

# Educational Technology Research Trends: A Bibliometrics Analysis And Visualization

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## Educational Technology Research Trends: A Bibliometrics Analysis And Visualization

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**Abstract:** Educational Technology has been developing in recent years. The implementation of educational technology has collaborated in several fields such as social sciences, computer science, engineering, and medicine. In this study, the researcher has conducted a bibliometric analysis of educational technology research during the period 1971 to 2019. A total of 8,134 bibliographic data have collected from the Scopus database. VOSviewer software are used for analysis. In the bibliometric analysis, various extracted metadata include journals and affiliations, citations, keyword distribution, many cited papers, and the most influential authors and journals. This study shows the development status and trends in educational technology. On the other hand, this study can be used as a reference for research and application of bibliometric analysis

**Keywords:** bibliometrics analysis, educational technology, scopus.

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### 12 1. INTRODUCTION

The development of information and communication technology massively correlates to the increase in digital data. We live in a world where vast amounts of data are collected every day. Analyzing the data is an essential requirement. One of the digital data is publication data. Data can be collected and explored using a technique called data mining. Data mining is the process of finding interesting patterns and knowledge from a large amount of data. Data sources can include databases, data warehouses, the Web, other information repositories, or data that is streamed to the system dynamically (Han, J., Kamber, M., & Pei, J., 2012). In this study, researchers conducted educational technology research data mining.

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At present, the role of educational technology in teaching is very important because of the use of information and communication technology [Stošić, L. (2015)]. Education digitalization has an expanded meaning, with the help of digital solutions and information systems, student access to the best university education resources in the world, to remote data from the results of scientific experiments and research, to the library of tasks and technical problems, and the creation of a workforce team, distributed research and education [3]. Educational technology is a systematic and organized process in applying modern technology to improve the quality of education (efficiency, optimal, correct, etc.). This is a systematic way to conceptualize the implementation and evaluation of the educational process, i.e. learning and teaching, and assisting in the application of modern educational teaching techniques [2]. Learning outside the classroom is also possible because of technology. Students are no longer limited to face-to-face learning because technological advances have allowed students to choose whether they want to attend classes either face-to-face or through online or both [4].

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The main contribution of this study is a bibliometric analysis using one of the most widely used databases, Scopus. Bibliometrics is the cross-disciplinary science of quantitative analysis of all knowledge carriers by mathematical and statistical methods [5]. The researcher selects significant parameters such as the most

productive writer, the most influential writer, the most quoted discipline, state, and affiliation. We have shown the top 10 in each parameter. The most common keywords from this field are visualized using VOSviewer. This paper is organized as follows: Section 2 explains the data collection process and the methods used in this paper. The results of a detailed bibliometric analysis are carried out in Section 3. The final section concludes the paper by summarizing the results.

This research has the main objective of analyzing quantitative and visual to comb the existing literature and get accurate results for the development of educational technology research and future research trends. This study has approved quantitative research based on bibliometric analysis and knowledge mapping with the support of Scopus, Publish or Perish, and VOSviewer databases.

## 2. METHODS

In this study, we have collected bibliometric data from one of the most commonly used repositories, Scopus. Scopus (<http://www.scopus.com/home.url>) is an abstract and citation database of peer-reviewed literature and also part of SciVerse provided by Elsevier as described in the section before and therefore based at the same database as ScienceDirect [6]. The results from this database have been summarized according to information regarding the development of the publication. The keywords that have been used for searching in the Scopus database are TITLE-ABS-KEY ("educational technology") AND (LIMIT-TO (EXACTKEYWORD, "Educational Technology") OR LIMIT-TO (EXACTKEYWORD, "Educational Technologies ")) AND (LIMIT-TO (DOCTYPE, "ar ") OR LIMIT-TO (DOCTYPE, "cp ")) and a search was carried out in April 2020. From Scopus, we took several tags such as author, title, abstract, country, citation notes, author affiliations etc. and obtained 8,134 documents. From the documents extracted in Scopus classified into Article (4,133) and conference paper (4,001).

