviors.
Connectivism	Addresses the learning needs of the digital age, highlighting the importance of learning networks and the ability to manage information across various digital platforms.	Connects learners to a vast network of information, encouraging efficient navigation and utilization of diverse online resources and opinions.
Andragogy	Adult learning theory that highlights the self-directed nature of adult learners, who bring rich, varied experiences to their education.	Provides personalized learning paths, choices, and opportunities for self-directed projects, making use of adults' prior experiences in the learning process.

Table 1. Key learning theories relevant to e-learning

In conclusion, understanding these learning theories helps educators and developers of e-learning platforms to design more effective learning environments that accommodate the varied ways individuals learn. By aligning educational content and activities with these theories, e-learning can maximize engagement, enhance knowledge retention, and facilitate the effective application of learned skills. This theoretical foundation is crucial for the ongoing development and refinement of e-learning methodologies and for ensuring that such platforms are deeply rooted in pedagogically sound principles.

The rationale for conducting this research is to gain a comprehensive understanding of the intricate relationship between e-learning platforms and student accomplishment in the era after COVID-19. A specific focus of this bibliometric study is to uncover trends, patterns, and gaps in the current research literature about the many impacts of digital learning on student accomplishment. A comprehensive analysis of these effects is the objective of this study. By conducting an

exhaustive synthesis of relevant scholarly literature, this research seeks to provide a nuanced perspective on the influence of e-learning platforms on academic performance. With the intention of contributing to the academic dialogue around digital education, this research examines the intricacies of this correlation. By using this methodology, it seeks to provide improved educational experiences and suggest well-informed teaching strategies. As a result, the objective of this bibliometric evaluation was to address the following research inquiries:

1. What is the distribution of student performance in publications on e-learning platforms from 2012 to 2022?
2. Which academic publications are most pertinent to the study of student performance on e-learning platforms?
3. Which nations have the most impact on student performance in the field of e-learning platforms research?
4. Which educational institutions have made the most notable contributions to the study of student

- performance in e-learning platforms?
5. Which authors have produced the most substantial contributions to the field of student performance in e-learning platforms?
6. Over the last decade, what have been the most prominent research terms concerning student performance on e-learning platforms?

2. Materials and Methods

2.1. Research Design

The present bibliometric investigation conforms to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) structure [6]. The primary aim of this comprehensive analysis was to thoroughly delineate the body of research that investigates the correlation between e-learning platforms and the academic performance of students. This encompasses an exhaustive examination of the foremost nations, academic establishments, publications, and writers who have made contributions to this field. Additionally, it identifies prevalent patterns and crucial terms associated with this particular field of study. This evaluation was subsequent to other pertinent studies, demonstrating the importance of bibliometric review articles in the field of study [7][8].

In conjunction with the PRISMA framework used for bibliometric analysis, VosViewer was widely utilised for data visualisation and analysis in this investigation. VosViewer simplifies bibliometric network construction and observation. These networks may comprise journals, publications, researchers, or individual works. Co-authorship, citation, and bibliographic coupling relationships underpin these networks. VosViewer

helped us map and analyse complicated e-learning research networks. It helped identify the most prominent journals, publications, and authors, visualise trends, and understand academic subjects. The software's interactive graphical user interface and huge dataset handling enabled thorough data analysis. This helped identify the most important e-learning research trends and patterns. VosViewer's geographical organisation of publications and institution-author cooperation improved knowledge of e-worldwide learning's effect and research dynamics.

2.1.1. Identification

- Database selection

Based on its comprehensive coverage and acclaimed reputation in the domain of scientific article analysis, the Scopus database was prudently chosen as the principal source for this review on December 17, 2023.

- Search Strings

In order to ensure a thorough retrieval of relevant research, the search methodology was carefully devised. Structured search queries, such as the one with TI-TLE-ABS-KEY, included specific criteria, such as "(e-learning AND students' performance)" (students AND performance AND e-learning). Publications from 2012 to 2022 were within the temporal scope that was established. Arts, social sciences, and computer science were the subject areas that were explicitly targeted. Strictly limiting the search to articles and English-language publications was implemented. Moreover, only journal sources were included in the search. Table 2 shows the inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Research specifically on e-learning and student performance	Research outside the specified subject areas
Publications from the years 2012 to 2022	Publications prior to 2012 and those from 2023
Articles published in English	Publications in other languages
Journal articles	Theses, conference papers, books, book chapters, blogs
Journals as the source type	All other sources

Table 2. Inclusion and exclusion criteria.

2.1.2. Screening and Selection

The first database search was conducted using the primary keywords "E-learning and student performance," which resulted in the retrieval of 8,060 items. By using the inclusion and exclusion criteria outlined in Table 1, the number of relevant articles was reduced to 1,420. The process of refining led to the exclusion of 6,640 papers that failed to satisfy the predetermined criteria.

