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The use of argumentation-based teaching model in education: A bibliometric research

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ABSTRACT

The aim of this study is to reveal the trends of educational research on argumentation listed in the Web of Science database based on bibliometric parameters and to draw a direction for future research. The research was conducted in accordance with the bibliometric paradigm. The scope of the study consists of 3468 educational articles indexed in Web of Science. Bibliometric measures were used to analyse the data obtained. As a result of the research, it was determined that there has been a significant increase in the number of publications since 2005 and the number of citations has increased at the same rate. The most productive country is the United States of America, the most productive author is Katherine L. McNeil, and the most productive institution is State University System of Florida. The journal that publishes the most articles is the International Journal of Science Education. The trending subject areas were science education, self-regulated learning and teacher education. The most cited article is "Establishing the norms of scientific argumentation in classrooms" produced by Driver et al. in 2000. The core keyword is argumentation. However, other core concepts are science education, critical thinking, argumentative writing and socioscientific issues. Popular keywords are argumentative writing, second language writing, writing assessment, writing performance, argumentative essays, academic language, metadiscourse, reading comprehension and corpus linguistics.

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Introduction

In the 21st century, students are expected to be able to produce arguments by utilizing different disciplines, share their claims based on these arguments, and refute counterclaims (Hasançebi, 2014). This can be possible by using current teaching methods such as argumentation. Argumentation approach can be defined as the foundation of scientific argumentation and is an important tool for developing and advancing scientific arguments (Hand & Keys, 1999). Since the argumentation-based teaching model focuses on reasoning skills, informal reasoning and argument construction are extremely important in solving controversial problems (Sadler, 2004). In a general assessment, argumentation can be defined as the structuring of knowledge by using the claims produced based on the available data; justifications, supporters, limiters and data to refute the opposing view (Toulmin, 1958). There is a lot of data showing that the argumentation-based teaching model has been used in education and training in recent years and has increased success (Arslan & Tüysüz, 2023; Erkol, Kışoğlu & Gül, 2017; Uluay & Aydın, 2018; Clark et al., 2007).

This study aims to analyze the research on argumentation-based teaching model through bibliometric measures. The main objective is to identify the countries, institutions, journals and authors that contribute the most to the pool of relevant publications and to provide a reading list for future researchers in this field. In addition, the trend is to identify popular subject areas by identifying key concepts. This data can play an important role in shaping the direction of researchers' interests in the argumentation subject area. Bibliometrics can be defined as a field in which various findings about scientific communication are

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obtained by analyzing certain characteristics of publications (Al, 2012). Analyzing the production of scientific knowledge and the distribution of this production according to different elements through quantitative methods such as bibliometrics provides researchers with a noticeable convenience in determining various characteristics of the information in question (Yılmaz, 2021). This is because bibliometric method-oriented reviews, which include analyses such as research productivity, citation rankings, association of concepts or citations, have the potential to make significant contributions to the literature (Gordon et al., 1984). Therefore, bibliometric method is used to obtain a holistic perspective in different fields (Al & Coştur, 2007; Al & Tonta, 2004; Becerikli, 2013; Çavuşoğlu & Akkaş, 2025; Ellegaard & Wallin, 2015; Erişen, 2025; Glänzel & Schoepflin, 1999; Hotamışlı & Erem, 2014; Khan et al. 2022; Kıdak et al., 2017; Merigó, 2018; Muslu, 2018; Thanuskodi, 2010). In recent years, it has been preferred as an analysis method in subfields of education (Hallinger & Chatpinyakoop, 2019; Huang et al., 2020; Kılıçaslan et al., 2025; Özkaya, 2019; Pradana et al., 2023; Rojas-Sánchez et al., 2023; Selvitopu et al., 2018; Swacha, 2021; Şeref & Karagöz, 2019; Ural & Özdemir, 2025; Usta et al., 2025; Yalçın & Yayla, 2016).

