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Original Article

Scientometric Mapping of Educational Technology (1999-2022)

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Abstract

Educational technology has grown appreciably in recent years and the number of books and articles published in this field is increasing day by day, and therefore the necessity of scientific research is determined. The current research is a kind of descriptive study that was carried out using scientometric indicators. the research area includes all the articles on Educational technology that were indexed in the Science Direct citation database from 1999 to 2022, and after filtering them, 7550 of them were analyzed with the help of Excel and VOS Viewer software. It was analyzed for analysis and display of data. The results of the research show that the number of articles has an upward trend and 2015 had the largest share in the number of articles. Also, Research articles (7,442), Journal Procedia - Social and Behavioral Sciences (2,111), and scientific field Social Sciences (3,220) were ranked first. 13 clusters were identified that the topics of lifelong learning, instructional design, secondary education, interactive learning environment, architectures for educational, and pedagogical are very popular and also previous in the field of ELearning and subjects: COVID-19, artificial intelligence, gamification, learning analytics, augmented reality, and Distance learning are new in the field of Educational Technology.

Keywords

Educational technology, Vosviewer, scientometrics.

Introduction

There Education is one of the most important infrastructures for the all-around progress of the country and a serious tool for improving the worthy human capital of the country in various fields (1). Achieving this goal requires a suitable program that must match the changes in various social, economic, and cultural aspects and the course of human progress. Each scientific field has its technology, In other words, technology is proposed for every field, and here we mean educational technology, communication devices, hardware, and the conscious and systematic use of technologies such as the educational design process. Educational technology aims to provide high-quality education and learning fields for every learner at any time (2,3). In pursuit of this goal, educational designers provide deeper and more stable learning fields by using more levels of students' senses, activating learners, and also creating their participation in the learning process, choosing appropriate goals and methods, and tools.

In the meantime, technology, which is no longer a tool to advance our goals, gradually imposes certain methods and views on its users and therefore transforms their lives. Technology changes a person's view of himself and the world around him. Complex systems are resistant to human intervention and create their policies. New technology has contributed greatly to the place of thinking among societies. Due to the influence of new technology, and as a result, new educational technology, thinking has become weak and less important in today's societies, especially among young people. Because the common educational technology in schools, as one of the examples of technology, has the greatest contribution to the life of students when distance learning programs and the use of radio or other means of communication are used as a supplementary means for

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teaching in the classroom. It is possible, this should be effective in increasing the academic progress of students (4,5).

Educational technology is a new, original and logical method for solving educational problems and lesson planning, which is associated with a kind of systematic thinking. In the meantime, the speed of increasing information in all disciplines has made the need for continuous revision of curricula a vital matter, and one of the topics raised in educational sciences is the orderly method or way of designing, implementing, and evaluating the entire process (6). Teaching according to certain goals and based on research in the field of learning and human communication and the use of human and environmental resources and tools to provide more practical, deeper, more stable, and effective learning and education (7,8). Educational progress means transformation in the educational system, this transformation needs its tools, and the use of educational technology is one of these tools.

The idea that today's electronic software can take the place of teaching resources is far from reality, and for the claimants of educational technology, the best place to show its application model is classroom hours, book pages, and scenes of educational and curriculum programs. Information and communication technology facilities can better and more easily fulfill this importance. The main secret of the teacher's success is to make the learner eager to learn and by involving him in the education process, he leads him to active learning (9). Also, efforts should be made to transform the teacher-centered culture and education-centered culture into a learning culture, as today the educational goal of the university is not to form a classroom and transfer a set of knowledge and skills to students, but to think about issues related to students' learning. How the student can better learn to think independently and gain critical thinking and methodology of accessing data and working with data (10). Among the advantages of educational technology, it is possible to speed up teaching and learning, increase accuracy in teaching and learning, provide meaningful and deep learning contexts, and most importantly, increase the amount of learning quantitatively and qualitatively.