2.1.3. Inclusion and Reporting

The results of this bibliometric analysis are presented in adherence to the PRISMA framework, as seen in Figure 1. [6]. The next part will begin by answering the research questions that were presented, presenting the results in a systematic and transparent manner.

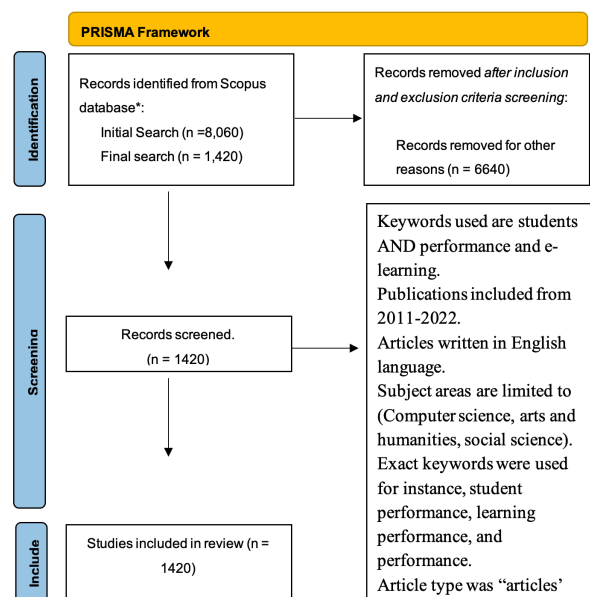


Figure 1. Prisma Framework.

3. Results

The results of a bibliometric investigation of the correlation between e-learning platforms and student performance are detailed in this section. Our study encompasses a decade of research and offers valuable insights into several aspects of this ever-evolving discipline. It includes prominent subject areas, publishing patterns, influential journals and nations, key academic institutions, prolific authors, and main research keywords. The objective of this synthesis is to delineate the progression of e-learning research, ascertain the fundamental components that propel scholarly investigation, and provide an all-

encompassing perspective on the worldwide endeavours to comprehend the influence of digital learning environments on student performance.

3.1. The distribution by years

The following research question will be addressed in this section: "What is the distribution of student performance in publications on e-learning platforms from 2012 to 2022?" By analysing the offered data, we can address the first study inquiry about the distribution of student performance in publications on e-learning platforms from 2012 to 2022. The number of publications pertaining to student performance on e-learning platforms has shown a discernible upward trend over time, as indicated by the statistics. There has been a consistent annual growth in the number of publications since 2012, when it reached 161. Following 2019, this expansion becomes more conspicuous, reaching its pinnacle in 2022 with a total of 952 publications. Particularly in recent years, this suggests a substantial increase in interest and research concentration in this field, as shown in Figure 2.

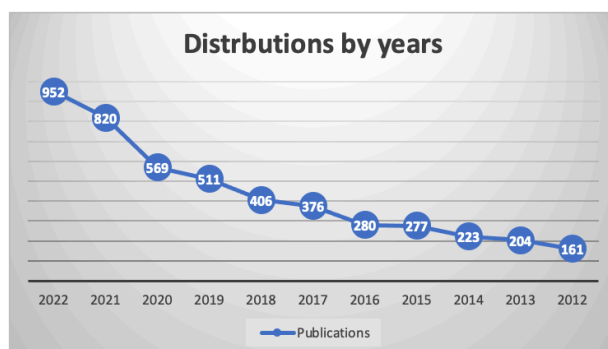


Figure 2. Distribution by years

The data shown in Figure 2 illustrates the distribution of publications concerning student performance on e-learning platforms from 2012 to 2022, which has a significant upward trajectory, suggesting a growing scholarly focus on this field. There were 161 publications in 2012, and that number has risen annually since then. The figure escalated to 277 by 2015, and this upward trend persisted consistently. A notable upswing in publishing output was seen beginning in 2019, when 511 works were published. This surge accelerated to 569 in 2020, 820 in 2021, and culminated in 952 works in 2022. The observed upward trajectory, specifically the substantial surge over the past three years, indicates an elevated emphasis on e-learning platforms and student performance. This may be attributed to worldwide transitions towards online education, which have been made necessary by the COVID-19 pandemic. The data indicate an increasing scholarly and applied curiosity about the effects of e-learning on student performance, signifying the emergence of a flourishing study domain characterized by developing approaches and a rising corpus of knowledge.

3.2. The most relevant journals

Regarding the second research inquiry, which academic publications are most pertinent to the study of student performance on e-learning platforms? A wide array of publications that provide substantial contributions to this topic is evident in Table 2, according to the data supplied for the years 2019 through 2022.