In this paper, various performance indicators have been extracted for bibliometric analysis. Total Papers for the total number of publications from the source, Total citations to find out the total number of citations received by the publication, and citation per paper to find out the total number of citations received divided by the total publications. The bibliometric method, which is used in this research, takes advantage of modern technology in computer engineering, database management, and statistics. The bibliometric method can assess future development trends or research orientations using the author's keywords, title keywords, and plus keywords [7]. Until now, bibliometrics has been widely used in the analysis of co-authorship, co-citation analysis, and development of all fields [8]. The bibliometric approach, together with VOSviewer software, is used to quantitatively evaluate global scientific research on educational technology from 1971 to 2019.

## 3. RESULTS

Bibliometric or Scientometric Analysis is a field of research that helps analyze the latest trends in the literature about a particular area and provides guidance and motivation for future research work [9]. The scientific field is the study of science, technology, and innovation from a quantitative perspective. The scientometric perspective adds a quantitative focus on text and communication to interdisciplinary science and technology [10]. In this section, we have shown bibliometric results for various performance parameters including documents by year, documents by author, documents by affiliation, documents by country, documents by source title, documents by subject area, most productive and highly cited authors, most sought after disciplines, and top journals.

### 3.1. Most Productive Country

A total of 8,134 articles were published by authors from 124 countries/regions. Figure 1 shows the total number of publications in Scopus. In Scopus, publication began in 1971 with a total of 1 document and increased exponentially. The highest number of publications is 2019 with 963 documents. The number of documents by country is shown in Figure 2. Figure 2 shows a map of the top 10 countries that contributed research on gamification. Based on figure 2, the United States is the top contributor with 2,248 documents (27.64%). The rapid growth of educational technology in the United States shows a clear impact on improving the quality of education in America. China and Australia contributed the second and third with 703 documents (8.64%) and 569 documents (7%) respectively. At present, technological developments in China are increasing. The development of technology in China reached the field of Education. In China, educational technology is an

important part of content for teacher professional development. Almost all universities in China offer technology courses for prospective teachers and school teachers for further study [11]. United Kingdom and Spain each contribute with a number of important publications from the total literature.

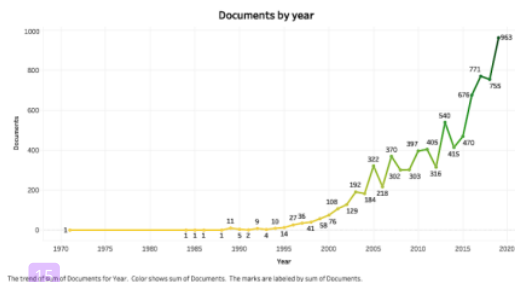


FIGURE 1. Total number of publications in Scopus

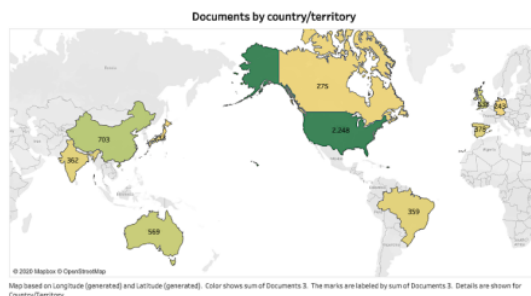


FIGURE 2. Top 10 most productive country

### 3.2. Most Productive Affiliation And Subject Area

Figure 3 shows the top 10 most productive based on affiliation. Based on the data it can be concluded that the five most significant contributors in educational technology research are Huazhong Normal University 114 documents (1.40%), Universidade de Sao Paulo 63 documents (0.77%), University of Melbourne 55 documents (0.67%), Monash University 45 documents (0.55%), and The Open University of Hong Kong 43 documents (0.52%). On the other hand, documents based on the subject area are shown in Figure 4. Based on the data obtained by the five most significant contributors in the subject area namely Social Sciences 4.172 documents (51.29%), Computer Science 3.954 documents (48.61%), Engineering 1,511 documents (18.57%), Medicine 1,335 documents (16.41%), and Mathematics 529 documents (6.50%).