The application of educational technology and the design of tools for teaching and learning in the field of education and learning, with changes and developments, was directed to the knowledge of problem-solving and a systemic approach to the issues raised in education, and today with special emphasis on the design of educational systems to create environments for Scientific activity evolved, educational technology and educational design should be considered as a powerful tool in human hands that can be most useful in education and training, and it is one of the most dynamic interdisciplinary courses in educational sciences and educational psychology. Technology, especially information and communication technology. However, it is obvious that the use of technology instead of traditional learning methods can turn our information into knowledge (11,12). But in fact, we use technology to make the skills we learn more permanent. Therefore, schools should ask students for this type of technology and teach them. To coordinate with the theory of change of attitude and method, education has to act towards the use of appropriate equipment and modern tools of educational technology, and also strive to provide the most important tool and tool of the post-industrial world in history, i.e. computers, and try to make technology and use He should also teach the learners about it because if he acts later, it will not be long before the use of the computer as a means of entertainment is institutionalized in the beliefs of the learners to make sure that if the computer cannot serve the teaching-learning process so that the teachers and By means of it, learners can reach new information and produce new information themselves, it will undoubtedly be considered an opiate tool for human resources in education. Now, some research related to the topic is mentioned.

Chen et al., (2020) for triumph The British Journal of Educational Technology (BJET)s 50th triennial and to show a full overview of the deal, they guidance a bibliometric analysis of the 3710 publications in this diary from 1971 to 2018 as insignitor in the Web of Science with full bibliographic advice. Their inference spotlight several investigation hotspots and emerging topics

such as Technology-better classroom education, Blended science, Online convivial communities, Mobile second diction lore, Game-supported lore, and Socialized e-learning.

Goksu's (2021) findings in a study going the bibliometric analysis of mobile learning, show, that the most serviceable countries in movable letters are Taiwan, the USA, China, and England. According to the keyword co-event analysis, movable devices, higher teaching, movable technologies, pill, and smartphone keywords endure out in the address of movable erudition. From 2015 to 2019, lean topics were broadly instructive technologies and, more specifically, tablets, movable rings, MOOCs, and lore strategies. It was found that G. J. Hwang is the most weighty researcher and the National Taiwan University of Science and Technology is the most potent school. It can be close that the most energetic inquiry are swell fact, higher culture, and smartphone pure fickle erudition exploration. According to the analyses guidance in Tex. of daily, Computers & Education, British Journal of Educational Technology and Educational Technology & Society were the most contributing journals.

Jiménez et al., (2019) psychoanalyze the expert product of instructive technology in the higher culture station, within the Web of Science database management system They infer that in late forever, and as indubitable from the course point, this is a maturation stretch that will lode to more exploration in the fond forever and The keywords most necessity as descriptors were "technology", followed by "higher education" and "students".

Phillips & Ozogul, (2020) in the study about Learning Analytics about Educational Technology, discharge a quote mesh analysis and found three imposing groups of inquiry. A qualitative thematic reëxamination of publications in these clumps divulges distinguished contexts, goals, and topics. The biggest group centralized on prophesy studier succession and might-have-been, the aid biggest on worn analytics to animate educational indicate, and the third on thing in instrument scholarship analytics systems. The creator alludes that further collaboration with instructive technology researchers and practitioners may be needment for lore analytics to understand its interdisciplinary goal.

Chen et al., (2019) with the purpose of bibliometric analysis of top-exuberant diary Computers & Education show that the yearly classification of concern proves a momentous augment in the diurnal publications, particularly from 2005 to 2011. The expert collaboration between say, institutions, and countries/provinces has grown increasingly consolidated. The expert collaboration charge between informants from the same education, and the same land/sphere, is relatively higher vie with those from distinct institutions and countries/provinces. Keyword maneuver analysis foreground some successful topics such as "interactive letters surrounding," "doctrine/letters strategies," "pedagogical progeny," and "improving classroom instruction." The findings of their ponder supply a full overview of the moment on instructive technology over the ended 40 forever.

Shen & Ho's (2020) findings touching on Technology-better erudition (TEL) show that among the top spiritually mention, name moment, five capital courses of TEL unraveling were recognized, namely embracement, critic, convertible media, podcasting, and commingled science. Then, the massed condition of erudition was resumed by playing up the pure subset topics in each rush with hidden semantic analysis.