Journal	*TP (2019- 2022)	*TC (2019- 2022)	cite score (2022)	Most cited article	Times cited	Publisher
Computers and Education	791	18,818	23.8	From dual digitalization to digital learning space: Exploring the digital transformation of higher education	80	Elsevier
International Journal of Emerging Technologies in Learning	1683	8389	5.0	Gamification Strategy to Support Self-Directed Learning in an Online Learning Environment	19	International Association of Online Engineering
Computers in Human Behavior	1536	27288	17.8	What is XR? Towards a Framework for Augmented and Virtual Reality	152	Elsevier
IEEE Access	54,351	490,387	9.0	A Metaverse: Taxonomy, Components, Applications, and Open Challenges	491	IEEE
Computer Applications in Engineering Education	475	2709	5.7	Virtual reality as a didactic resource from the perspective of engineering teachers	27	Wiley-Blackwell
British Journal of Educational Technology	533	7381	13.8	Student engagement in online learning in Latin American higher education during the COVID-19 pandemic: A systematic review	105	Wiley-Blackwell
International Journal of Advanced Computer Science and Applications	4553	9537	2.1	Breast Cancer Detection and Classification using Deep Learning Xception Algorithm	33	Science and Information Organization
IEEE Transactions on Learning Technologies	227	1923	8.5	Constructing an Edu-Metaverse Ecosystem: A New and Innovative Framework	38	IEEE
International Journal of Engineering Education	413	1203	2.9	Emergency Remote Learning: Developing an Understanding about Online Learning Leatures and Students' Leelings	7	Tempus Publications
Internet and Higher Education	96	1592	16.6	Influences of depression, self-efficacy, and resource management on learning engagement in blended learning during COVID-19	21	Elsevier

Table 2. The Top 10 journals in student's performance in e-learning platforms research.

*TP= Total publications, *TC= Total citations

Table 2 displays the publications most relevant to student success in e-learning systems. The data from 2019 to 2022 highlight many important publications. "Computers and Education," a scholarly journal distributed by Elsevier, distinguishes itself with a

remarkable total of 791 articles and 18,818 citations. The article that receives the most citations, 80, pertains to the digital revolution of higher education and has a citation count of 23.8. In the meantime, the "International Journal of Emerging Technologies in Learning," published by the International Association of

Online Engineering, demonstrates a significant impact with a total of 1683 articles, 8389 citations, and a cite score of 5.0. With 19 citations, its renowned paper on gamification in self-directed learning has attracted attention. The journal "Computers in Human Behavior," which is likewise published by Elsevier, is distinguished by its 1536 articles, 27,288 citations, and 17.8 cite score. With 152 citations, its most-cited piece examines augmented and virtual reality. Likewise, "IEEE Access," an official magazine of IEEE, has an impressive compilation of 54,351 publications and a remarkable 490,387 total citations, accompanied by a cite score of 9.0. Cited 491 times, the journal's main article examines the taxonomy and difficulties of the Metaverse. "Computer Applications in Engineering Education" by Wiley-Blackwell makes a scholarly contribution of 475 articles, 2709 citations, and a cite score of 5.7. Cited 27 times, its linchpin piece investigates the use of virtual reality as an instructional tool. With a cite score of 13.8, the "British Journal of Educational Technology," another publication by Wiley-Blackwell, catalogs 533 articles and 7381 citations. Among these, a systematic review on student engagement in Latin American online learning is particularly noteworthy, having been cited 105 times.

The Science and Information Organization's "International Journal of Advanced Computer Science and Applications" has a cite score of 2.1 with a substantial publishing count of 4553 articles and 9537 citations. With 33 citations, its most-cited paper focuses on breast cancer diagnosis using deep learning. "IEEE Transactions on Learning Technologies," an IEEE publication, has a cite score of 8.5 and 227 articles and 1923 citations. Cited 38 times, a prominent paper from this magazine presents a foundation for an educational Metaverse.

Furthermore, Tempus Articles' "International Journal of Engineering Education" has a cite score of 2.9 and is comprised of 413 publications and 1203 citations. Its most-cited paper, which is cited seven times, examines student sentiments and online learning characteristics in emergency remote learning. Finally, "Internet and Higher Education" by Elsevier, which has been referenced 1592 times and has 96 publications and 1592 citations for a cite score of 16.6, has a 21-times-cited important paper on learner engagement in blended learning during COVID-19. Journals with high citation counts, prolific publication counts, and important publications have significantly influenced the development of research pertaining to student performance in e-learning platforms.

3.3. The most significant countries

In order to examine the third study inquiry, which nations have the most impact on student performance in the field of e-learning platforms research? An analysis of the data presented reveals a heterogeneous worldwide impact, as seen in Figure 3. Distribution of publications by nation.

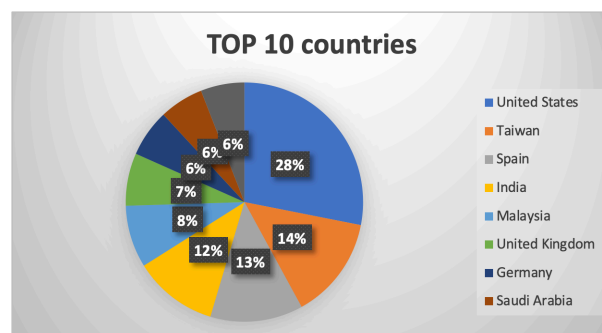


Figure 3. Distribution by Countries.

