Utilization of Educational Technology in Bilingual Education: A Bibliometric Analysis

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Abstract. Education packaged in bilingual classrooms is increasingly being offered in various developing and developed countries. One way to optimize learning outcomes in bilingual classrooms is to utilize technology in the learning process. This study aims to elaborate on the effectiveness of technology used in a bilingual classroom, the sources of technology used in bilingual classrooms, and the integration of technology using bibliometric analysis. This study covers a qualitative method utilizing a bibliometric approach operated in the R program. The 138 articles were collected from the Scopus database of research articles, reviews, conference articles, conference reviews, books, and book chapters from 1974–2022. Those studies originated from 36 countries using two languages. The nation with the most significant publication dealing with the theme is the United States. In addition, the information of the most often keywords and the most frequently trend of research published is addressed well in this study. This study reveals that the research trend dealing with making use of technology in bilingual education is increasing significantly started from 1874 up to 2022. The research dealing with it rise in the pandemic era. The trend of research is still going to be consistent on the interest with the four-research topic predicted to be trending in the future by the analysis. Those research topics are learning systems, computer-aided instruction, content language integrated learning, and sign language. It can be implied that the support of educational parties to the improvements of bilingual education is still high and the following bilingual education researchers can meet the demand in educational technology by addressing those topics in their research.

Keywords: Bilingual Education · Bibliometrics · Biblioshiny · Educational Technology

1 Introduction

Bilingual education will lead to an education system that can understand and speak actively, properly, and correctly by using two languages [1]. The language taught in bilingual education varies significantly according to the demands in which the education is carried out, but English is one of the languages that must be mastered. Bilingual

education is education that reinforces two languages at once in the process. Following what was stated by Najat M Muthalib M, Jawad (2021), bilingual education is teaching academic subjects using two languages, for example, the mother tongue with a second language that someone should master [2].

Bilingual education is increasingly being discussed by scholars and researchers in education [3, 4]. Even more extreme, Minea Armijo Romero (2021) argues that bilingual education is a fundamental educational right for all children [5]. Bilingual education is a strategic topic to be researched and discussed in education. Usually, the things discussed in bilingual education are related to bilingual implementation and its impact, directly or indirectly, on teachers or students. The effects of bilingual education can be seen from the cognitive side of students.

Many studies declare that bilingual education significantly contributes to students (see [2, 6–9]). However, not with research conducted by A. Chin (2018) states that bilingual education programs do not significantly impact standardized test results when compared to teaching programs with only one language [10]. It is undoubtedly a hot debate to be studied more deeply and comprehensively, considering that bilingual education is widely applied to the education system in several countries, including Indonesia.

Seeing the urgency and significance of bilingual education in its implementation, it should be supported and endeavoured to provide optimal learning outcomes. Learning outcomes from bilingual education can achieve effective learning by integrating learning with technology. Technology-supported classes improve language skills, create a motivating and full of fun learning environment, encourage learners' participation, and assist educators in suiting the lessons to their needs and interests [11], as we know that technology development is high-speed. The existence of technology is also very much needed and helps the world of education. Indeed, not all technology products can be applied in the world of education, especially in bilingual education. It takes seeing the advantages and disadvantages, opportunities and obstacles that can be brought by using technology in bilingual learning. Therefore, it is necessary to integrate technology so that its use can be effective. Integrating technology is essential to be concerned about the needs, possibilities, and available resources.

Technology has been used to help learning and teaching activities to help educators since the 1920s. In the classroom, film and radio were first implemented [12]. However, it was not lasting for an extended period because, in the n1980s–1990s, computers started to be spread widely in the school environment to help teachers in teaching and students in learning individually [12]. At first, teaching using computers merely focused on memorizing that only functional cognitive skills at the lower level of it, such as memorizing information, facts, news, and numbers [13], but nowadays, it is better since the emerging technologies are more efficient in building critical thinking skills that include in higher-level cognitive skills [14]. Based on those explanations, it is obvious that integrating technology in teaching and learning activities is essential to pursue the learning objective in the form of higher-order thinking skills and students critical thinking skills.

