

Research Landscape of Digital Learning Over the Past 20 Years: A Bibliometric and Visualisation Analysis

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Abstract—The concept of digital learning has grown in popularity significantly over the last few decades especially in the past couple of years due to covid-19. Digital learning is defined as any type of learning that integrated Information and communication technology in its conduct. This study aims to presents a research landscape of digital learning research published in the past 20 years. We conducted a bibliometric analysis to determine the pattern of digital learning published literature from 2002 to 2021. The search for the relevant articles was made on the basis of keywords linked with digital learning in the article's title, abstract, and keywords. As a result, we retrieved 1361 papers from Scopus for bibliometric analysis. The review identifies the publication growth trend, most cited articles, top journals, productive authors, and the leading countries and institutions and major subject areas. According to the findings of our analysis, the United States is the most productive country in terms of publications and citations. Computers and Education is the leading journal. Through the co-occurrence of keywords analysis, we determined that the most significant keywords associated with digital learning are covid-19, online learning, e-learning and digital learning environment, higher education, digital technologies and so on. The highest number of digital learning articles are published under social science domain. The publication growth trend is consistently rising and is projected to continue in the following years, indicating the importance of digital learning in different domain. The study provides a roadmap for future researchers to follow, where they can focus on key areas where success is possible.

Keywords—digital learning, e-learning, m-learning, bibliometric analysis, visualisation, online learning, research trend analysis, covid-19

1 Introduction

From household appliances to organisational applications, information and communication technology has pervaded the worldwide population. As a result, the concept of digital learning has emerged as a novel and practical concept. There isn't much in our life these days that isn't digitised, and the Covid-19 pandemic taught us that more and more can be done online. We've quickly adjusted to online meetings, and virtual learning and the future perspective is exciting in terms of what's conceivable.

Digital learning is defined as any form of learning that actively integrates technology and/or employs instructional practises that successfully utilise technology. It is increasingly being used to supplement both remote education and face-to-face learning activities. Any form of learning that is accompanied by technology or instructional practise that makes efficient use of technology is referred to as digital learning. Digital learning is learning that is supported by technology and allows students to have some control over time, place, pathway, and pace. The words electronic learning (e-learning), mobile learning (m-learning), and digital learning (d-learning) are used interchangeably or in conjunction to refer to technological learning. Electronic learning has also been referred to as "technology-enhanced learning" however the recently the term digital learning has evolved for such learning methods and is often used interchangeably with e-learning [1]. Digital learning is an umbrella term, the broadest term on the list. It means any type of learning that includes using digital technology.

The digital revolution of education systems at all levels has enabled the incorporation of a new teaching–learning environment known as digital learning. The covid 19 has showed the strengths and weaknesses of education systems facing the challenge of digitalization. Distance education has evolved from offline to online settings with the access to internet and COVID-19 has made online learning the common delivery method across the world [2]. As a result of technology advancements, two prominent notions have been used in learning literature: m-learning and e-learning. Sometimes these two concepts have also been used interchangeably. According to [3] m-learning is a subset to e-learning whereby the e-learning is a micro concept which involves as learning environment in online learning and m-learning. The concept of digital learning is relatively new as compared to the other two terms and is still evolving. However, it is now believed that digital learning is a broader notion, and that m-learning and e-learning are subsets of digital learning [4] as shown in Figure 1. In other words, digital learning is the digitization of the complete learning experience, including social learning, electronic learning, virtual meetings with professionals, online tests, mobile learning, blended learning, distance learning, virtual learning, alumni networking, professionalisation workshops, and so on.

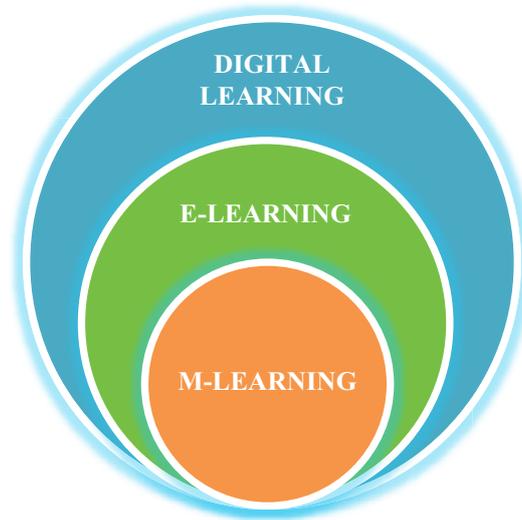


Fig. 1. Digital learning conceptualisation; Source Basak et al., (2018)

2 Literature review

E-learning is “the learning supported by digital electronic tools and media” while m-learning is the “e-learning using mobile devices and wireless transmission” (Hoppe et al., 2003, p.255). While Digital learning is “any type of learning that is facilitated by technology or by instructional practice that makes effective use of technology” and it occurs in all learning areas and domains as previously mentioned.