With a cumulative count of 695 articles, China emerges as the frontrunner in this field of study (Figure 3), signifying a considerable commitment and financial investment in comprehending the intricacies of e-learning and its impact on student performance. The United States ranks closely behind with 660 articles, which demonstrates its substantial contribution to the advancement and investigation of e-learning approaches and their effects on students. Taiwan, with 327 articles, appears as a significant contributor, demonstrating its expanding emphasis on educational technology. A substantial European interest in the area is shown in Spain's 297 articles, which mostly concern the investigation of the ways in which e-learning platforms might improve student results. The rising importance that India places on digital education is shown by its 269 publications, which is particularly pertinent in a nation with such a large and diversified student body. Malaysia's substantial body of work in this field, consisting of 198 publications, underscores the nation's dedication to the integration of technology in education. In 167 publications, the United Kingdom demonstrates its enduring fascination with educational technology and its practical implementations. Germany demonstrates its research prowess in technical innovation within the field of education via its 151 publications. The 141 papers contributed by Saudi Arabia demonstrate an increasing regional interest in the use of e-learning to improve education. Australia's involvement in the creation and investigation of e-

learning platforms and their effects on students is shown by its 140 publications.

Collectively, these nations constitute a substantial proportion of the worldwide scholarly investigation concerning e-learning platforms and student performance. This underscores the extensive and multifaceted nature of the interest that transcends continents. The wide-ranging contributions highlight the worldwide significance of e-learning platforms in contemporary educational systems and the

international pursuit to comprehend their influence on student performance.

3.4. The most significant educational institutions

The data presented in answer to the fourth research question—"Which educational institutions have made the most notable contributions to the study of student performance in e-learning platforms?"—emphasizes several such institutions, as seen in Figure 5, Table 3, and Figure 4.

Educational institution	*TP	Country
National Taiwan University of Science and Technology	21	Taiwan
National Taiwan Normal University	20	Taiwan
Universitat Oberta de Catalunya	17	Spain
King Abdulaziz University	15	Saudi Arabia
National Cheng Kung University	13	Taiwan
Universidad Politécnica de Madrid	13	Spain
Central China Normal University	12	China
National Chengchi University	12	Taiwan
The University of Hong Kong	10	Hong Kong
Universiti Teknologi Malaysia	10	Malaysia

Table 3. The most significant educational institutions in student performance in e-learning platforms research

*TP= Total publications

The National Taiwan University of Science and Technology has produced the most total publications (TP) in Taiwan, with 21 (Table 3), which demonstrates the institution's commitment to e-learning and student performance research. The 20 publications of the National Taiwan Normal University, likewise located in Taiwan, demonstrate the nation's commitment to education technology research. With seventeen publications, the Universitat Oberta de Catalunya in Spain has had a substantial effect on Europe. This demonstrates the institution's dedication to the impact of online education on student learning outcomes. Likewise, the Universidad Politécnica de Madrid, situated in Spain as well, demonstrates a considerable level of enthusiasm for the subject matter through its thirteen publications. With fifteen publications, King Abdulaziz University in Saudi Arabia distinguishes itself in the Middle East and signifies an increasing emphasis on e-learning within the realm of educational research in the area. The regional distributions of publications are shown in Figure 4.

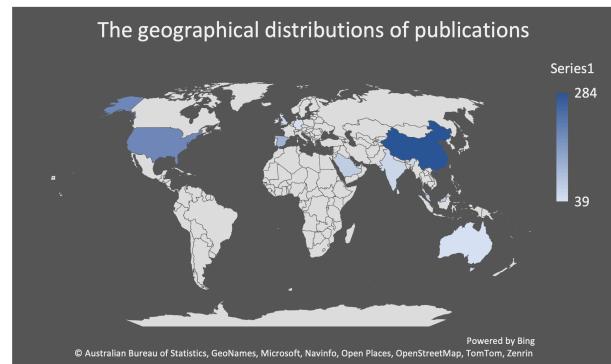


Figure 4. The geographical distributions of publications

With thirteen publications, National Cheng Kung University in Taiwan reaffirms its preeminent position in this field of study. Twelve papers from National Chengchi University, which is also located in Taiwan, demonstrate the nation's focused efforts in e-learning research. Twelve publications from the Central China Normal University in China attest to the nation's growing emphasis on the integration of technology into the educational sphere. Ten papers from The University of Hong Kong, outside of these areas, demonstrate the city's active engagement in the investigation of e-learning platforms. With a notable ten publications, Universiti Teknologi Malaysia distinguishes itself across Southeast Asia, showcasing Malaysia's

dedication to the progression of educational technology. The VosViewer software-based examination of the geographical distribution is shown in Figure 5.

