January 2019

E-learning Research Papers in Web of Science: A Biliometric Analysis

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Abstract

Purpose – The paper aims to explore and identify the trends in E-Learning research at the global level.

Design/methodology/approach – The data were collected from the Web of Science database covering the period from 1989- 2018 in order to identify substantial contributions that have been published in the field of E-Learning. A total of 9826 records were retrieved. The data was analyzed to reveal different trends prevailing in E-Learning research including prominent contributing countries, authorship patterns adopted, the degree of collaboration, collaborative index, prominent sources for publication of research, visibility of research in term of citation trends like citations received/citations per paper etc.

Findings –The analysis revealed a positive growth in literature. It is clear that USA and UK have contributed to more than half of the research output with PEI of 1.07 and 1.45 respectively. Computers & Education and Journal of Chemical Education were the two most used journals. The study also found out that Bradford's Law of scattering does not hold good to the journals cited in the three journals

Keywords–E-Learning, Bibliometrics, Web of Science

Introduction

Since the main insightful paper in electronic-learning, or e-learning, showed up in 19671, and as indicated, by Social Science Citation Index (SSCI) database investigations of the conceivable outcomes of e-learning have seen an overwhelming advancement, particularly over the most recent fifteen years attributable to the Information and Communication Technology (ICT)(Chiang, Kuo, & Yang, 2010). The analysis of the improvements in ICT-based e-learning was from 1996 to 2002, contended that e-learning in began in 1996 and achieved its top in 2000(Kruse, 2002). The term e-

learning has numerous definitions. Some allude to e-learning as either bundled substance pieces or specialized frameworks; some view it as non-concurrent to independent learning; while still others see e-learning as asynchrony for shared learning(Chiang et al., 2010). However, it has been considered as a novel type of learning (Nicholson, 2008) that uses the qualities of the Internet to give synchronous or offbeat connection, showing materials, and customized projects to different groups(Tibaná-Herrera, Fernández-Bajón, & De Moya-Anegón, 2018). This technique for learning energizes learning outside the four divider classrooms and dismissal time span for learning as it is the situation in a classroom framework. It is a type of discovering that gives the opportunity of independent and free learning. Numerous individuals hold the view that e-learning is the bedrock of long-lasting learning (LLL). The act of e-learning is making a noteworthy commitment towards the advancement, flawlessness, development, refinement and viable routine with regards to long-lasting learning. The encounters acknowledged the reason for honing e-learning exercises, reinforce the long-lasting learning among numerous various networks over the globe(Harande & Ladan, 2013).

Bibliometrics is an examination strategy that deals about nature and way on which data is displayed quantitatively. It is very adaptable and applicable strategy that could be used in assessing, blending and examining both printed and non-printed wellsprings of data(Harande & Ladan, 2013). It is defined as the application of mathematical and statistical methods to measure the research output of scholarly publications (Mattsson, 2008). The bibliometric examination is a significant device for the scientific network since it offers components to break down science and innovation approaches (Okubo, 1997). In addition, they give estimations of connections among analysts and research regions through the statistical investigation of joint publications and citations (Mingers & Leydesdorff, 2015). Usually bibliometric investigation yields publication pattern, authorship trends, citations, prime journals and other parameters (Hazarika, Goswami, & Das, 2003). Similarly, the main aim of this study is to examine the research output of e-learning using bibliometric indices.

Literature Review

Various bibliometric studies have been carried out in the field of educational sciences (Diem & Wolter, 2013; Ivanović & Ho, 2017; Lin, Lin, & Tsai, 2014; Lopes, Faria, Fidalgo-Neto, & Mota, 2017; Perry, 2018) and only very few are focusing on the e-learning literature. Shih, Feng, and