Moreover, in the pandemic and post-pandemic era, online learning activity is mainly done in almost all educational fields. The use of technology is more favourable in the process of learning and teaching than the traditional ones. On the other hand, research

reveals that an online learning atmosphere gives many benefits. For instance, involving WebCT in the device of teaching has proved to improve critical thinking skills and reading engagement. Besides, a study reported that students believed that utilizing the website in learning activities donated most development of critical thinking skills [15]. Furthermore, teaching and learning activities in the form of an online atmosphere open up students' opportunities to master their material, learn their material in their place, and engage in discussion [16].

Besides online learning, the teaching and learning process done outside the classroom also can be supported by technology. Teaching and learning activities can now be conducted into face-to-face activities, online activities, or the combination of those two due to technological advances. This easiness can be realized because of the significant increase in technologies and the internet.

Seeing the benefits of using technology in online and offline learning, the application of technology in bilingual learning will also certainly have a positive impact on the learning process. So that the goals to be achieved through bilingual education can be easily achieved. The integration of educational technology in bilingual education can be seen in several studies that have been carried out [17–22].

To better understand the research trends that have been carried out related to the use of technology in education in bilingual education, analysis is related to publications that have been carried out so far related to the use of technology in bilingual education. Thus, studies related to technology used so far can be explored further so that research trends related to the use of educational technology in bilingual education can be identified. After knowing the research trends related to the topic, always be involved in discussions related to the use of technology in bilingual education; future predictions of interesting and useful topics for bilingual education also need to be studied. Therefore, this study aims to delve into research trends that have been carried out related to the use of technology in bilingual education and try to analyze research topics that are the target of researchers regarding the use of technology in bilingual education in the future.

2 Method

2.1 Research Design

The purpose of this research is to dig deeper into information related to scholars' publications on educational technology in Bilingual Education. In connection with the research objectives, this research was conducted in the form of bibliometric research. The bibliometric study offers exploration related to publications of a particular research topic [23].

2.2 Data Sources and Search Strategy

The data used in this research is sourced from the Scopus database by directly downloading it from the Scopus website (scopus.com).

Table 1. The strategy search for documents

TITLE-ABS-KEY (educational AND technology AND in AND bilingual AND education)
AND (LIMIT TO (SUBJAREA, "soci") OR LIMIT-TO (SUBJAREA, "arts"))
AND (LIMIT-TO (PUBSTAGE, "final"))
AND (LIMIT-TO (LANGUAGE, "english"))

2.3 Data Acquisition

Data were collected by searching documents on scopus.com using the keyword Educational Technology in Bilingual Education on the Scopus website. Here is the strategy for searching the articles (Table 1).

From inputting that information of search, documents filtered are 138. The next step is downloading some selected points in downloading articles in CSV format. The details attached in downloading the articles from Scopus database are the first is citation information such as author, author ID, document title, year, EID, source title, volume, issue & pages, source and document type, publication stage, DOI and open access. The second information is about bibliographical details, affiliations, and abbreviated source titles. The third is abstract and keywords consisting of abstract, author keywords and index keywords, followed by other information, including references, as the fourth information included. After picking all those information, the downloading process is run. The articles collected in CSV data are ready to be analyzed.

2.4 Data Analysis

The data collected in the CSV file was analyzed using the R program software and the Biblioshiny program [24, 25]. The results of the bibliometric analysis provide information related to the production of documents, resources of documents, the documents' author/s, and documents' trends of the topic.

3 Results and Discussion

3.1 Publication Results

A total of 138 papers with details of 72 articles, two books, 15 book chapters, 34 conference articles, ten conference reviews, and five reviews have been collected from the Scopus database without specifying the year of publication. The keyword used in the search for these papers is educational technology in bilingual education. After several articles are collected and stored in one CSV file with detailed information from the included reports, such as all information on citation information, affiliations, and abbreviated source titles in bibliographical details, abstract, author keywords, index keywords, and include references. The metadata of these articles was then analyzed using Biblioshiny in the R program [24, 25].