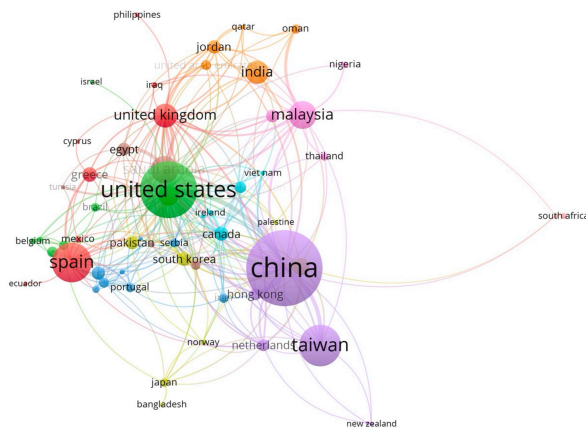


Figure 5. The geographical distribution based on VosViewer software.

The multinational presence of these establishments in different nations emphasizes the worldwide scope of e-learning research. Their noteworthy contributions exemplify the wide range of methodologies and viewpoints that are included in the examination of e-learning platforms and their influence on academic performance. The presence of such variety not only enhances the field but also contributes to a holistic comprehension of the ways in which e-learning platforms are influencing education in various educational and cultural settings.

3.5. The most prolific authors

Regarding the fifth research inquiry, "Which authors have produced the most substantial contributions to the field of student performance in e-learning platforms?" the data shown in Table 4 underscores a number of authors who have made noteworthy contributions in this domain.

Author	Year of first publication	*TP	h-index	*TC	Current affiliation	Country
Hwang, Gwojen	1995	550	75	21,793	National Taiwan University of Science and Technology	Taiwan
Tawafak, Ragad Moufaq	2018	57	16	691	Al Buraimi University College	Oman
Chen, Chihming	1999	180	37	5,306	National Chengchi University	Taiwan
Yueh-Min, Huang Ray	1996	613	53	10,823	National Cheng Kung University	Taiwan
Malik, Sohail Iqbal	2013	55	18	858	Buraimi University College	Oman
Tsai, Chiawen Wen	2005	99	23	1,502	Ming Chuan University	Taiwan
Adnan, Muhammad	2018	26	8	447	University of Management and Technology Lahore	Pakistan
de-Marcos, Luis	2006	99	16	2,557	Universidad de Alcalá	Spain
Al-Adwan, Ahmad Samed	2015	80	21	1,376	Al-Ahliyya Amman University	Jordan
Al-Khanjari, Zuhoor Abdullah Salim	2017	13	4	40	Sultan Qaboos University	Oman

Table 4. The top 10 authors in the student's performance in e-learning platforms research area

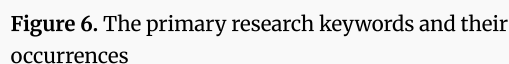
*TP= Total publications, *TC= Total citations

The most prolific authors are shown in Table 4. For example, Hwang Gwojen, who published his first work in 1995, has accumulated a remarkable 550 publications and an h-index of 75, which translates to 21,793 citations. Hwang, who is now associated with the National Taiwan University of Science and Technology in Taiwan, has established himself as a preeminent authority on the subject via his substantial body of research. Since Tawafak Ragad Moufaq started her academic career in 2018, she has amassed 57 articles to date, garnering 691 citations and an h-index of 16. Her affiliation with Al Buraimi University College in Oman signifies her increasing prominence in the field of study in question. Since his first publication in 1999, Chen Chihming has accumulated a total of 180 articles and now has an h-index of 37. The 5,306 citations he has accumulated and his association with National Chengchi University in Taiwan testify to his lasting and influential reputation in the area. Yueh-Min Huang Ray

has accumulated a significant h-index of 53, 613 articles, and 10,823 citations since his inception in 1996. His affiliation with National Cheng Kung University in Taiwan underscores the considerable advancements that the country has achieved in the domain of e-learning research. Fifty-five of Malik Sohail Iqbal's papers have been cited 858 times and have earned him an h-index of 18. The individual's association with Buraimi University College in Oman highlights the growing academic focus on e-learning within the field. Since her first publication in 2005, Tsai Chiawen Wen has accumulated an h-index of 23, 99 articles, and 1,502 citations. Her affiliation with Ming Chuan University in Taiwan contributes to the elevation of the country's standing in the field of e-learning research. Adnan Muhammad, who started his scholarly pursuits in 2018, has produced a total of 26 publications. These works have received 447 citations and have an h-index of 8. His association with the University of Management and Technology Lahore in Pakistan indicates that he has

The knowledge and advancement of e-learning platforms and their influence on student performance have been profoundly influenced by the authors' copious research and publications. Further emphasising the international scope of this study domain are their varied international connections.