Argumentation-based research in different fields in education was analysed using bibliometric measures. Pabucçu-Akış (2024) analysed research in chemistry education, Yeşiltaş et al. (2024) and Admoko et al. (2021) analysed studies on socioscientific issues in science education, Kartika et al. (2023) analysed publications on mathematics education, Ashel et al. (2024) and Rahma et al. (2024) analysed research in physics education with bibliometric analysis. Suliyanah et al. (2024) analysed publications indexed in Scopus. It is also seen that educational research on argumentation is analysed by choosing different analyses. Yıldırım (2020) analysed the research on this model with descriptive analysis method, and Koç-Dudak & Yavuz (2023) analysed the publications in the field of science education with content analysis. A careful review of the literature reveals bibliometric analyses of research published in disciplines such as science education, physics education, chemistry education and mathematics education. It is also seen that techniques such as content analysis and descriptive analysis are used. However, there is no study that analyses the research on argumentation in educational research from a bibliometric perspective. In addition, the fact that the publications in the Web of Science database were analysed can be considered as another difference of this study. With this research, scientists who will work on argumentation will be able to easily see the journals, authors and publications that should be taken into consideration in argumentation, reach the core subject areas and concepts in the relevant subject area, and follow popular concepts. In order to respond to this importance, the research sought to answer the following questions about the studies analysed:

1. What is the distribution of publications by year and the number of citations?
2. Which countries are the most productive?
3. Who are the most productive authors?
4. Which are the most productive institutions?
5. Which journals are the most productive?
6. What are the trending subject areas?
7. What are the top ten most cited articles?
8. What are the core key concepts?
9. What are the popular key concepts?

Method

Research design

Bibliometric methods were used in this study. Bibliometrics refers to the quantitative measurement of qualitative aspects of scientific disciplines such as quality and reputation (Rehn et al., 2014). More specifically, bibliometrics deals with the statistical examination and quantitative analysis of certain characteristics of publications or documents such as author, subject, cited author, publication information, and cited sources (Yılmaz, 2021). In this study, bibliometric quantitative measures were used in order to provide a holistic perspective on the quality of articles on the argumentation-based teaching model. In this way, important data on the general view of the relevant publication pool will be presented and a deep insight into which aspects of the articles stand out will be obtained.

Data collection process

The data source of this study consists of 3468 articles listed in the Web of Science citation index. Data downloading was carried out on 07.02.2025. During the searches, the keywords "argumentation, argumentation skills, argumentation writing, collaborative argumentation, collective argumentation, mathematical argumentation, online argumentation, scientific argumentation, toulmin model" were preferred. Accessed publications were limited to articles as document type. Then, the articles listed in the

Education Educational Research category were examined. As a result of the scans carried out in this way, 3468 articles were accessed, and these studies were included in the analysis.

Data analysis

The data were analysed using bibliometric analysis technique. Bibliometric analysis is an analysis approach to understand global research trends in a particular field based on the output of academic publications (Alsharif et al., 2021). The records of 3468 articles accessed before this process were entered into the "Export" section in Web of Science and downloaded by selecting the "Plain text file" format. The data downloaded in this format were mapped by "co-occurrence" analysis using VOSviewer open source software. The purpose of this analysis is to obtain an image of the co-occurrence of the keywords assigned to the articles by the authors. On the other hand, data on the distribution of articles by year, number of citations, most productive country, most productive author, most productive institution, focus journal, trending subject areas, ten most cited articles, etc. were retrieved from Web of Science. These data are presented in graphs and tables.

Findings

In this part of the study, the distribution of publications by years, the number of citations by years, the most productive countries, the most productive researchers, the most productive institutions, the most frequently published journals, trending subject areas, core keywords and key concepts that have come to the fore in recent years are presented. In this context, firstly, the distribution of publications by years and the number of citations are presented (Chart 1).