E-learning is a vast term for transferring knowledge to learners asynchronously or synchronously through the efficient use of ICT [6]. M-learning is a portable and light-weight e-learning platform in which the student is not restricted by geographical locations [7]. E-learning and mobile learning are both subsets of digital learning [8][9]. Digital learning on the other hand is the enhanced e-learning encompasses all online learning methods and technique.

The use of digital technology allows students to learn and attend their lectures without regard for time constraints, as well as have continuous access to the content of their lectures [10]. E-learning enhances global connectivity by linking people from all over the world and eliminating academic institutions’ physical limitations [11]. E-learning provides for the involvement of many students at a cheap cost while also improving the quality of instructional materials at the institutional level. As a result, e-learning has made education more engaging, flexible, and inclusive [12].

The absence of digital learning in any country is expected to be considered as a setback and an indication of the inability of education system to adapt to pandemics such as COVID-19 or any other natural disasters. The amount and quality of e-learning research articles may be a useful predictor of a country's ability to apply and implement e-learning practises [13]. Researchers feel that the use of mobile technologies in education, especially higher education, should be maximised while remaining true to the primary goal of education [14].

Garrison (2016) claims e-learning to be a disruptive technology which is revolutionising the educational setting in which learning is approached [15]. Digital learning is considered as an educational tool capable of transforming the way higher education is provided, and it is growing in popularity in the digital world over time [16]. Nowadays, digital learning is a promising and extensively used mode of education. This calls for a comprehensive review of the literature and its related topics. However, to the best of our knowledge, no research has explored publications about digital learning in the Scopus database using bibliometric analysis.

Bibliometric analysis is the use of mathematical and statistical approaches to assess the academic publication research output in a specific domain [17]. Only a few bibliometric studies have looked into and evaluated research efforts on e-learning in general [18][19][20][13] while other performed the similar analysis on the concept of m-learning [21][22][23][24][25]. Digital learning is still a new concept that has piqued the interest of academicians. The previous bibliometric analysis and review studies on e-learning or m-learning are mentioned in the Table 1 below.

The research objectives focused on this study are as follows:

- RO1: To investigate the topic's influence and research productivity over the past 20 years.
- RO2: To identify the highly cited articles in the digital learning domain.
- RO3: To examine the top contributing journals.
- RO4: To identify the most productive authors, as well as their affiliated organisations and countries.
- RO5: To identify the hot topics in the digital learning domain.
- RO6: To find the citation distribution of publications
- RO7: To perform the bibliometric analysis using co-occurrence of keywords analysis to identify the significant and emerging topics.
- RO8: To perform the bibliometric analysis using co-authorship of countries analysis to examine the collaborative work of different countries in the digital learning field.

3 Methodology

3.1 Data collection

For data collection process we used research articles from Scopus database. The article selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [26], and a bibliometric analysis was

Table 1. Similar studies in the previous literature

No	Author	Title	Duration	Database	Focus	Journal	Type of Study
1	Farheen Mujeeb Khan	A bibliometric analysis of mobile learning in the education sector	Until dec 2020	WOS	m-learning focused on students as learners.	Interactive Technology and Smart Education	bibliometric analysis
2	Idris Goksu	Bibliometric mapping of mobile learning	1991–2019	WOS	m-learning	Telematics and Informatics	bibliometric analysis
3	Siti Zuraidah Md Osman	A Visual Pattern of Two Decades of Literature on Mobile Learning: A bibliometric Analysis	2001 to 2020	Scopus	m-learning	International Journal of Learning, Teaching and Educational Research	bibliometric analysis
4	Sónia Rolland Sobral	Mobile Learning in Higher Education: A Bibliometric Review	2003–2019	Scopus and WOS	m-learning	International Journal of Interactive Mobile Technologies	bibliometric analysis
5		A bibliometric analysis of m-learning from topic inception to 2015	1982–2015	WOS	m-learning	International Journal of Mobile Learning and Organization	bibliometric analysis
6	Jesús Valverde-Berrocoso	Trends in Educational Research about e-Learning: A Systematic Literature Review (2009–2018)	2009–2018	Scopus	e-learning	Sustainability	SLR
7	Waleed M. Sweileh	Global Research Activity on E-Learning in Health Sciences Education: A Bibliometric Analysis	1966–2020	Scopus	e-learning	Medical Science Educator	bibliometric analysis
8	Michail N. Giannakos	Systematic Literature Review of E-Learning Capabilities to Enhance Organizational Learning			e-learning to enhance organizational learning	Information Systems Frontiers	SLR
9	Essohanam Djeki	E-learning bibliometric analysis from 2015 to 2020	2015–2020	WOS	e-learning	Journal of Computers in Education	bibliometric analysis
10	Suman Das	Research Trends of E-Learning: A Bibliometric and Visualization Analysis	1970–2020	Scopus	e-learning	Library Philosophy and Practice	bibliometric analysis