In response to the sixth inquiry, "Over the last decade, what have been the most prominent research terms concerning student performance on e-learning platforms?" The figure illustrates the principal research terms and their frequency of occurrence, as shown by the information presented in the picture.



student performance on e-learning platforms, which reflects the broad spectrum of interests that exist in this sector. The term "e-learning" surfaced as the most frequent keyword, appearing 1,393 times, indicating its critical significance in the field of educational research. The term "students" was also often occurring, being used 842 times, which emphasises the primary focus of the research. The terms "teaching" and "learning systems," which appear 362 and 331 times, respectively, underscore the considerable attention given to the methodologies and technology used in e-learning. The terms "education computing" and "computer-assisted teaching" are used often, highlighting the technical foundations of e-learning settings. The comprehensive nature of the approach shown by the occurrences of "human," "curricula," and "online learning" in the list (77–159) implies that it involves not just curriculum creation but also human issues. A focused examination of certain fields, such as "engineering education" and "academic performance," signifies an emphasis on performance measures and disciplinary aspects. The prevalence of the terms "virtual reality" and "data mining" indicates a significant fascination with cutting-edge technology and analytical methodologies. An in-depth analysis of gender disparities in e-learning is shown by the 52 instances of the gender-specific terms "male" and "female." Finally, the study places significant importance on the outcomes of "learning performance" and "student performance," which underscore the overarching objective of comprehending and improving the learning process.

In order to investigate the seventh research inquiry, which topic area is the most critical in terms of students' success on e-learning platforms? Based on the facts presented, Computer Science emerges as the preeminent field of study, with a substantial collection of 970 articles. The significance of this indicates that technical components of e-learning, such as algorithmic development, software creation, and system architecture, are fundamental to comprehending and enhancing student performance on these platforms, as seen in Figure 7.

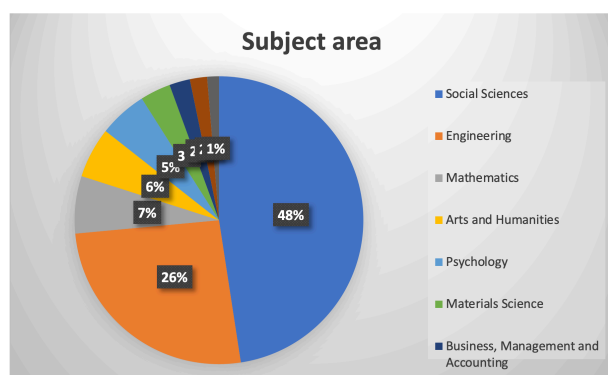


Figure 7. The most important subject area

The paramount domain is shown in Figure 7. The Social Sciences have a substantial interest in the sociological, behavioural, and pedagogical ramifications of e-learning, as seen by their 864 articles in close proximity. This includes the sociology of education, education policy, and the application of learning theories to e-learning settings. Engineering, which has been the subject of 471 articles, is another significant area of interest, since it involves the use of engineering concepts in the development and improvement of e-learning platforms and technologies. While the presence of certain topic areas may be somewhat limited, they still provide significant contributions to the discipline. With a combined total of 103 and 117 papers, the Arts and Humanities and Mathematics, respectively, provide significant contributions to the body of knowledge about the use of e-learning. Psychology's 98 publications demonstrate an interest in the cognitive, motivational, and behavioural aspects of e-learning. Profound insights into the application of e-learning may be obtained from the academic fields of Mathematics and the Arts and Humanities, which together include 117 and 103 publications, respectively. Behaviour, motivation, and cognition as aspects of e-learning are emphasised in psychology, which has published 98 publications on the subject.

In summary, while much research has been conducted in the Social Sciences and Computer Science about student performance on e-learning platforms, there are several other academic disciplines that contribute to a comprehensive understanding of this intricate matter.

This bibliometric study's findings show a variety of academic papers that deepen our comprehension of the link between online learning environments and student achievement. The growing quantity of articles, the variety of nations and organisations that have

contributed, and the frequency with which certain topics and keywords appear all point to the growing significance of e-learning in the field of education. The findings highlight the multidisciplinary nature of research on e-learning, demonstrating the collaborative efforts of academics, technologists, and professionals from many countries. This research not only offers valuable insights into the current corpus of knowledge but also lays the groundwork for future inquiries that will consistently impact instructional methodologies and the academic experiences of pupils in an increasingly digital setting.

4. Discussion

With regard to the dynamic realm of e-learning and its influence on student performance, the bibliometric study detailed in this article provides a comprehensive viewpoint. The findings illustrate the growth and progress of an academic discipline marked by a variety of contributions from different nations and organisations, as well as a growing focus from scholars.