Tsai (2008) did a content analysis of five journals in the area of e-learning indexed in the Social Science Citation Index from 2001-2005. They identified Instructional Approaches, Learning Environments and Meta-Cognition as popular research topics. Utilizing a blend of bibliometric indicators and examination methods, this investigation by Tibaná-Herrera et al.,(2018) has classified e-learning as a developing order on the world arrangement of scientific productions, comprising of 64 descriptors and 219 journals and congresses listed by Scopus between 2012 and 2014. Accordingly, it was resolved that the arrangement of 219 productions demonstrate a high bibliometric interrelation among its articles and these are displayed chiefly in the sociologies and transversally between computer science and health profession. In analysing the growth and development of e-learning literature in Nigeria, Harande & Ladan, (2013) found that e-learning publications have recorded some huge development in Nigeria. In light of the discoveries of the examination, one can reason that, the e-learning literature in Nigeria is accepting huge consideration from the researchers and scientists. Tibaná-Herrera, Fernández-Bajón & De-Moya-Anegón(2018) analysed the output, impact and collaboration of 39,244 documents related to e-learning, indexed in the Scopus database from the period 2003-2016. The results demonstrated that at the country level, the United States create a greater part of the works and produced the best worldwide collaborative effort. At the institutional level, the University of Hong Kong is the most productive and the National Taiwan University of Science and Technology is the one with the best joint effort. Moreover, the investigation demonstrated that Taiwan positions first in productivity and effect, or, in other words, connected these outcomes to a concise examination of its national approaches. This investigation exhibits another technique to break down both rising and built up learning areas. Chiang et al., (2010) analysed the distributing patterns of e-learning publications classified in SSCI database amid 1967-2009. They found out that the amount of ongoing exploration on e-learning is extending astoundingly; the recurrence lists of authors efficiency don't seem to comply with Lotka'sLaw, most research papers on e-learning are created by different origin and utilization of e-learning have most found in research regions such as Education and Educational Research, Information Science and Library Science, also, Computer Science/Interdisciplinary applications.

Objectives

The main objective of the present study is to find the growth of E-Learning literature published during 1989-2017 as per the Web of Science database and make the quantitative and qualitative assessment by way of analyzing various features of research output such as growth of publications, citations, authorship pattern, degree of collaboration, collaborative index, collaborative coefficient, highly cited journals, average citation per paper, etc.

Design/methodology/approach – The data was the study was collected from the Web of Science database from SCI-EXPANDED covering the period from 1989- 2017. A total of 9826 records were retrieved using the terms "electronic learning" or "e-learning" or "online learning" or "internet learning" or "distributed learning" or "networked learning" or "tele learning" or "virtual learning" or "computer assisted learning" or "web-based learning" or "distance learning". The analysis was done only on 8751 titles, as we focused only on research papers, reviews and conference proceedings papers. The data was further analyzed to reveal different trends prevailing in E-Learning research including most productive countries, authorship pattern, the degree of collaboration most cited papers etc.

Data analysis

Annual Publication output of E-Learning

Figure 1 displays the block-wise time period, number of publications and citations received in each block year. Consistent with each block year, the number of paper published gets a positive growth. A maximum number of articles was published in 2013-17 block year with 3497 articles and 22804 total citations (6.52 citations per paper) which was followed by 2008-12 block year with 2620 articles and 50151 total citations (19.14 citations per papers). Average citation per paper is calculated by dividing the number of citations with no. of papers. There were 8751 articles altogether with an average of 13.59 citations per articles. Research on E-learning was least in the year 1989 i.e. only 4 articles but year by year it grows positively the reason for the growth of the research is the development of information and communication technology.

Figure 1: Year-Wise Output

Block Years	Total Citation	Total Papers	ACPP

1989-1992	342	52	6.58
1993-1997	2788	228	12.23
1998-2002	11390	639	17.82
2003-2007	31463	1715	18.35
2008-2012	50151	2620	19.14
2013-2017	22804	3497	6.52
Total	118938	8751	13.59

Country Wise Analysis

Spanning 29 years of e-learning research, table 2 shows the breakdown of PEI of different countries. It is found that US has contributed to a maximum number of papers (3651) with 53046 citations, followed by UK (2351 papers) with 46283, Netherlands (841 articles) with 11981 citations. Together US and UK has contributed 6002 papers which is about 70% of world output. An attempt has been made to identify the Publication Efficiency Index of Most cited countries. PEI measures the quality of a research (Guan and Ma, 2007). PEI is calculate by using the formula:

$$PEI = \frac{TNC_i/TNC_t}{TNP_i/TNP_t}$$

Where

TNCi= Total number of citations of country i.