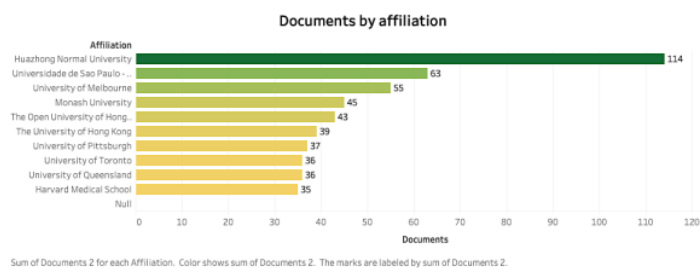


FIGURE 3. Top 10 most productive affiliation

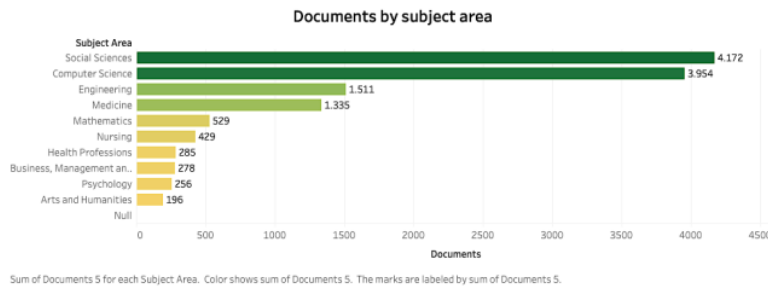


FIGURE 4. Top 10 subject areas covered by educational technology

### 3.3. Most Productive And Highly Cited Authors

The number of citations is a significant factor to reflect the quality of publications [12]. The most productive authors in Scopus are sorted by number of publications. We analyzed the data using Publish or Perish software. Publish or Perish can do a quick literature review to identify the most cited articles in a particular field. This can be used to identify whether research has been conducted in a particular area or to evaluate the development of literature on a particular topic from time to time [13]. From Table 1, the five most productive writers are Liu, H. (1.37%), Zhang, Z. (0.47%), Ellaway, R. (0.38%), Yang, H.H. (0.30%), and Shu, J. (0.22%). On the other hand, Liu, H. and Ellaway, R. are the most cited writers. Skiba, D.J., Ng, K.K., and Shu, J. are positioned in 3rd, 4th and 5th place on the list.

Table 1. Top 10 most productive and highly cited authors

Author Name	Paper	Citations	Cites/year	Cites/paper
Liu, H.	112	1,403	73.84	12.53
Zhang, Z.	39	99	6.19	2.54
Ellaway, R.	31	517	34.47	16.68
Yang, H.H.	25	71	6.45	2.84
Shu, J.	18	151	7.95	8.39
Skiba, D.J.	16	269	16.81	16.81
Lai, I.K.W.	16	19	4.75	1.19
Ng, K.K.	15	40	8.00	2.67
Peres, H.H.C.	13	68	5.23	5.23
Kaneda, S.	11	18	1.20	1.64

### 3.4. Top Source/Journal

In this section, we have extracted the top ten most productive sources or journals in the field of educational technology. The top sources or journals most frequently cited in the field of educational technology were analyzed using Publish or Perish software. A summary of the ten most frequently published analyzes or journals are shown in Table 2. ACM International Conference Proceeding Series (3.23%), Ceur Workshop Proceedings (2.36%), Communications in Computer and Information Science (2.23%), Lecture Notes in Computer Science (1.97%), and British Journal of Educational Technology (1.76%).

Table 2. Top 10 journals publishing works on educational technology

Source/Journal Name	Paper	Citations	Cites/year	Cites/paper
• ACM International Conference Proceeding Series	263	401	28.64	2.01
• Ceur Workshop Proceedings	192	242	17.29	1.21
• Communications in Computer and	182	198	23.58	1.43

Source/Journal Name	Paper	Citations	Cites/ year	Cites/ paper
Information Science				
• Lecture Notes in Computer Science	161	829	27.63	4.15
• British Journal of Educational Technology	149	6310	134.26	31.55
• Journal of Dental Education	123	1957	65.23	10.81
• Computers and Education	94	11303	403.68	56.52
• Medical Teacher	88	4697	114.56	33.31
• IEEE Transaction on Education	71	1635	36.33	20.19
• Proceedings Frontiers in Education Conference Fie	62	302	10.79	3.82