4.1. Trends in Publication and Geographic Distribution

The notable surge in scholarly articles pertaining to the correlation between e-learning and student performance, namely after 2019, indicates an expanding scholarly focus on this field. The aforementioned pattern, which was presumably instigated by the worldwide transition to online instruction throughout the COVID-19 crisis, underscores the criticality and pertinence of comprehending the efficacy of e-learning. The worldwide scope of this study is underscored by the substantial contributions from nations such as China, the United States, and Taiwan, which are distributed around the globe in these publications. The influence of various educational and cultural settings on the development of e-learning approaches is a fascinating phenomenon that provides a wealth of viewpoints and insights.

4.2. Influential Journals and Educational Institutions

The study discerns prominent academic publications and establishments that are conducting cutting-edge research on e-learning. This knowledge is of the utmost importance for academics who want to participate in cutting-edge research in this particular sector. Furthermore, the prominence of these academic institutions and publications indicates not just their

scholarly influence but also their potential to mould forthcoming e-learning policies and methodologies.

4.3. Prolific Authors and Research Keywords

The ongoing dedication and accomplishments of exemplary scholars are acknowledged via the recognition of prolific writers within this field. The fundamental basis for current understanding and future progressions in e-learning is their research. Furthermore, an analysis of keyword extracts obtained from primary sources offers valuable insights into the vastness and intricacy of the field, including subjects such as students, technology, and education. When juxtaposed with terms like "students" and "teaching," which underscore the human and pedagogical dimensions of e-learning, the prominence of buzzwords like "education computing" and "computer-assisted instruction" suggests a significant prioritisation of the technological elements.

4.4. Subject Areas and Their Implications

The research covers a wide array of subject matters, highlighting the multidisciplinary nature of electronic learning. As seen by the prevalence of computer science and social sciences, technological progress and educational theory and practice have merged. The use of an interdisciplinary approach is critical in the development of engaging and efficacious e-learning environments that accommodate a wide range of

learning requirements.

In summary, the findings of this bibliometric study provide an all-encompassing depiction of the present condition and future direction of scholarly inquiry concerning student performance and e-learning. In addition to being crucial for scholarly objectives, this expanding corpus of information has pragmatic ramifications for practitioners, policymakers, and technologists. It is crucial to remain updated on the ongoing advancements in e-learning in order to guarantee that digital learning environments are productive, all-encompassing, and favourable for the performance of students.

4.5. Summary of the results of this review

The following table provides a consolidated summary extracted from this research article that conducts an exhaustive analysis of the development, consequences, and potential future developments of e-learning, with a specific emphasis on its effect on student performance. The data is classified into significant domains, including discoveries, ramifications, patterns, and prospective plans. These classifications provide a comprehensive understanding of the scholarly attention, geographic distribution, primary authors, and subject-specific emphasis in the field of e-learning. The objective of the research is to delineate the present state of affairs and forecast forthcoming paths in this swiftly progressing domain, as seen in Table 5.

Aspect	Findings	Implications	Trends	Future Agenda
Publications	An enormous surge in publications after 2019. In 2022, the greatest number of publications (952) was produced.	An increased scholarly focus on e-learning is evident, particularly in light of the COVID-19 epidemic.	Consistent yearly expansion of publications, marked by a significant upsurge starting in 2019.	Ongoing investigation to comprehend and improve the effect of e-learning on student performance.
Journals	"Computers and Human Behavior," "International Journal of Emerging Technologies in Learning," and "Computers and Education" are all significant periodicals.	Academics in pursuit of the most recent developments in e-learning must consult these periodicals.	Extensive contributions from a variety of periodicals, with an emphasis on the use of technology in education.	Additional investigation into developing approaches and technology in the field of e-learning.
Countries	The most significantly contributing nations are Taiwan, the United States, and China.	Indicative of the many educational and cultural settings and the worldwide aspect of e-learning research.	Increasing contributions from several nations on a worldwide scale.	International research that is more collaborative in order to improve global e-learning techniques.
Educational Institutions	National Taiwan Normal University and National Taiwan University of Science and Technology are notable contributors to this cause.	The significance of educational institutions in the progression of e-learning research is emphasised.	E-learning research is produced in significant quantities by a number of countries, including Taiwan and Spain, amongst others.	It is important to encourage additional educational institutions all around the globe to participate in research on e-learning.
Authors	There is a mixture of recognised and new scholars in the subject, as shown by the fact that notable writers such as Hwang Gwojen and Tawafak Ragad Moufaq contributed to the writing.	In the field of e-learning, this article highlights the devotion and accomplishments made by individual researchers.	There is a combination of seasoned researchers and newcomers who are contributing to the area.	It is important to provide researchers with support and recognition in order to encourage additional advancements in e-learning.
Keywords	The following are some of the most important keywords: "e-learning," "students," "learning systems," "teaching," "computer-aided instruction," and "education computers."	Reflects the emphasis placed on student-centered issues, pedagogy, and technology in the context of online education.	This reflects the emphasis that e-learning places on things like technology, pedagogy, and student-centered perspectives.	In the realm of e-learning, further investigation into cutting-edge educational tools and analytical methods.
Subject Areas	In terms of importance, the most significant subject fields are computer science and social sciences, followed by engineering, mathematics, and the arts and humanities.	The interdisciplinary character of e-learning is shown by the fact that it combines the development of technology with educational theory and practise.	Research that draws from a variety of disciplines and places a significant emphasis on educational and technical factors.	Putting an emphasis on multidisciplinary methods in order to develop efficient online learning environments that can accommodate a wide range of educational requirements.