TNCt= Total number of citations of all countries.

TNPi= Total number of papers of country i.

TNPt= Total number of papers of all countries.

If the value of PEI is more than 1 it shows a greater impact of publication than the research efforts devoted to it. The three countries UK, US and Netherlands have the PEI of more than 1 which means that their publications have more impact. The UK had the highest PEI (1.45) followed by the US with 1.07, Netherlands with 1.05. A PEI of less than 1 means publication has less impact

than efforts devoted to its publication. As is observed from the table, the rest of the countries have less than 1 PEI which means that their publication doesn't have a greater impact.

S. NO.	Country	Total Citation	Total papers	PEI
1	USA	53207	3691	1.06
2	UK	46283	2351	1.45
3	Netherlands	11981	841	1.05
4	Germany	2165	693	0.23
5	Ireland	662	129	0.38
6	Switzerland	499	109	0.34
7	Egypt	714	96	0.55
8	Japan	296	96	0.23
9	Austria	421	85	0.36
10	Romania	216	71	0.22

Most Cited Journals

In every field, there are few journals which are the most productive. They produce most of the research papers. In the field of e-learning there are also core journals which are listed below. A total of 2022 journal has contributed to 8751 research papers and top ten journals has contributed to 1270 research papers. It was found that Computers & Education was the top journal with total publications of 610 titles, with 25038 citations followed by the Journal of Chemical Education with 204 papers and 1176 citations and International Journal of Engineering Education with 152 papers and 798 publications.

S. No.	Row Labels	TC	TP	ACPP	h-index	IF	Country
1.	Computers & Education	25038	610	41.05	134	4.538	UK
2.	Journal Of Chemical Education	1176	204	5.76	65	1.758	US

3.	International Journal Of Engineering Education	798	152	5.25	41	0.77	Ireland
4.	Expert Systems With Applications	2863	129	22.19	145	3.768	UK
5.	Medical Teacher	1726	112	15.41	86	2.45	UK
6.	Computer Applications In Engineering Education	776	112	6.93	22	1.153	US
7.	IEE Transactions On Education	2286	111	20.59	57	1.6	US
8.	Nurse Education Today	1335	111	12.03	60	2.067	UK
9.	BMC Medical Education	771	111	6.95	48	1.938	UK
10.	Neurocomputing	1851	97	19.08	100	3.241	Netherlands

Authorship pattern

An attempt has been made to analyse the authorship pattern in the field of e-learning. It is observed from the table that a maximum number of single-authored paper has been published in 2013-17block years which was followed by the block year 2008-12. In terms of more than one author, it was found that all authorship pattern follows a similar trend of positive growth in all block years. The degree of collaboration was calculated by using Subramanyam's formula. Subramanyam, (1983) proposed a mathematical formula for calculating author's degree of collaboration in a discipline. The degree of collaboration shows the ratio of the number of multi-authored papers published to the total number of papers published in a discipline over a period of time. The degree of collaboration among authors is measured mathematically as:

C= Nm/ (Nm+Ns), where:

C = degree of collaboration.

Nm = number of multi-authored works.

Ns = number of single-authored works.

For calculating the collaborative index, the following formula was used (Lawani 1980):

$$CI = \frac{\sum_{j=1}^{A} jf_j}{N}$$

And collaboration coefficient was calculated by using (Ajiferuke, 1988):

$$CC = 1 - \frac{\sum_{j=1}^{A} (1/j)f_j}{N}$$

The strength and extent of collaboration in E-learning research were further analysed by collaboration coefficient, the degree of collaboration and collaboration index. Degree of collaboration and collaboration coefficient was highest in the block year 2013-17 whereas collaboration index was highest in 1989-1992 years block. The analysis shows that there is growth in the three indices during the period under study which indicates an increasing trend of collaborative learning in the field of E-Learning.