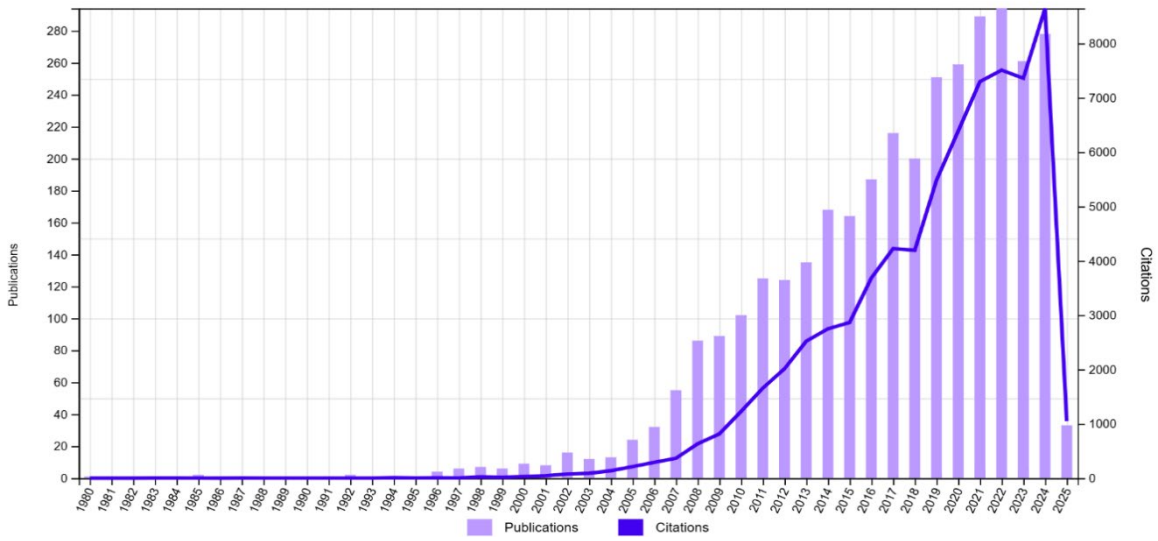

Chart 1. Distribution of publications by years and number of citations

Looking at Chart 1, it is seen that the number of articles on argumentation until the 2000s was low and showed a horizontal picture. In 2002, there was an increase, but there was a decline in the following year. After 2005, there was a significant increase. This increase has mostly increased every year, presenting a stable image. In 2021 and 2022, the number of publications peaked. The graph also shows the course of the number of citations to articles over the years. Along with the increase in the number of articles, the number of citations has also increased noticeably and regularly. The total number of citations received by the articles in all years is 71,662 and the number of citations per publication is 20.66. In the next section of the study, data on the most productive countries in the production of articles on argumentation are shared (Figure 1).

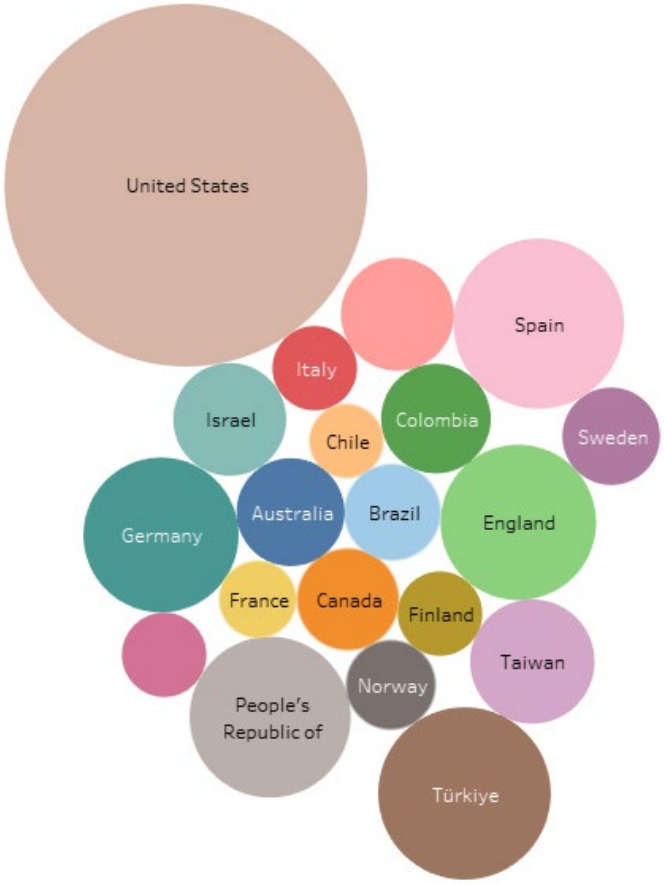

Figure 1. Most productive countries

Figure 1 shows that the United States of America is the most productive country in the production of argumentation articles. Considering the difference in the number of publications between it and the nearest country, it is not difficult to predict that the USA will maintain this title in the future. This country is followed by Turkey with 250 articles. Turkey is followed by Spain, the People's Republic of China, the UK and Germany. The next section of the study presents data on the most prolific authors in the production of argumentation articles (Chart 2).