Table 5. A Thorough Examination of E-Learning and Its Influence on Academic Performance: Principal Discoveries and Prospects for the Future

The examination of the correlation between e-learning and student performance is succinctly shown in Table 5. This table highlights the dynamic and ever-growing nature of the subject. The substantial surge in scholarly articles and international contributions since 2019 is indicative of the expanding significance and dynamic characteristics of e-learning, particularly in the aftermath of the COVID-19 pandemic. The participation of several nations, academic establishments, and researchers underscores the multifaceted and multidisciplinary nature of the area. E-learning is widely recognised as a critical domain of study and implementation, since it integrates pedagogical principles, technological advancements, and student-centered methodologies. In the future, it is anticipated that there will be a greater emphasis on leveraging nascent technologies, cultivating global partnerships, and embracing multidisciplinary inquiry in order to augment the efficacy of e-learning and its favourable influence on student performance. This phenomenon establishes a sanguine course for forthcoming investigations and advancements in the field of digital schooling.

5. Conclusions

The bibliometric analysis performed in this research provides a thorough and inclusive examination of the dynamic correlation between e-learning platforms and the academic performance of students. It underscores a substantial surge in academic research in this field, which demonstrates the expanding significance of e-learning in contemporary education. The worldwide and interdisciplinary character of e-learning research is underscored by the predominance of certain topic areas and keywords, as well as the variety of the contributing nations and institutions. The international collaboration of scholars, technicians, and researchers has not only shed light on the present state of study but has also established a foundation for further investigations. Ongoing research is crucial for shaping educational methods and improving student learning experiences in an era when digital platforms are becoming more prevalent.

Statements and Declarations

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflicts of interest.

Data Availability Statement: All data used in this research are available upon reasonable request.

References

- ¹ Hollister B, Nair P, Hill-Lindsay S and Chukoskie L (2022) Engagement in Online Learning: Student Attitudes and Behavior During COVID-19. *Front. Educ.* 7:851019. doi: 10.3389/educ.2022.851019
- ² Lockee, B.B. (2021). Online education in the post-COVID era. *Nature Electronics*, 4, 5–6. <https://doi.org/10.1038/s41928-020-00534-0>
- ³ Zhang, J., Ding, Y., Yang, X., Zhong, J., Qiu, X., Zou, Z.,... & Wang, Y. (2022). COVID-19's impacts on the scope, effectiveness, and interaction characteristics of online learning: A social network analysis. *PLOS ONE*, 17(8), e0273016. <https://doi.org/10.1371/journal.pone.0273016>
- ⁴ Abuhassna, H., Busalim, A. H., Mamman, B., Yahaya, N., Megat Zakaria, M. A. Z., Al-Maatouk, Q., & Awae, F. (2022a). From Student's Experience: Does E-learning Course Structure Influenced by learner's Prior Experience, Background Knowledge, Autonomy, and Dialogue. *Contemporary Educational Technology*, 14(1), ep338. <https://doi.org/10.30935/cedtech/11386>
- ⁵ Keržič, D., Alex, J.K., Balbontín Alvarado, R.P., Bezerra, D.D.S., Cheraghi, M., Dobrowolska, B.,... & Sobaih, A.E. E. (2021). Academic student satisfaction and perceived performance in the e-learning environment during the COVID-19 pandemic: Evidence across ten countries. *PLOS ONE*, 16(10), e0258807. <https://doi.org/10.1371/journal.pone.0258807>
- ⁶ Moher, D., et al. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ*.
- ⁷ Hassan Abuhassna, Nguyen Thuy Van, Noraffandy Yahaya, Megat Aman Zahiri Megat Zakaria, Fareed Awae, Diaya Ud Deen Al Zitawi, & Kawthar Bayoumi. (2022b). Strategies for Successful Blended Learning—A Bibliometric Analysis and Re-views. *International Journal of Interactive Mobile Technologies (IJIM)*, 16(13), pp. 66–80. <https://doi.org/10.3991/ijim.v16i13.30739>

8. [^]Hassan Abuhassna, Freed Awae, Kawthar Bayoumi, Diaya Uddeen Alzitawi, Ahmed H Alsharif, & Noraffan dy Yahaya. (2022c). *Understanding Online Learning R*

eadiness among University Students: A Bibliometric Analysis. International Journal of Interactive Mobile Technologies (IJIM), 16(13), pp. 81–94. <https://doi.org/10.3991/ijim.v16i13.30605>

Declarations

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.