performed to provide a comprehensive and systematic evaluation of the past research on digital learning.

To keep the literature review simple and concise the keywords used in the search string is “Digital Learning” as we consider the concept of e-learning and m-learning are the subsets of digital learning [4]. The search query was run on 13th February 2022. As of 13 February 2022, all articles from Scopus database relating to digital learning were incorporated in the study. For exploring the growth trends in academic and professional literature on digital learning the 2002-to-2021-time window was selected as the time frame for analysis. The resulting articles received were 3492 on which we performed few filters to get the desired number of articles. A total of 3372 articles selected from journals, conference proceedings, reviews and book chapters were identified in the given time frame. We included only journal articles in this study that which were 1468 in total. Out of these 1468 articles only 1361 were published in English language so our final dataset consisted of 1361 article on which the data analysis was performed. The article inclusion and exclusion process are depicted in Figure 2 below.

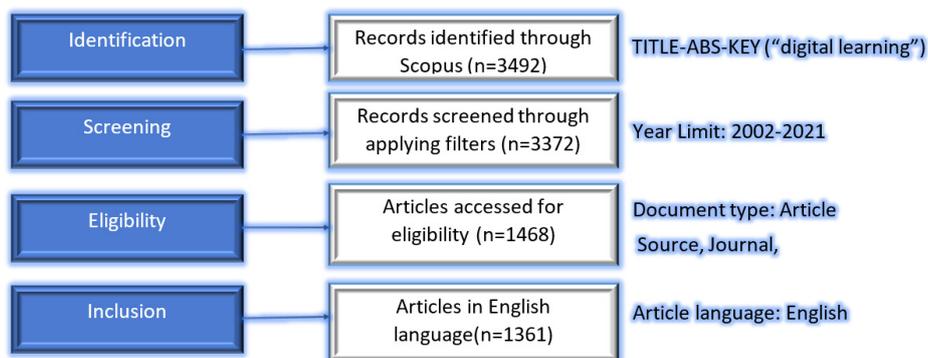


Fig. 2. Search strategy for selecting articles as per PRISMA protocol [26]

3.2 Data analysis

Field experts employ bibliometric analyses to exploit, organise, and analyse material in a certain field in order to evaluate scientific activity on a certain topic [27]. Bibliometric studies are recognized for assisting professionals and academicians in mapping their knowledge of a topic, allowing them to gather information for decision-making and directing future research on the topic. The bibliometric analysis in this review is done with the Vos Viewer software. Many similar studies [28][29][30][13] used Scopus database in the past to conduct bibliometric due to its advantages over other scientific databases like PubMed, google scholar and Web of Science [31] Scopus database was chosen as a research platform because it is one of the most comprehensive databases for journals, books, and conferences in the world, with a vast coverage of articles [32] [33].

4 Results and discussion

4.1 Publication trend

We noticed that the number of publications increased after 2001, so we specifically looked into the number of publications from 2002 onwards, using data from the previous 20 years. The publication trend can be divided into three segments to illustrate the nature of the development. The first is the growth development from 2002 to 2007, when scholars began to take an interest in digital learning and started publishing articles. The second phase of publication growth prevailed from 2008 to 2018, when the number of articles published increased from 20 to 117 per year. The final phase is the saturated growth period from 2019 to 2021 where the publication of articles rose to its maximum of 355 articles per annum. The publication growth charts explain two things vividly that is, digital learning is an emerging area of research and that the trendline of growth implicates that the growth in the articles will continue to rise in future.