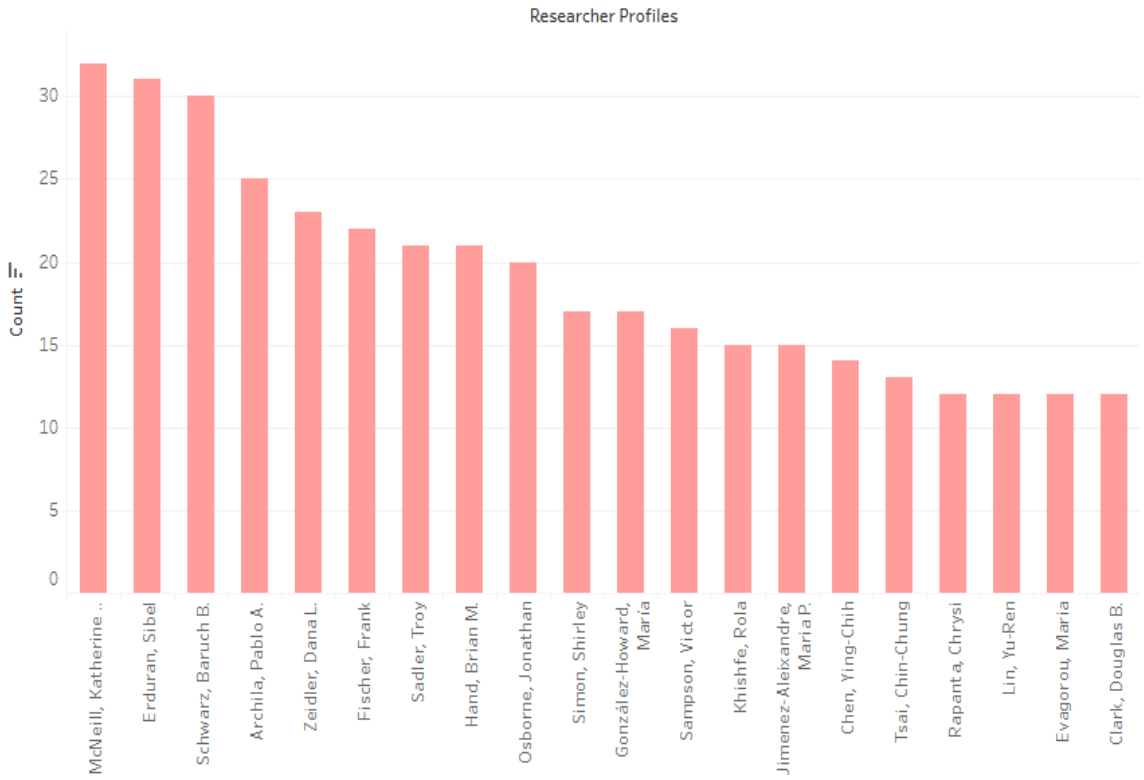

Chart 2. Most productive researchers

Chart 2 shows that Katherine L. McNeil, who contributed to the field with 32 articles, is the most prolific author. According to Google Scholar data, the total number of citations of the researcher, who continues her research at Boston College, is 10,738 and her h-index is 43. McNeil was followed by Sibel Erduran with 31 articles. Erduran, who is based at Oxford University, has a total citation count of 20,410 and an h-index of 53. These researchers were followed by Baruch B. Schwarz and Pablo A. Archilla. In the following section of the study, the most productive affiliations are presented (Table 1).

Table 1. Most productive affiliations

No	Affiliations	Count	No	Affiliations	Count
1	State University System of Florida	96	11	Universidade De Santiago De Compostela	44
2	Pennsylvania Commonwealth System of Higher Education (PASSHE)	79	12	Hebrew University of Jerusalem	42
3	University of California System	73	13	University of Hong Kong	41
4	University System of Ohio	63	14	Michigan State University	40
5	University System of Georgia	60	15	Florida State University	39
6	Arizona State University	49	16	Indiana University System	37
7	Pennsylvania State University	49	17	Pennsylvania State University University Park	37
8	Arizona State University Tempe	48	18	University Of Georgia	37
9	University of London	48	19	University of Iowa	37
10	California State University System	44	20	Boston College	36

Table 1 shows that the most productive institution in the production of argumentation-based articles is the State University System of Florida. This institution is followed by Pennsylvania Commonwealth System of Higher Education, University of California System and University System of Ohio. The common feature of these institutions is that they are located in the USA. When the list of the top twenty most productive institutions is examined, it is noteworthy that the institutions are mostly located in the USA. In the rest of the study, the list of journals in which the articles on argumentation were published most frequently was shared (Table 2).