Table 2. Main information from Documents

Category	Results
Documents' Information	
Timespan	1974:2022
Sources	121
Documents	138
Documents' Authors	
Authors	339
Authors of single-authored docs	38
Types of Documents	
article	72
book	2
book chapter	15
conference paper	34
Conference review	10
review	5
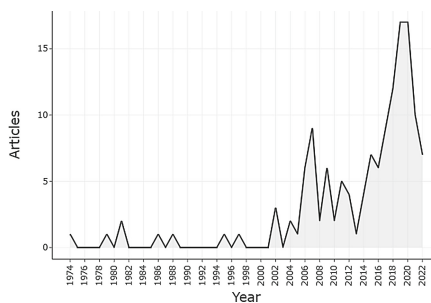
Fig. 1. Publications per year

From Table 2, it can be seen from a search on the Scopus database with the keyword "educational technology in bilingual education" that 138 documents were obtained from 121 sources: research articles, books, book chapters, conference papers, conference reviews, and reviews. Of the 138 papers, two languages were used, namely English and Russian. Most of the papers came from journal articles with 339 authors involved. These papers have a reasonably long period, namely from 1974 to 2022. For more details, Fig. 1 presents the publication period of the resulting papers.

It can be seen from Fig. 1 that the discussion about educational technology first appeared in 1974. There is one article that discusses educational technology in bilingual education with the article title "instructional resources for the bilingual technologist"
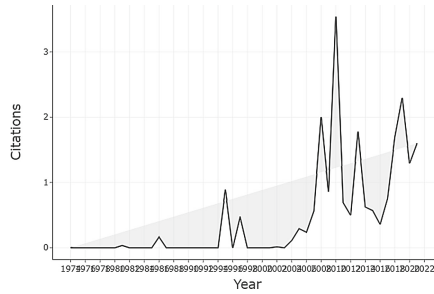
Fig. 2. Average citation per year

[26] and most recently, a paper entitled 'we just learned from each other: ESOL preservice teachers learning to use digital tools across coursework and student teaching [27].

The first paper discussing educational technologies.

Those 138 documents were not always cited as the sources of information by the following authors. The detailed average citation per year can be seen in detail in Fig. 2.

The first year of publication of an article discussing educational technology in bilingual education has no citation. It shows that during this period, the discussion on this theme has not attracted the interest of scholars, especially those working on education and language midwives. However, for future publications.

Table 3 shows publications every year and offers an increasing trend starting from 1974, which only amounted to 1 article written in Spanish related to the use of technology in the learning of immigrants, in other words, people who have and learn two languages or are lingual. Almost ten years after the first article, there were no publications related to integrating technology in bilingual education, proving love for the Scopus database. A second article related to this theme appeared in 1998 and began to move up until it reached its peak in 2008, with annual publications matching eight articles.

3.1.1 The Status of Global Contributions

From Fig. 3, The United States was captured as the most significant country contributing to publishing papers dealing with educational technology in bilingual education. The detail of the countries and the number of publications can be seen in Table 3.

Table 4 shows the frequency of involvement of a country in publications related to educational technology in bilingual education either by single author or collaboration between authors. A total of 85 frequencies from the USA were recorded as the highest frequency of publication of documents related to the theme of this research. In second place is Spain with the number of published documents related to the theme being discussed is 29. Followed by Peru with the number of publications from Peruvian authors of 27 and the next highest is from the UK, which is 23 documents.