Block Years	Single author paper	Two authored paper	Three authored paper	Four authored paper	Five authored paper	More than five authored paper	Total Papers	Sum of TC	Degree of Collaboration	Collaboration Coefficient	Collaboration Index
2013-17	259	711	858	604	429	636	3497	22804	0.93	0.64	1.08
2008-12	311	607	663	477	246	316	2620	50151	0.88	0.60	1.13
2003-07	238	469	422	284	145	157	1715	31463	0.86	0.57	1.16
1998-2002	157	184	145	84	29	40	639	11390	0.75	0.48	1.33
1993-97	69	76	40	25	5	13	228	2788	0.70	0.43	1.43
1989-1992	18	17	9	3	1	4	52	342	0.65	0.40	1.53

Core authors

on enquiring about core authors it was found that Lin, Faa-Jeng had contributed a maximum number of articles (22) with a total citation of 350 which was followed by Cook, David A (14 articles) with 560 citations, Lin, Chih-Hong (11 articles) 25 citations.

S. NO.	Row Labels	Total Papers	Total Citations	ACPP
1.	Lin, Faa-Jeng	22	350	15.91
2.	Cook, DavidA.	14	560	40.00
3.	Lin, Chih-Hong	11	25	2.27
4.	Chen, Chih-Ming	9	508	56.44
5.	Jeong, Hwa-Young	9	51	5.67
6.	Chen, Hung-Yi	8	28	3.50
7.	Dewhurst, D	7	32	4.57
8.	Hazan, Elad	7	125	17.86
9.	Tekin, Cem	7	69	9.86
10	Cook, DA	6	513	85.50

Core Areas

Results of the study show that computer science is the most researched area in the field of e learning. Researchers have published 6566 research papers on computer science which was followed by Education & Educational Research (2004 papers), Engineering (940 papers), Automation & Control Systems (833 papers) and chemistry (530 papers).

s. no.	Row Labels	Total count

1.	Computer Science	6566
2.	Education & Educational Research	2004
3.	Engineering	940
4.	Automation & Control Systems	833
5.	Chemistry	530
6.	Health Care Sciences & Services	375
7.	Nursing	276
8.	Dentistry, Oral Surgery & Medicine	206
9.	General & Internal Medicine	173
10.	Public, Environmental & Occupational Health	153

Most Cited Articles

S. No.	Authors Name	Title	Journal	Year Of Publication	Total Citation
11.	Amari, Shun-Ichi.	Natural gradient works efficiently in learning.	Neural computation	1998	1043
12.	Mairal, Julien, et al.	Online learning for matrix factorization and sparse coding.	Journal of Machine Learning Research	2010	1027
13.	Sun, Pei-Chen, et al.	What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction.	Computers & education	2008	633
14.	Ruiz, Jorge G., Michael J. Mintzer, and Rosanne M. Leipzig.	The impact of e-learning in medical education.	Academic medicine	2006	626
15.	Duchi, John, EladHazan, and Yoram Singer.	Adaptive subgradient methods for online learning and stochastic optimization.	Journal of Machine Learning Research	2011	614
16.	Angelov, Plamen P., and Dimitar P. Filev.	An approach to online identification of Takagi-Sugeno fuzzy models.	IEEE Transactions on Systems, Man, and Cybernetics, Part B	Cybernetics	519

17.	Piccoli, Gabriele, Rami Ahmad, and Blake Ives.	Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training.	MIS Quarterly	2001	473
18.	Gu, Bin, et al.	Incremental support vector learning for ordinal regression.	IEEE Transactions on Neural networks and learning systems	2015	417
19.	Tzeng, Gwo-Hshiung, Cheng-Hsin Chiang, and Chung-Wei Li.	Evaluating intertwined effects in e-learning programs: A novel hybrid MCDM model based on factor analysis and DEMATEL.	Expert systems with Applications	2007	405
20.	Shadmehr, Reza, and Thomas Brashers-Krug.	Functional stages in the formation of human long-term motor memory.	Journal of Neuroscience	1997	404