Table 2. Most frequently published journals

No	Journals	Count	No	Journals	Count
1	International Journal of Science Education	221	11	Education Sciences	41

2	Science Education	196	12	Learning Culture and Social Interaction	40
3	Journal of Research in Science Teaching	102	13	Reading and Writing	40
4	Research in Science Education	87	14	Revista Eureka sobre Ensenanza y Divulgacion de las Ciencias	40
5	International Journal of Science and Mathematics Education	65	15	Journal of Science Education and Technology	38
6	Computers Education	54	16	Educational Studies in Mathematics	37
7	Instructional Science	47	17	Frontiers in Education	36
8	Chemistry Education Research and Practice	43	18	Learning and Instruction	36
9	Journal of Science Teacher Education	43	19	Journal of Biological Education	35
10	International Journal of Computer Supported Collaborative Learning	42	20	Journal of Mathematical Behavior	35

Table 2 presents the top twenty journals in which articles are published most frequently. Accordingly, the journal that published the most articles in this field is International Journal of Science Education. A total of 221 articles were published in this journal. With 196 articles, Science Education ranked second on this list. These journals were followed by Journal of Research in Science Teaching, Research in Science Education and International Journal of Science and Mathematics Education. The presence of journals related to science education in the first four places of the list is noteworthy. In the next section of the study, data related to trending subject areas are presented (Table 3).

Table 3. Trending topic areas

No	Topic Areas	Count	No	Topic Areas	Count
1	Science Education	1639	11	International Students	17
2	Self-Regulated Learning	321	12	Numerical Cognition	14
3	Teacher Education	314	13	History Education	14
4	Language Policy	197	14	Technology Acceptance Model	13
5	Phonological Awareness	190	15	Public Sociology	13
6	Academic Writing	77	16	Conditional Reasoning	12
7	School Leadership	36	17	Six Sigma	11
8	Conversation Analysis	31	18	Item Response Theory	11
9	Philosophy for Children	23	19	Creativity	10
10	Answer Set Programming	20	20	Educational Science	10

Table 3 shows the data on the fields in which the articles on argumentation are mostly concentrated. When the table is examined, it is understood that more attention is paid to the argumentation model in science education. 47% of the articles analysed are in the field of science education. This field is followed by self-regulated learning, teacher education, language policy and phonological awareness. In the rest of the study, information on the top ten most cited studies from the articles on argumentation was shared (Table 4).

Table 4. Top ten most cited articles

No	Title	Authors	Publication Year	Total Citations	Average per Year
1	Establishing the norms of scientific argumentation in classrooms	Driver, R. ; Newton, P. ; Osborne, J.	2000	1143	43,96
2	Sociomathematical norms, argumentation, and autonomy in mathematics	Yackel, E. ; Cobb, P.	1996	938	31,27
3	Enhancing the quality of argumentation in school science	Osborne, J. ; Erduran, S. ; Simon, S.	2004	749	34,05
4	Fostering students' knowledge and argumentation skills through dilemmas in human genetics	Zohar, A. ; Nemet, F.	2002	691	28,79
5	TAPping into argumentation: Developments in the application of Toulmin's argument pattern for studying science discourse	Erduran, S. ; Simon, S. ; Osborne, J.	2004	646	29,36
6	Doing the lesson or doing science: Argument in high school genetics	Jiménez-Aleixandre, M. P. ; Rodríguez, A. B. ; Duschl, R. A.	2000	549	21,12
7	Science education in three-part harmony: Balancing conceptual, epistemic, and social learning goals	Duschl, R.	2008	535	29,72
8	Deliberative discourse ıdealized and realized: Accountable talk in the classroom and in civic life	Michaels, S. ; O'Connor, C. ; Resnick, Lauren B.	2008	504	28

9	Supporting students' construction of scientific explanations by fading scaffolds in instructional materials	McNeill, K. L. ; Lizotte, David J. ; Krajcik, J. ; Marx, Ronald W.	2006	425	21,25
10	Understanding students' practical epistemologies and their influence on learning through inquiry	Sandoval, W. A.	2005	425	20,24

Table 4 lists the top 10 most cited articles out of the 3468 articles included in this study. According to this, the most cited article is "Establishing the norms of scientific argumentation in classrooms". Published in 2000, the total number of citations was 1143 and the number of citations per year was 43.96. This article, which aims to determine the norms of scientific argumentation in classrooms, was prepared by Driver et al. The second article in the list is "Sociomathematical norms, argumentation, and autonomy in mathematics". The total number of citations of the study related to mathematics is 938 and the number of citations per year is 31.27. This study was followed by "Enhancing the quality of argumentation in school science" and "Fostering students' knowledge and argumentation skills through dilemmas in human genetics". The next section visualizes the frequency of keywords assigned to the articles by the authors (Figure 2).