In addition to these four countries, several countries also took part in the publication of documents related to educational technology in bilingual education. There were 32 other countries from Asia, Europe, America, and Australia. From the Asian side, Indonesia also took part in the discussion of this international scientific forum by publishing 3

Table 3. Average Citation per Year

Year	N	Mean TC/Art	Mean TC/Year	Years
1974	1	0.00	0.00	48
1979	1	0.00	0.00	43
1981	2	1.50	0.04	41
1986	1	6.00	0.17	36
1988	1	0.00	0.00	34
1995	1	24.00	0.89	27
1997	1	12.00	0.48	25
2002	3	0.33	0.02	20
2004	2	2.00	0.11	18
2005	1	5.00	0.29	17
2006	6	3.83	0.24	16
2007	9	8.44	0.56	15
2008	2	28.00	2.00	14
2009	6	11.17	0.86	13
2010	2	42.50	3.54	12
2011	5	7.60	0.69	11
2012	4	5.00	0.50	10
2013	1	16.00	1.78	9
2014	4	5.00	0.63	8
2015	7	4.00	0.57	7
2016	6	2.17	0.36	6
2017	9	3.78	0.76	5
2018	12	6.75	1.69	4
2019	17	6.88	2.29	3
2020	17	2.59	1.29	2
2021	10	1.60	1.60	1
2022	7	0.14		0

documents related to educational technology in bilingual education. It can be concluded that research trends related to educational technology in bilingual education are indeed considered an important research topic that is a necessity in the world of education for various countries in the world.
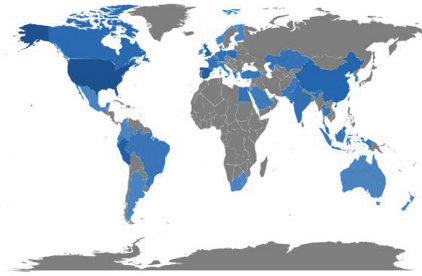
Fig. 3. Countries contribution

Table 4. The frequency of countries

Region	Freq	U6	Freq
USA	85	Mauritius	3
Spain	29	Pakistan	3
Peru	27	Turkey	3
UK	23	Cyprus	2
China	16	Denmark	2
Canada	9	Ecuador	2
Greece	7	Italy	2
Malaysia	7	Saudi Arabia	2
Poland	7	South Korea	2
Germany	6	Argentina	1
India	5	Australia	1
Egypt	4	Colombia	1
France	4	Finland	1
Kazakhstan	4	Ireland	1
Netherlands	4	Mexico	1
Thailand	4	New Zealand	1
Brazil	3	Norway	1
Indonesia	3	South Africa	1

3.1.2 Trend Topic

Based on the results of the translation of the number of publication frequencies of each country involved in publications related to educational technology in bilingual education, Fig. 4 shows the research themes that have been discussed by scholars in their publications. It can be seen in Fig. 4 that topics related to educational technology are the most important topics discussed by most authors.
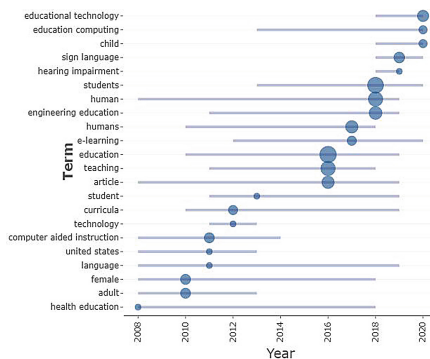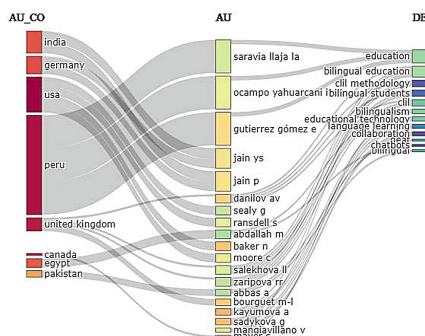
Fig. 4. The trend of research topics


Fig. 5. The three-field plot

3.1.3 Three Field Plot

The bibliometric analysis of Biblioshiny in the R program presents a three-field plot menu. This feature allows us to understand complete bibliometric research in one image and shows the proportionality between the contents presented in these papers [28]. Figure 5 shows the 15 countries/regions most active in publishing papers related to the theme. In the middle are the authors compiling these papers; on the left are the keywords used by the authors.