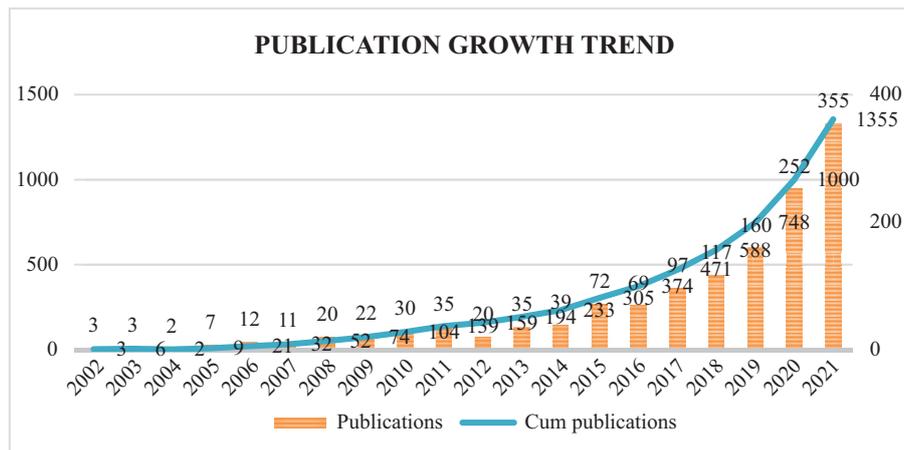


Fig. 3. Publication trend over the past 20 years in digital learning

The research outputs on digital learning have obtained total 1361 documents and 11265 citations in the past 20 years. Figure 4 shows the relationship of published articles with per year citations. With a total citation count of 1605, digital learning garnered the most citations in 2018. It has been noticed that the number of citations in papers has been steadily increasing, particularly after 2017. The year 2021 earned fewer citations than the previous four years, however this is understandable given that it contains several recently published articles.

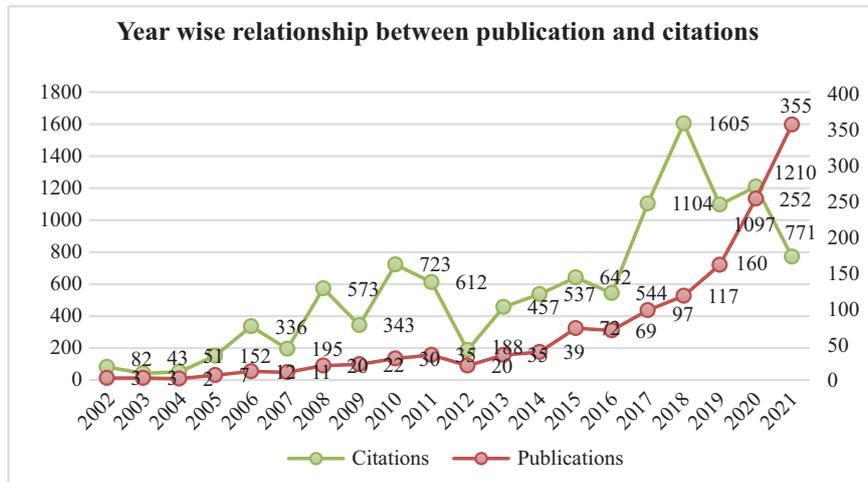


Fig. 4. Year wise relationship between publication and citations

4.2 Top cited articles

The top 3 cited articles on digital learning are “Mitigating the psychological impact of covid-19 on healthcare workers: A digital learning package”, “Predicting secondary school teachers’ acceptance and use of a digital learning environment: A cross-sectional study” and “Gamified learning in higher education: A systematic review of the literature”. The list of top 10 highly cited articles along with their citation count and their source titles are mentioned in Table 2.

Table 2. Top cited articles

Rank	Authors	Title	Year	Source Title	Citations
1	Blake H., Bermingham F., Johnson G., Tabner A.	Mitigating the psychological impact of covid-19 on healthcare workers: A digital learning package	2020	International Journal of Environmental Research and Public Health	191
2	Pynoo B., Devolder P., Tondeur J., Van Braak J., Duyck W., Duyck P.	Predicting secondary school teachers’ acceptance and use of a digital learning environment: A cross-sectional study	2011	Computers in Human Behavior	182
3	Subhash S., Cudney E.A.	Gamified learning in higher education: A systematic review of the literature	2018	Computers in Human Behavior	174

(Continued)

Table 2. Top cited articles (*Continued*)