3.5. Keyword Analysis Of Research Hotspot On Educational Technology

In this section, we study content by analyzing keyword distribution. Keywords co-occurrence can effectively reflect the research hotspots in the discipline fields, providing auxiliary support for scientific research [14]. The co-occurrence keyword network of educational technology was built by VOSviewer software. VOSviewer software is used to do data mining, mapping, and grouping articles were taken. The size of the circle is positively correlated with the appearance of keywords in the title and abstract. Therefore, the size of the item label and circle is determined by the weight of the item. The higher the weight of the item, the greater the label, and circle of the item [15]. The distance between the two nodes reflects the strength of the relationship between the two nodes. Shorter distances generally indicate stronger relationships. The line between the two keywords states that they have appeared together [16]. The link strength between two nodes refers to the frequency of co-occurrence. It can be used as a quantitative index to depict the relationship between two nodes [17]. Figure 5 provides a visualization of the most popular keywords used by writers on Scopus. In all publications related to educational technology, we get 3,344 keywords at a time. The keyword "teaching" has the highest occurrence of 2375. Other keywords with a high occurrence include "education" (2317), "students" (1981), "e-learning" (1550).

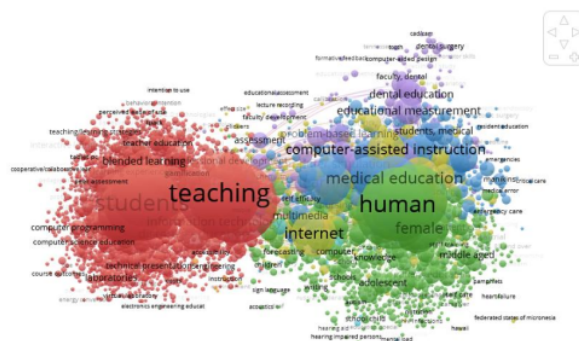


FIGURE 5. The analysis of keyword co-occurrence on educational technology

Table 3. The top 10 keywords of educational technology

Rank	Keywords	Occurrences	Total Link Strength
1	Teaching	2375	35816
2	Education	2317	35391
3	Students	1981	21785
4	Human	1925	41335
5	E-learning	1550	16768
6	Engineering education	1296	13653
7	Learning systems	843	9019
8	Medical education	762	15908

Rank	Keywords	Occurrences	Total Link Strength
9	Computer instruction	733	8296
10	Internet	711	14273

VOSviewer can make density visualizations (see Figure 6). Each node in the keyword density visualization plate has a color that depends on the item density at that node. In other words, the color of a node depends on the number of items in the node environment. Keywords in the red area appear more often; conversely, keywords in green areas appear less frequently (Liao et al., 2018). From Figure 6, we can see the focus of research studies of educational technology intuitively. "Human", "teaching", and "students" are essential keywords. These keywords are the core keywords in the study of educational technology.

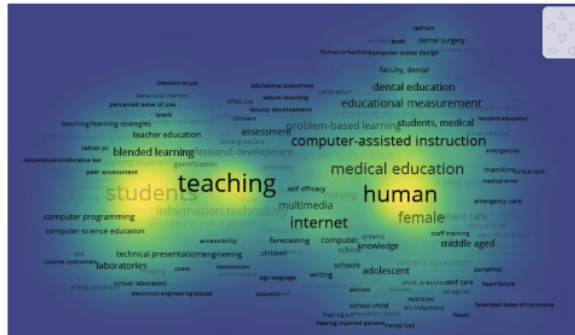


FIGURE 6. Keywords density visualization map of educational technology

4. CONCLUSIONS

In this paper, an emerging bibliometric analysis in the field of educational technology has been carried out. The bibliometric analysis helps find structure and development in this field. One widely used repository used for bibliometric analysis is Scopus. Based on the Scopus database, there were 8,134 publications related to educational technology. The United States, China, and Australia are ranked in the top three countries for total educational technology research publications. Besides, three subject areas that are the focus of educational technology studies are Social Science, Computer Science, and Engineering. The three most cited writers are Liu, H., Ellaway, R., and Skiba, D.J. Keyword analysis offers exciting insights into the dynamics of the field of educational technology. In all publications related to educational technology, we get 3,344 keywords at a time. The keyword "teaching" has the highest occurrence of 2375. Other keywords with a high occurrence include "education" (2317), "students" (1981), "e-learning" (1550). "Human", "teaching", and "students" are essential keywords. These keywords are the core keywords in the study of educational technology. A limitation of this study is that the bibliometric study provides several papers and their citations. However, the number of publications only indicates the quantity and does not show quality. Subsequent research, more analysis using other indexing databases such as Web of Science or Google Scholar.

5. CONFLICT OF INTEREST

No conflict of interest

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