With the emergence of Corona and according to the global trend of education, these tools for teaching and training have become more common; In this regard, the number of articles, books, and scientific research has also been developed accordingly, and in fact, Educational technology has become a very interesting research topic. Some researchers study the stages of Educational technology, others study the factors that affect the development, while others focus on the forms of students' professional learning, and this point indicates attention to this field. Research on the factors of Educational technology can significantly contribute to increasing the awareness of individuals and communities about the impact of different factors on professional development and effectively creates a single factor in terms of learning. Based on this, the current research

aims to draw a thematic map of published articles in this field and to identify hot and new topics.

Methodology

The current article is descriptive-applied and was carried out in the field of scientometrics; it is based on the visualization of co-occurrence networks and can generate, visualize and qualitatively analyze a bibliography based on a network among the documents of many scientific publications (19). Scientometrics is a quantitative and as much as possible qualitative analysis of the process of production, distribution, and use of scientific information for planning, policy-making, awareness, and scientific and research foresight. The data was collected from Science Direct scientific database as a comprehensive and multidisciplinary citation profile and the network drawing tool was done using VOS Viewer software and Excel. The research community includes all the articles in this scientific database published from 1999 to 2022. First, with the help of the keyword Educational technology, 234,512 articles were identified, and by limiting them to different fields the number of articles was reduced, and in the next step, a large number of articles were removed due to lack of relevance, and The words similar, same, plural and singular were merged and by removing the articles of other subjects manually, the final number of articles reached 7550. Finally, with the expert option, 80 RIS files were extracted and entered into VOS Viewer software. VOS Viewer software has gained popularity in bibliometric research and is one of the latest source analysis software. This software was designed by van Eck and Waltman (2010) to help easily create and visualize bibliometric maps that are easy to interpret. It effectively gathers the literature, establishes similarities between the selected publications in parameters, and creates an important theme among the publications (20,21).

Findings

Figure 1 shows the growth trend of scientific productions in the field of Educational technology during the years 1999-2022 in the Science Direct citation profile using Excel software. As can be seen, the number of articles has been on an upward trend since the beginning, and this trend continued until 2015, but since that year, it has taken a downward trend, and in recent years, the amount of attention to it has increased. The lowest share of scientific productions is in 1999 with 66 records and the highest share is in 2015 with 886 records. Among the magazines, Procedia - Social and Behavioral Sciences (2,111), Computers & Education (1,206), Computers in Human Behavior (451), Procedia Computer Science (341), System (272), The Internet and Higher Education (173), Nurse Education Today (116), Studies in Educational Evaluation (114), Teaching and Teacher Education (108), International Journal of Educational Research (105), Biochemical Education (103); Also Research articles (7,442), Book chapters (646), Book reviews (345), Review articles (278)have the most articles.

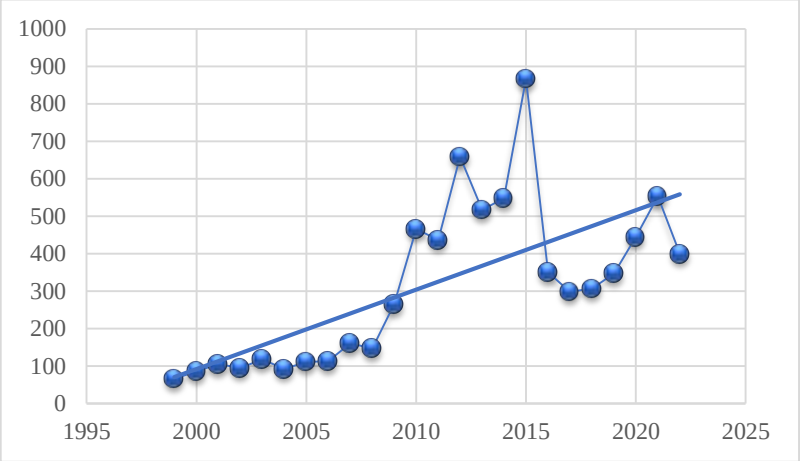

Figure 1. shows the growth trend of scientific productions in the field of Educational technology during the years 1999-2022

Also, scientific fields Social Sciences (3,220), Arts and Humanities (1350), Computer Science (950), Psychology (650), Medicine and Dentistry (350), Engineering (350), Business, Management and Accounting (250), were the most abundant.