Rank	Authors	Title	Year	Source Title	Citations
4	Shih J.-L., Chuang C.-W., Hwang G.-J.	An inquiry-based mobile learning approach to enhancing social science learning effectiveness	2010	Educational Technology and Society	166
5	Nokelainen P.	An empirical assessment of pedagogical usability criteria for digital learning material with elementary school students	2006	Educational Technology and Society	125
6	Kim Y., Baylor A.L., Shen E.	Pedagogical agents as learning companions: The impact of agent emotion and gender	2007	Journal of Computer Assisted Learning	121
7	Shih J.-L., Chu H.-C., Hwang G.-J., Kinshuk	An investigation of attitudes of students and teachers about participating in a context-aware ubiquitous learning activity	2011	British Journal of Educational Technology	119
8	Ramasundaram V., Grunwald S., Mangeot A., Comerford N.B., Bliss C.M.	Development of an environmental virtual field laboratory	2005	Computers and Education	111
9	Pokhrel S., Chhetri R.	A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning	2021	Higher Education for the Future	104
10	Kreijns K., Van Acker F., Vermeulen M., Van Buuren H.	What stimulates teachers to integrate ICT in their pedagogical practices? the use of digital learning materials in education	2013	Computers in Human Behavior	94

4.3 Top journals

The number of publications and citations of the publishing journals were compared to see if the publishing journal had an impact on how often the articles were cited. The top 5 journals are mentioned in Table 3. The top journal with most publications is Computer and Education as mentioned by previous researchers [28][34] with 33 publications and 1018 citations. However, the most cited article was “An investigation of attitudes of students and teachers about participating in a context-aware ubiquitous learning activity” published in British Journal of Educational Technology, which is ranked second in the list with 25 publications and total 372 citations. It is not necessary that the most cited article must also belong to the top journal but generally, it is assumed that publication in any of the top five or ten journals may increase the likelihood of being cited.

Table 3. Top journals

Rank	Journal	TP	TC	Cite Score 2020	SJR 2020	SNIP 2020	Publisher	The Most Cited Article	Time Cited
1	Computers And Education	33	1018	3.2	3.026	4.411	Elsevier	Development of an environmental virtual field laboratory	111
2	British Journal of Educational Technology	25	372	7.6	1.790	2.494	Wiley-Blackwell	An investigation of attitudes of students and teachers about participating in a context-aware ubiquitous learning activity	119
3	Educational Technology Research and Development	25	180	5.0	1.346	2.099	Springer Nature	Online discussion compensates for suboptimal timing of supportive information presentation in a digitally supported learning environment	29
4	International Journal Of Emerging Technologies In Learning	20	107	2.6	0.454	1.342	International Association of Online Engineering	Understanding the generation z behavior on D-learning: A Unified Theory of Acceptance and Use of Technology (UTAUT) approach	32
5	Sustainability Switzerland	19	45	3.9	0.612	1.242	Multidisciplinary Digital Publishing Institute (MDPI)	Information and communications technology used in higher education: An empirical study on digital learning as sustainability	10

4.4 Top authors

We have identified top authors who contributed to the field with more publications. We discovered that Lee, J.S. is the top author in the digital learning category, with 12 publications and 130 citations. Kreijns, K. and Vermeulen, M. are ranked second with 8 publications and 240 citations each. It is interesting to note that both Kreijns, K. and Vermeulen are co-authors as well as associated with the same institution. M.Van Buuren, H is the top third author, with 7 articles and 146 citations. Similarly top 5 authors according to their ranking are listed in Table 4 along with their related information such as Scopus ID, total publication (TP), h-index, total citations (TC), current affiliation and country.

Table 4. Top 5 authors in the digital learning field

Rank	Author	Scopus Author ID	TP	h-Index	TC	Current Affiliation	Country
1	Lee, J.S.	57192108958	12	11	130	The Education University of Hong Kong	China
2	Kreijns, K.	6603214240	8	21	240	Open Universiteit, Heerlen, Netherlands	Netherlands
2	Vermeulen, M.	55092455400	8	14	240	Open Universiteit, Heerlen, Netherlands	Netherlands
3	Van Buuren, H.	7005787035	7	11	146	Open Universiteit, Heerlen, Netherlands	Netherlands
4	Hwang, G.J.	7202677655	6	65	411	National Taiwan University of Science and Technology, Taipei, Taiwan	Taiwan
4	Van Acker, F.	23101563800	6	15	177	Vrije Universiteit Brussel, Brussels, Belgium	Belgium
5	Busstra, M.C.	16023715900	5	7	49	Wageningen University & Research, Wageningen, Netherlands	Netherlands

4.5 Leading countries

The results of our findings suggest that total 135 countries contributed to the literature of digital learning. The top three countries actively involved in digital learning research are United States, Germany, and United Kingdom. It is interesting to note that top 10 countries have contributed about 67% in publishing digital learning research. About 27 countries contributed to the literature with just a single publication. Overall, 58 countries have contributed to the digital learning literature with less than 10 publications per country. The US has published 276 articles while Germany and UK have published 101 and 98 articles respectively. They are therefore ranked as the top three most productive countries. Figure 5 shows the top productive countries along with their number of publications.