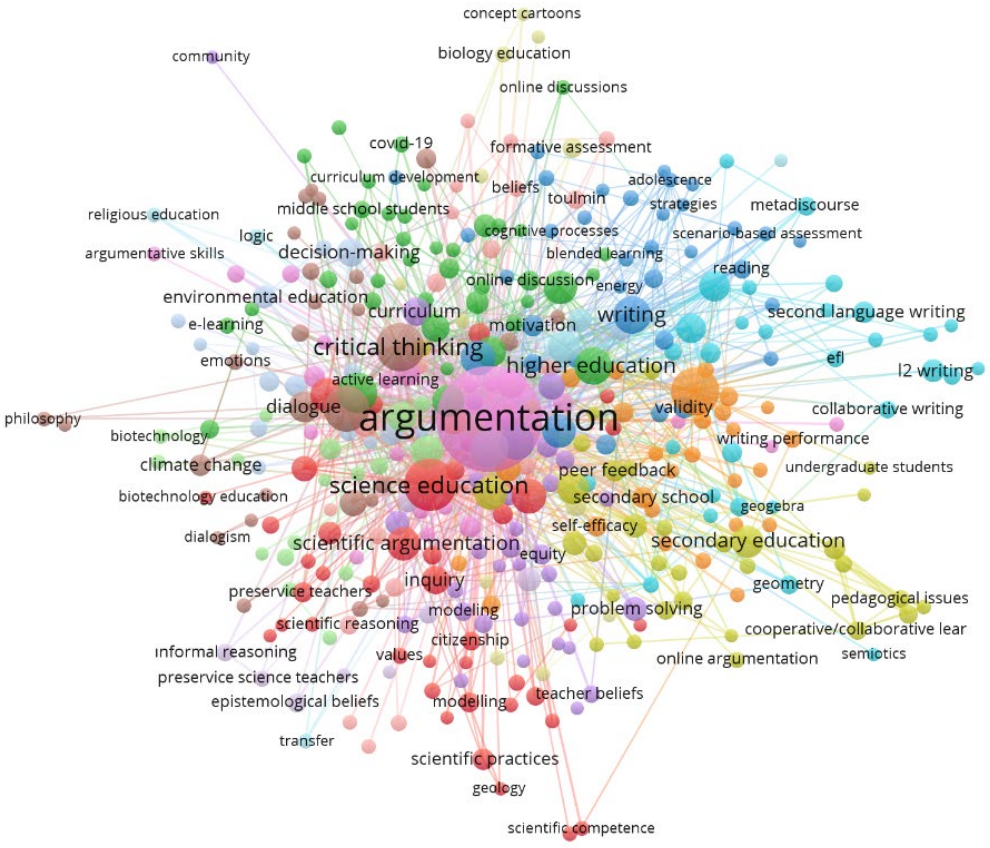

Figure 2. Keyword frequency

Figure 2 shows that the core keyword was argumentation (f=805). This concept was followed by science education (f=137), critical thinking (f=114), argumentative writing (f=113) and socioscientific issues (f=101). As a result of the analysis, it was observed that the keywords consisted of 15 clusters. This situation reveals that the topic of argumentation attracts interest in different fields. In general, it can be stated that researchers mostly focus on science education, critical thinking, argumentative writing and socioscientific issues in articles on argumentation. In the following part of the study, the distribution of keywords by years and the key concepts that have been trending in recent years are shown (Figure 3).