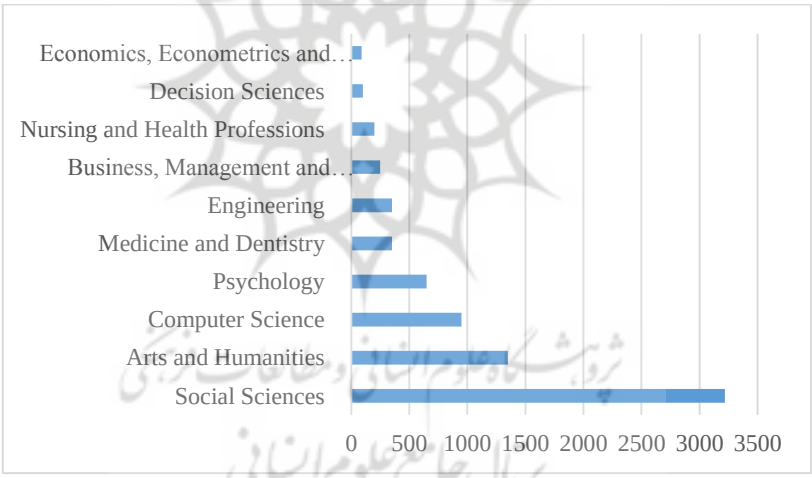

Figure 2.

Table 1 also shows the keywords with the highest co-occurrence among all the words. Based on these keywords: educational technology, e-learning, education, higher education, teaching/learning strategies, interactive learning environments, technology, pedagogical issues, and online learning have the most frequency.

Table 1. the keywords with the highest co-occurrence

keyword	occurrences	total link strength
educational technology	279	614
e-learning	253	517
education	242	451
higher education	215	404
teaching/learning strategies	186	622
interactive learning environments	171	540
technology	165	369
pedagogical issues	145	438
online learning	130	279
architectures for educational technology system	124	391
improving classroom teaching	122	403
learning	112	272
secondary education	105	300
blended learning	104	198
distance education	100	192
collaborative learning	91	180
motivation	90	175
mobile learning	88	182
cooperative/collaborative learning	81	265
computer-mediated communication	80	235
elementary education	80	238
media in education	80	248
ICT	76	158
virtual reality	75	201
augmented reality	74	140
social media	74	139
teacher education	73	136
distance learning	72	145
learning analytics	69	114
post-secondary education	68	220
applications in subject areas	67	228
simulation	65	112
instructional design	63	107
Internet	63	154
covid-19	62	118

The software presents its analytical results in the majority of maps, three of which are mentioned. To present the existing connections based on repetition 6, among the articles of this field, 612 items were formed, each belonging to a specific topic and shown as circles. In the meantime, the larger the circle is, it shows the wide connection of that collection with other collections. Also By thinking about the shape of the lines between the circles, it can be seen that they indicate the connection between the sets, and the thicker these lines are, the stronger the connection. In the research network, 13 clusters and 7769 links are formed.

As seen in Fig. 3, in the network visualization, the clusters formed by each of them are shown in specific colors. Examining the clusters of Educational Technology showed that cluster number one, which is marked in the red circle image, is the largest and the best cluster. This cluster has 95 thematic categories and 1120 links, and among the categories, Technology has the most links (187 links) with other members of the network, and therefore the corresponding node has a larger size than the other nodes of the mentioned cluster. Cluster number two, which is shown in green in the image, with 91 members and 1090 links, is the cluster that ranks second in terms of establishing links. Among the categories, blended learning has the most links (118 links) with other nodes.