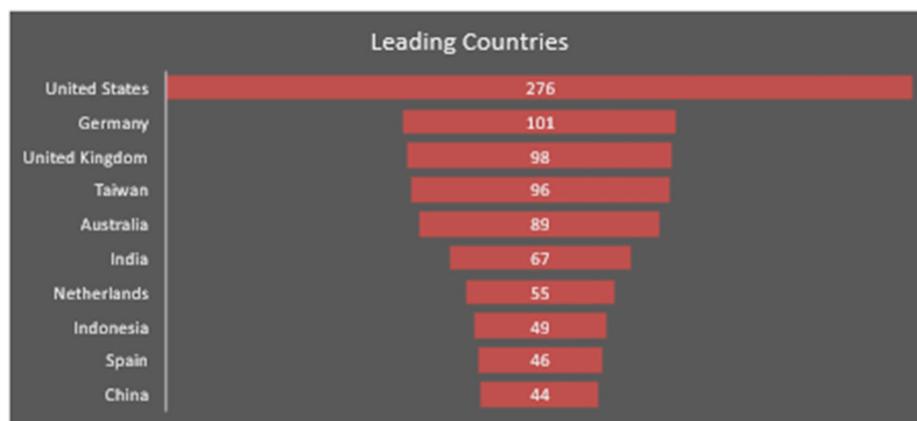


Fig. 5. Leading countries in digital learning research

4.6 Subject area

The social sciences have been the most popular subject area for digital learning publishing (n = 1003, 41.9%), followed by computer science (n = 444, 18.9%), engineering (n = 189, 8.1%), arts and humanities (n = 113, 4.7%), psychology (n = 109, 4.5 percent), medicine (n = 88, 3.7 percent), and business and management (n = 79, 3.4%). The distribution of subject areas is shown in Figure 6.

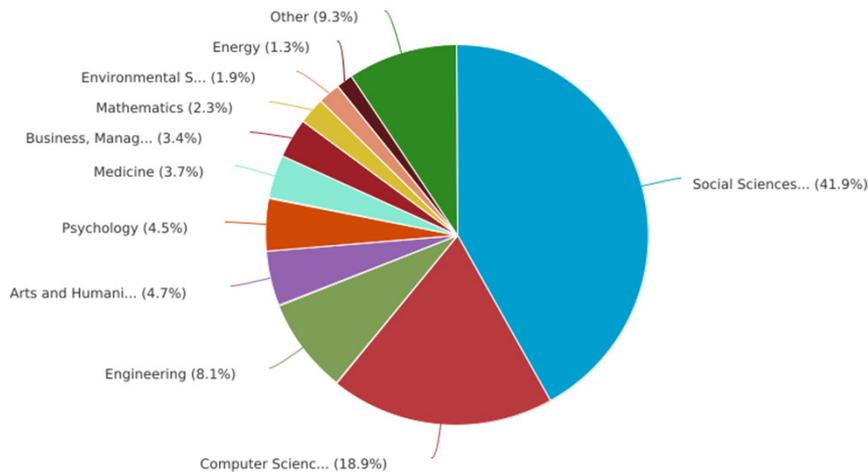


Fig. 6. Subject areas in which digital learning articles are published

4.7 Bibliometric analysis

Keyword analysis. The aim of the keyword analysis is to highlight the most important keywords found in the literature. For keyword co-occurrence analysis, we used VOS viewer. Co-occurrence of keywords map illustrates keyword co-occurrence, which includes keywords that appear in the same document.

In bibliometrics, one common challenge is the allocation of co-authored publications to individual author. various approaches to this problem have been proposed in the context of bibliometric indicator calculation. The two most popular ways are the “full counting method” and the “fractional counting method”. Under the full counting approach, a publication co-authored by five researchers is assigned to each researcher with a full weight of one. In the fractional counting system, each researcher is given a fractional weight of 1/5 for each publication [35]. We used the ‘Full Counting’ method for investigation.