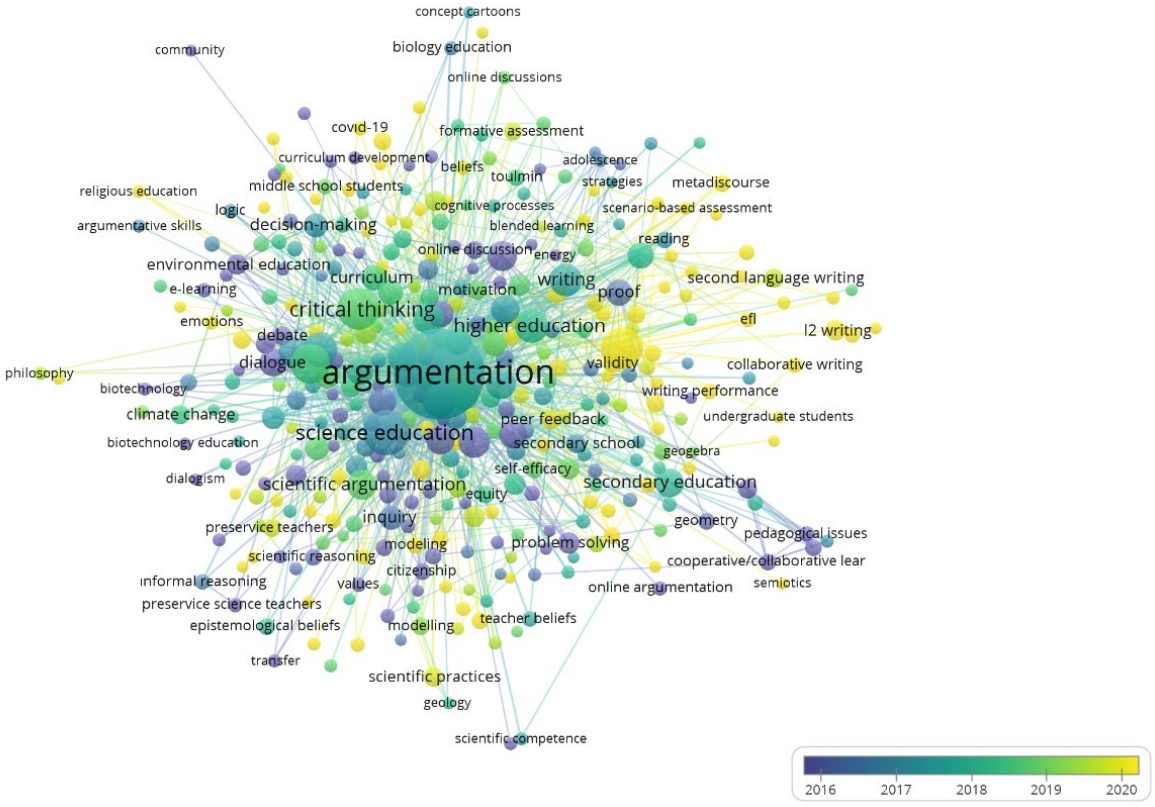

Figure 3. Trending keywords in recent years

Figure 3 shows that argumentative writing is the most popular subject area after 2020. Within this cluster, the key concepts of second language writing, writing assessment, writing performance, argumentative essays, academic language, metadiscourse, reading comprehension and corpus linguistics stand out. From this point of view, it can be stated that the argumentation model has attracted attention especially in the writing subject area in recent years.

Conclusion, discussion and suggestions

In this study, it was aimed to reveal the use of Argumentation-Based Teaching Model in education through bibliometric parameters. In the study, 3468 articles listed in the Web of Science database were analysed. In this context, since it was aimed to determine the general and holistic view, no subject area limitation was made. In this respect, the study is important because it reflects the trends of articles on argumentation from a broad perspective and gives an idea about the situation on a global scale. In the analyses conducted for this purpose, it was determined that the first publication belonged to 1980, and 35 articles were already listed in 2025. It was determined that the number of articles increased significantly in 2005, and there was a significant increase in the following years. Along with this increase, it was observed that the number of citations also increased in direct proportion. This indicates that the impact values of the articles are in the same direction. In contrast to this result, Yıldırım (2020) found that there is a fluctuation in the distribution of articles and graduate theses produced in Turkey over the years and that there is not a stable picture.