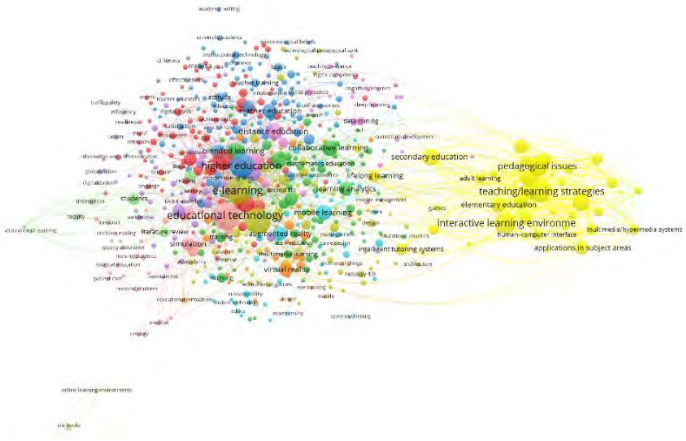

Figure 3.

Figure 4. Also with a black background, it shows the density of all eight clusters, which corresponds to the previous figure in the color of items and shows all eight clusters and their subsets in the form of densities.

Figure 4.

As can be seen in Figure 5, darker colors indicate the areas that in previous years such as lifelong learning, instructional design, secondary education, interactive learning environment, architectures for educational, and pedagogical issues are very popular and also previous in the field of Educational Technology.
Table .2

Table 2.

subject	Examples
lifelong learning	(22–24)
instructional design	(25–27)
secondary education	(28–30)
interactive learning environment	(27,31,32)
architectures for educational	(33–35)
pedagogical issues	(36–38)

Lighter colors indicate new areas that have recently been researched and investigated and

subjects: COVID-19, artificial intelligence, gamification, learning analytics, augmented reality, and Distance learning are new in the field of Educational Technology.

Table .3

subject	Examples
COVID-19	(39–43)
artificial intelligence	(44–46)
gamification	(27,31,47)
learning analytics	(30,48,49)
augmented reality	(50–52)
Distance learning	(27,48,49,53–55)

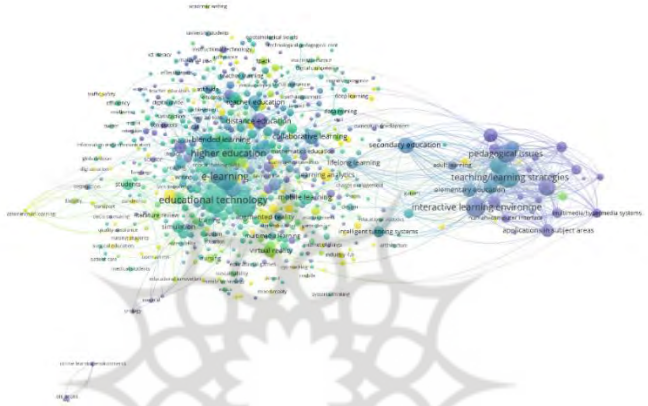

Figure 5.

As shown in the visualization of vocabulary density in the field of teacher education. The blue (navy) colored areas indicate articles or topics in which no research has been done so far and in the future, it is possible to research them, or they probably had a low density due to the very low number of articles. The red colors indicate the articles and topics under hot revision, they have the highest density, and the most important articles in this field are located in these areas. Other colors are located between these two areas and have a limited number of articles

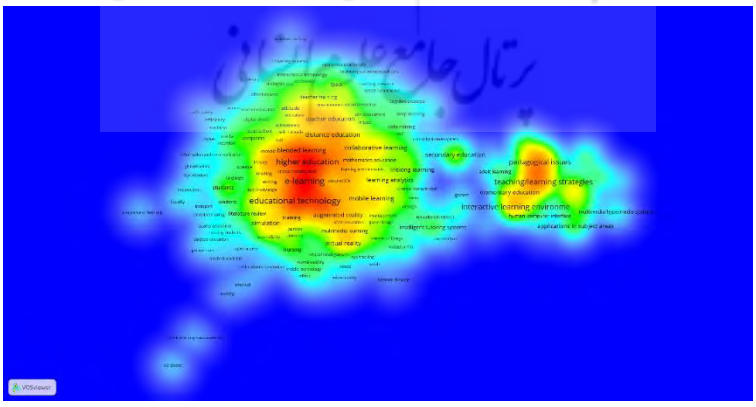

Figure 6.