The three field plots presented show that the most productive countries in producing articles on research topics related to educational technology in bilingual education are the United Kingdom and the United States. Each of the two countries made four articles related to the discussed theme, followed by Peru, which produced three papers that all refer to the education discussion.

Of the most prolific and relevant authors to the topic discussed, three authors from Peru who used the keyword education in their research occupied the top three positions [23–25].

From the collection of keywords, it can be said that the most common keywords when talking about educational technology in bilingual education are related to education
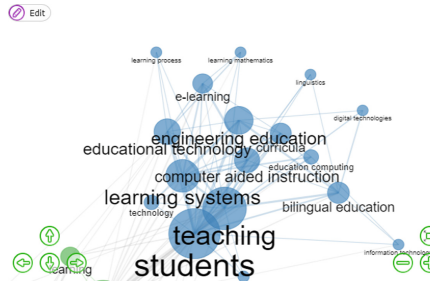
Fig. 6. The Thematic map

and bilingual education. Indeed, these two keywords represent the theme chosen in this analysis. But what is interesting here is the discussion related to CLIL (Content Language Integrated Learning). Many papers involved CLIL in the form of educational technology in bilingual education [3, 29–35].

3.1.4 Co-occurrence Network

In the digital era like today, the role of technology is increasing, impacting changes in all aspects of people's lives, including education. The academic community must adapt to this condition [24], including the bilingual education system. The learning process in bilingual education is designed to be more varied so that it is more exciting and could improve learning outcomes. One of the designs is to integrate technologies into the learning process. It is relevant to research results, which show that educational technology development and discussion have increased over the years, starting from the first emergence in 1974 up to 2022. It increased significantly in 2019–2021 when the pandemic hit worldwide, especially educational field. The study results reveal that many authors and scholars worldwide were eager to discuss these topics currently dominated by the USA and the UK (Fig. 6).

Many topics have been discussed and researched: education, engineering education, learning systems, educational technology, bilingual education, and sign language. The most common keywords are education, engineering education, and learning systems. The learning systems topic relates to using educational technology in a bilingual classroom. Moreover, in the pandemic and today's new normal era, the integration of the educational technology field, especially bilingual education, is very beneficial and needed. Learning systems can help to learn effectiveness [36]. It is because learning systems meet learners' needs and correctly provide appropriate information to individual students [37].

In addition to bilingual education, learning systems in the form of computer-aided instruction and Content Language Integrated Learning (CLIL) (see [3, 34, 38–41] are the other most discussed topic. In bilingual education, computer-aided language learning can be accommodated by feature-rich learning management systems [42]. Learning techniques in computer-aided instruction is believed to improve foreign language learning; bilingual education has the same benefit. The system's framework can enhance the learning experience for more enjoyable learning and better learner management.

The next future research trend in educational technology in bilingual education is addressing inclusion in education. To make education felt by all human being, education also must be prepared and supported for the disabilities. So that, educational technology in bilingual education for the disabilities much improved and developed. And one of research trend dealing with it in the future is sign language [20, 43–47].

4   Conclusion

Research trends related to educational technology in bilingual education tend to be good. Research trends are indicated by the growth in the number of publications which continues to grow yearly. Besides that, many researchers are involved in educational technology in bilingual education research. In addition, many international journals, books, and conferences consistently publish research results on educational technology in bilingual education. Apart from that, various countries are also involved in contributing and collaborating in publishing the results of educational technology in bilingual education research.

On the other hand, based on the research trends, several topics are trending in research related to educational technology in bilingual education. Learning systems, Computer-aided Instruction, Content Language Integrated Learning, and Sign Language lately have become topics that most often appear in educational technology in bilingual education research. These topics will underlie the direction of future educational technology in bilingual education research.

Authors' Contributions. U.F.: Conceptualization, data collection, analysis, writing. B. K.: supervision final approval. A.H.: writing. N.P.: critical revision of the manuscript report. E.W.: data analysis/interpretation and writing.

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