The most productive countries are the USA, Turkey and Spain. Especially the USA has almost four times more publications on this subject than other countries. In other words, 32% of the articles analysed were addressed to the USA. In other words, US publications should be carefully examined during research on argumentation. On the other hand, the productivity of Turkey and Spain cannot be ignored at this point. In this direction, Admoko et al. (2021), who examined science education research on argumentation, found that the most productive country was the USA. Kartika et al. (2023), who analysed argumentation articles in mathematics, came across the same result. Related to these results, the study also found that the most productive organizations are based in the USA. The most prolific authors are Katherine L. McNeil, Sibel Erduran and Baruch B. Schwarz. Of the top ten most productive researchers, six were from the USA, one from the UK, one from Israel, one from Colombia and one from Germany. This shows that researchers in US

institutions are more productive in argumentation. Scientists who will conduct research on argumentation should carefully examine the publications of the researchers on this list. Especially taking into account the most cited publications will make the intellectual structure of the research more qualified (Bamberg & Georgakopoulou, 2008; Engle & Conant, 2002; Mercier & Sperber, 2011; Yackel & Cobb, 1996).

Most articles were published in International Journal of Science Education, Science Education, Journal of Research in Science Teaching and Research in Science Education. The common feature of these journals is that their scope is science education. On the other hand, it has been revealed that the top twenty journals are mostly from the field of science and a few journals are for social sciences. Similar focus journals were also found in the studies of Pabuçcu-Akış (2024) and Wang et al. (2022). This shows that the argumentation model attracts more attention in the sciences (Driver et al., 2000; Osborne et al., 2004; Zohar & Nemet, 2002) and much less attention in the social sciences (Gregory & Holloway, 2005; Jeliazkova & Westerheijden, 2002). In other words, it should be stated that there is a great need for research based on the argumentation model in social sciences. These data also give an idea about the field in which the argumentation model attracts the most attention. It was determined that the most popular subject area was science education. In addition, self-regulated learning (Kim & Hannafin, 2011; Kramarski & Mevarech, 2003), teacher education (Walshaw & Anthony, 2008), language policy (Deane, 2013), and phonological awareness (Bråten et al., 2011; Newell et al., 2011) were also found to be prominent. The subject areas that need to be developed are educational science, creativity, item response theory, six sigma, conditional reasoning and public sociology.

The most cited article is the research titled "Establishing the norms of scientific argumentation in classrooms" by Driver et al. (2000). The total number of citations of this article is 1143. The second ranked article is "Sociomathematical norms, argumentation, and autonomy in mathematics" by Yackel and Cobb (1996). The total number of citations of this study is 938. This research ranks first in terms of the number of citations in Kartika et al.'s (2023) study. The determination of the most cited articles provides a reading list for researchers who will conduct future studies on argumentation. Because these studies directly shape the intellectual structure of the related field. Researchers are advised to carefully scrutinize the studies in this list while shaping their articles.

As a result of the keyword analysis, it was determined that the core concept was argumentation. Wang et al. (2022) also revealed similar results. Since all articles in the field of education were analysed in this study, different concepts were encountered from the studies in the literature. At this point, the concepts of critical thinking (Durkin, 2008), argumentative writing and socioscientific issues (Evagorou & Osborne, 2013) stand out. In addition, writing (Johns, 2017), collaborative learning (Noroozi et al., 2012), higher education (Noroozi, 2022), teacher education (Sadler, 2006) and scientific literacy (Dawson & Venville, 2009) are other core concepts. The most popular key concept is argumentative writing (Chuang & Yan, 2023). Related to this concept, second language writing (Xu, 2023), writing assessment (Kushki et al., 2022), writing performance (ten Peze et al., 2021), argumentative essays (Molnar & Šplihal, 2024), academic language (Deng, 2022), metadiscourse (Yoon, 2021), reading comprehension (Kim et al., 2021) and corpus linguistics (Degano, 2016) have attracted the attention of researchers in recent years.

This study is limited to data on 3468 educational articles on argumentation indexed in Web of Science. Education research was included in the scope of the study. A similar careful examination of argumentation studies in other categories may provide a different perspective on the argumentation literature. On the other hand, articles were analysed in this study. In future research, publications in different document types can also be examined. In order to obtain more detailed information, the thematic structure of the research in the related field can be revealed through detailed analysis on keywords.

Declarations

Ethics statements

There was no ethical violation in this study. The study content does not require ethics committee approval.

Informed consent

The study does not involve human participants.

Availability of data and materials

The data is available in the relevant database.

Competing interests

There is no conflict of interest with any institution or person in this study.

Funding

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Authors' contributions

The article is single-authored.

Artificial intelligence

Artificial intelligence was not used in the preparation of this article.

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