The map shows the co-occurrence of words in researchers' articles. According to Figure 6, categories such as educational technology, e-learning, education, higher education,

teaching/learning strategies, interactive learning environments, technology, pedagogical issues, and online learning most influential categories in the field. Since these categories are assigned red points on the map, these categories are called the hot spots of this area. In addition, according to the mentioned map, it is necessary to mention the articles related to learning strategy, pedagogy issues, and computer studies (cluster 8), which at the same time can be a new and independent field in the current research field, while being related to the whole system and maybe it indicates the gradual attention of research to that side.

Discussion and conclusion:

The purpose of the current research was to draw a thematic map of articles published in the field of technology and identify hot and new topics during the years 1999-2022 in the Science Direct citation profile, which was done based on the analysis based on scientometrics. The findings of the first part of the research showed that the growth trend of scientific productions in the field of educational technology was generally upward, but in some years it had a downward trend, and in 2015, most articles were published in this field. This indicates that probably the researchers have gradually realized the importance of scientometric articles and their role in the systematic review of scientific sources, and more research measures have been taken in this direction.

There are 13 clusters and 7769 links in the research network. The study of educational technology clusters showed that cluster number one (cognition and learning) is the largest and best cluster. This cluster has 95 subject categories and 1120 links, and among the categories, technology has the most links (187 links) with other members of the network, and therefore the corresponding group has a larger size than other nodes of the said cluster. Cluster number two (Hardware) is shown with 91 members and 1090 links, which is the second most linked cluster. Among the categories, blended learning has the most links (118 links) with other nodes.

Among the investigated topics, lifelong learning topics, educational design, secondary education, interactive learning environment, educational and educational architectures were very popular topics and many studies have been conducted on them. But the new topics that were raised in the field of education technology included: COVID-19, artificial intelligence, gamification, learning analysis, augmented reality, and distance learning. Because these topics are new, they can do more research.

The next results of the research showed that respectively, the most articles published in the field of educational technology related to research articles (7442) in Procedia - Social magazine and (2111) in Behavioral Sciences magazine had the highest number. Of course, to get more comprehensive results, it is better to study other sites.

In terms of the number of articles, the result of the survey showed that; System (272), Internet and Higher Education (173), Nurse Education Today (116), Studies in Educational Evaluation (114), Teacher Education and Training (108), International Journal of Educational Research (105), Biochemistry Education (103); Also, research articles (7442), book chapters (646), book reviews (345), and review articles (278) have the most articles. Also, based on the research findings, according to the order of priority, the most articles are in the fields of social sciences (3220), art And humanities (1350), computer science (950), psychology (650), medicine and dentistry (350), technical and engineering (350), commerce, management and accounting (250) were published. Among the scientific fields, the social sciences field won the first rank with several (3220) subjects. According to the findings of the present research in this section, it can be seen that scientometrics in educational technology has been given great attention in some areas and has been published in related publications, but in many scientific fields, not much attention has been paid to it. It can be effective in other fields as well. Including sports, geography, history, literature, physics, chemistry, etc.

Topics that have been under-appreciated include: university education, student-centered learning, learning at work, world wide web, security, semantic web, smartphones, constructivist approach,

educational research, information technology, educational technologies, Intervention, learning outcome, technology acceptance model (TOM), validation, virtual community, and web tools are the study of issues that are scattered and far from the center, which can be present as new and independent fields in the field of research and be considered by researchers as research subjects. In the end, according to the achievements of scientometric studies and the increasing growth of scientometric articles and research in the world, this possibility and opportunity exist for all specialists in various fields. Therefore, it is suggested that researchers should pay special attention to the neglected areas and new topics in different disciplines, and scientific research in the field of educational technology should also be conducted on indigenous subjects, and in this regard, it is also suggested that databases The science of our country should provide scientific measurement facilities for researchers by developing technological infrastructure.

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