The minimum number of documents per keyword was set to six. This means we examined the co-occurrence of each keyword that appears in this section at least six times. The total number of keywords in our dataset were found to be 3793 of which 109 keywords met the threshold forming 10 clusters. After this a thesaurus was created to merge similar keywords and discard the irrelevant one after which we got 88 keywords. Closely related terms are color-coded and grouped together in the same cluster [36] [37]. The largest set of connected keywords contained 87 keywords forming 6 clusters as shown in Figure 7.

Emerging areas in digital learning research. We have also identified the emerging areas in the digital learning domain where there is still room for further research. This includes topics like computer-based learning, digital storytelling, simulations, digital competence, educational innovation, collaboration, digital learning games, flipped classroom, open educational resources, technology integration, digital learning tools and technologies, gamification, sustainability, digital literacy etc. The study lays out a path for future researchers to follow, allowing them to focus on crucial areas which has received less attention so far.

Countries analysis. We also conducted a co-authorship analysis of countries to determine the level of collaboration between them. To do so we used the ‘full counting’ method. The 1361 documents extracted from Scopus belonged to 135 different countries. We set the criteria for the minimum number of publications per country to 5, as a result, we got 49 countries with a total of 262 links and total link strength of 436 forming 7 clusters. Following that, we grouped and re-clustered all of these countries according to their continents, resulting in a total of five clusters. We re-clustered the countries according to their respective continents, which are Europe (1), Asia (2), America (3), Africa (4), and Oceania (5), to get a simpler and better visualisation. We found that from the complete dataset, 24 countries belonged to Europe, 15 countries were from Asia, 3 items were from America and 3 from Africa, and 2 countries were from Oceania. This indicates that European countries are the most active in digital literature research.

The greater the number of publications generated by a country, the larger the size of its circle; the higher the scale of cooperation, the thicker the connecting line [37]

The results of our analysis revealed that the United States, Germany, United Kingdom, Taiwan, Australia, India, Netherlands, Indonesia, Spain, China, and Canada are the countries with the most publications (Figure 8)

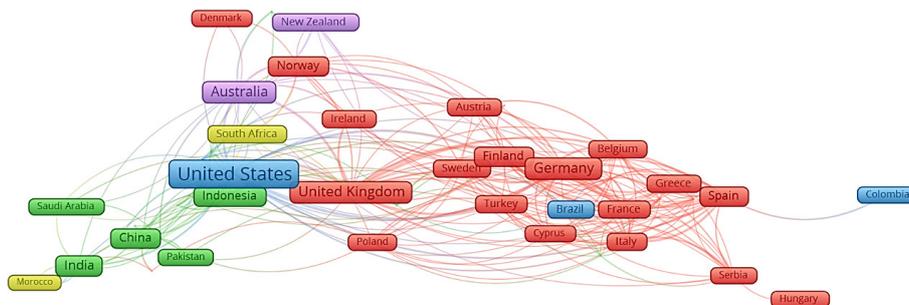


Fig. 8. Network Visualisation view of co-authorship of country analysis; figure available online at URL: <https://bit.ly/34PRFdA>

Authors from the US published 277 documents with 24 different countries and has 30 links with other countries and total link strength (TLS) of 59. Similarly, Germany is the second-largest country with most publications having published 101 documents with 23 other countries and has total link strength of 62. United States published 2 documents each in collaboration with United Kingdom and Germany. The United Kingdom is placed as the third most productive country and has published a total of 98 documents

with 28 other countries having total link strength of 63. The top 20 countries with the most publications are listed in Table 6.

Table 6. Top 20 countries along with the number of published documents and citations is shown in table

Country	Documents	Citations	TLS	Country	Documents	Citations	TLS
United States	277	2842	59	Canada	43	536	17
Germany	101	651	62	Norway	42	357	21
United Kingdom	98	1137	63	Finland	39	419	28
Taiwan	96	1314	18	Russian Federation	36	121	14
Australia	88	734	38	Malaysia	35	145	11
India	67	216	14	Italy	26	125	33
Netherlands	55	715	38	Sweden	25	157	27
Indonesia	49	190	13	Austria	22	142	17
Spain	46	359	47	France	21	221	30
China	44	154	15	Turkey	20	77	19

We also examined the distribution of publication and citations by country as shown in Figure 9. It is evident from the figure that United States has the highest publications (n = 277) and citations (n = 2842). Germany has 101 publications with 651 citations and the United Kingdom has 98 publications with 1137 citations. However, it has been noticed that the highest number of publications does not always correlate with the number of citations as is the case with Germany which has more publications than the UK but has significantly fewer citations.