Conclusion

This paper tries to identify the research trends in the discipline of E-Learning during 1989-2017. Based on the data retrieved from Web of Science, authors analyzed Year-Wise Output, Most productive Countries, most used journals, and authorship pattern journals etc. There is a positive growth in literature. It is clear that USA and UK have contributed to more than half of the research output with PEI of 1.07 and 1.45 respectively. Computers & Education and Journal of Chemical Education were the two most used journals. The number of papers with two or more authors has grown steadily in all block years during 1989-2017 but papers with one author were fewer in all the block years. Further, about one-third of the total cited references were from 11 journals only and rest two third were scattered in more than 1600 journals. The study also found out that Bradford's Law of scattering does not hold good to the journals cited in the three journals. Based on the reference analysis of the appended articles, it can also be concluded that the field of commerce is highly multidisciplinary as it integrates knowledge from several fields like business and management, economics, psychology and so on.

References

Chiang, J. K., Kuo, C. W., & Yang, Y. H. (2010). A bibliometric study of e-learning literature on SSCI database. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. https://doi.org/10.1007/978-3-642-14533-9_15

Diem, A., & Wolter, S. C. (2013). The Use of Bibliometrics to Measure Research Performance in Education Sciences. *Research in Higher Education*. https://doi.org/10.1007/s11162-012-9264-5

Harande, Y. I., & Ladan, B. F. (2013). *A Bibliometrics Study on E-Learning Literature of Nigeria*. *Journal of Education and Human Development* (Vol. 2). Retrieved from www.aripd.org/jehd

Hazarika, T., Goswami, K., & Das, P. (2003). Bibliometric Analysis of Indian Forester: 1991-2000. Retrieved from http://eprints.rclis.org/5828/

Ivanović, L., & Ho, Y. S. (2017). Highly cited articles in the Education and Educational Research category in the Social Science Citation Index: a bibliometric analysis. *Educational Review*. https://doi.org/10.1080/00131911.2017.1415297

Kruse. (2002). The State of e-Learning: Looking at History with the Technology Hype Cycle. Retrieved October 26, 2018, from http://www.e-learningguru.com/articles/hype1_1.htm

Lin, T. C., Lin, T. J., & Tsai, C. C. (2014). Research Trends in Science Education from 2008 to 2012: A systematic content analysis of publications in selected journals. *International Journal of Science Education*. https://doi.org/10.1080/09500693.2013.864428

Lopes, R. M., Faria, D. J. G. dos S. de, Fidalgo-Neto, A. A., & Mota, F. B. (2017). Facebook in educational research: a bibliometric analysis. *Scientometrics*. https://doi.org/10.1007/s11192-017-2294-1

Mattsson, P. (2008). Bibliometrics as a tool for research evaluation, (5), The euroscience.

Mingers, J., & Leydesdorff, L. (2015). A review of theory and practice in scientometrics.

European Journal of Operational Research. https://doi.org/10.1016/j.ejor.2015.04.002

Nicholson, P. (2008). A history of E-Learning: Echoes of the pioneers. In *Computers and Education: E-Learning, From Theory to Practice*. https://doi.org/10.1007/978-1-4020-4914-9_1

Okubo, Y. (1997). Bibliometric Indicators and Analysis of Research Systems: Methods and Examples. *OECD Science, Technology and Industry Working Papers*. https://doi.org/http://dx.doi.org/10.1787/208277770603

Perry, L. B. (2018). Assessing the performance of educational research in Australian universities: an alternative perspective. *Higher Education Research and Development*. https://doi.org/10.1080/07294360.2017.1355893

Tibaná-Herrera, G., Fernández-Bajón, M.-T., & De-Moya-Anegón, F. (2018). Output, collaboration and impact of e-learning research: Bibliometric analysis and visualizations at the country and institutional level (Scopus 2003-2016). *El Profesional de La Información*. https://doi.org/10.3145/epi.2018.sep.12

Tibaná-Herrera, G., Fernández-Bajón, M. T., & De Moya-Anegón, F. (2018). Categorization of E-learning as an emerging discipline in the world publication system: a bibliometric study in SCOPUS. *International Journal of Educational Technology in Higher Education*. https://doi.org/10.1186/s41239-018-0103-4