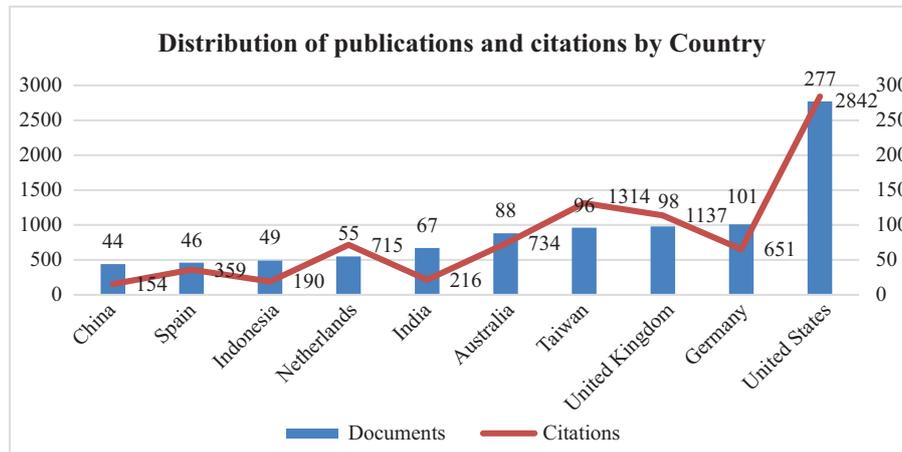


Fig. 9. The distribution of publication and citations by country

It is worth noting that Estonia, Morocco, Egypt, Colombia, Hungary, Serbia, Kazakhstan, Latvia, Pakistan, and Ukraine are some of the least productive countries

in terms of publications as well as collaborative research on digital learning. Scientific collaboration is seen as a vital component for boosting the quality and impact of research. The results of this analysis will allow researchers to fill the gaps in the existing literature and broaden their efforts in future studies. Countries with lower level of interest in digital learning publications are shown in the Table 7.

Table 7. Countries with lowest publications in digital learning research

Country	Documents	Citations	TLS	Country	Documents	Citations	TLS
Estonia	5	37	14	Kazakhstan	7	5	3
Morocco	5	5	1	Latvia	7	74	3
Colombia	6	32	2	Serbia	7	63	21
Egypt	6	32	5	Pakistan	8	59	5
Hungary	6	16	1	Ukraine	8	15	4

5 Conclusion

The study’s findings will help academics obtain a better understanding of the global impact of digital learning. Through quantitative technique analysis, bibliometric study highlights the core journals, top authors, top keywords, top publishing country, highly cited article, co-occurrence map of terms, co-citations map, and so on. The research outputs on digital learning have obtained total 1361 documents and 11265 citations in the past 20 years. The highest number of citations were garnered in 2018 with 1605 total citations. Articles in the digital learning area garnered the most citations in 2018, with 1605 total. The publication trend has grown over years and is expected to continue further. The highly cited articles have been identified so is the most productive authors, journals and countries. Approximately 42% of papers in the digital learning literature are from the social sciences, while 18.9% are from the computer science sector. The article by Blake et al., (2020) titled as “Mitigating the psychological impact of covid-19 on healthcare workers: A digital learning package” is the highly cited article with 191 total citations. Computers And Education is the most productive journal with most publications (33 publications) in the digital area domain. Lee J.S is the most prolific author with 12 publications in the said field. The US, Germany and UK are the top three countries actively involved in the publication of digital learning research. The most significant keywords in the Digital Learning published literature are Covid-19, E-Learning, Online Learning, Digital Learning Environment, Digital Technologies, Distance Learning, M-Learning, Student Engagement, Blended Learning. The countries most actively involved in collaborative research are United Kingdom, Germany, United States, Spain and Netherlands

5.1 Limitations and future directions

The scope of the data collection was limited to the Scopus database. Future research should compare the findings of different databases, such as Scopus and Web of Sciences. In this research, VOS viewer was utilised as a bibliometric tool to perform various

forms of analysis. Future research studies could expand on this one by combining other cutting-edge bibliometric tools, such as Publish or Perish, Citespace, Bib Excel, and RStudio, among others, for improved visualisation and thorough analysis. In addition to co-authorship and co-occurrence analysis, future research could include co-citation and bibliographic coupling.

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