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A Bibliometric Analysis of Articles on "Scientific Inquiry": Sample of WoS Database

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ABSTRACT

The aim of this study is to examine the articles published on scientific inquiry in the Web of Science (WoS) database in terms of bibliometric indicators. The sample of the research using the bibliometric analysis technique consists of 926 studies in the type of article searched with the word "*Scientific inquiry*". MS Excel and VOSviewer programs were used to analyze the data. The data obtained from this analysis are presented with tables and bibliometric maps. As a result of the analysis, it was determined that most articles on scientific inquiry were published in 2020. It has been determined that the most frequently used keyword in scientific inquiry is "scientific inquiry". It has been concluded that the most effective journal in scientific inquiry is "Science Education". In addition, it has been determined that "English" comes to the fore as a language in studies conducted on scientific inquiry and that the "USA" as a country works actively in scientific inquiry.

Keywords: *Scientific Inquiry, Bibliometric Analysis, Web of Science, Descriptive Analysis.*
Jel Codes: I20, I21.

"Bilimsel Sorgulama" Konusundaki Makalelerin Bibliyometrik Analizi: WoS Veritabanı Örneği

ÖZET

Bu çalışmanın amacı, Web of Science (WoS) veri tabanında, bilimsel sorgulama konusunda yayımlanan makaleleri bibliyometrik göstergeler açısından incelemek olarak belirlenmiştir. Bibliyometrik analiz tekniği kullanılan araştırmanın örneklemini "*Scientific inquiry*" kelimesi ile aranan makale türündeki 926 çalışma oluşturmaktadır. Verilerin analizinde MS Excel ve VOSviewer programından yararlanılmıştır. Bu analizlerden elde edilen veriler tablolar ve bibliyometrik ağlar kullanılarak sunulmuştur. Yapılan analizler sonucunda, bilimsel sorgulama konusunda en fazla makalenin 2020 yılında yayımlandığı belirlenmiştir. Bilimsel sorgulama konusunda en sık kullanılan anahtar kelimenin "*scientific inquiry*" olduğu tespit edilmiştir. Bilimsel sorgulama konusunda en etkin olan derginin "*Science Education*" olduğu sonucuna ulaşılmıştır. Ayrıca bilimsel sorgulama konusunda yapılan çalışmalarda dil olarak "İngilizce"nin ön plana çıktığı ve ülke olarak "ABD"nin bilimsel sorgulama konusunda aktif bir şekilde çalıştığı tespit edilmiştir.

Anahtar Kelimeler: *Bilimsel Sorgulama, Bibliyometrik Analiz, Bilim Ağı, Betimsel Analiz.*
Jel Kodu: *I20, I21.*

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1. INTRODUCTION

With the developing technology, raising scientific literacy individuals has become a common aim for all educators. One of the important components of this aim is the concept of "scientific inquiry", which has long been the focus of science education (Çetin, 2021; Dogan, 2017). With the introduction of the concept of "scientific inquiry" among science education achievements and standards in the world and in Türkiye, the importance of determining whether students have achieved the aim of understanding and applying scientific inquiry has been emphasized in the studies conducted (Doğan, Han Tosunoğlu, Özer & Akkan, 2020; Saka, Yaman, Tunç Şahin, Pekay & Gerçek, 2012; Şenler 2015).

Scientific inquiry refers to the processes of how scientists do their jobs and how emerging scientific knowledge is produced and accepted (Lederman, Lederman, Bartos, Bartels, Meyer & Schwartz, 2014). Scientific inquiry plays an important role in directing students towards science, improving their scientific attitudes, helping them think critically, and increasing their academic success by working like a scientist (Anderson, 2002; Schneider, Krajcik, Marx & Soloway, 2002). Schwartz, Lederman & Lederman (2008) presented an eight-component framework for defining scientific inquiry: "*There is no a single method, scientific investigations begin with a question, the procedures are guided by the question asked, the same procedures do not necessarily have same result, the procedures can influence the results, the conclusions must be consistent with data collected, data and evidence are different, and explanations are based on data and previous knowledge*".

One of the main goals of science education is to enable students to learn information fully and to develop scientific inquiry understanding by developing their skills such as scientific thinking, curiosity, research, and questioning (Ekici, 2016). By using scientific inquiry, students observe their environment and nature, make various researches to make sense of what they observe, gain new ideas or realize that they need to change their old thoughts thanks to the evidence they have reached (Yaşar & Duban, 2009). In addition, with scientific inquiry, it is aimed to prevent students from memorizing information and to learn and structure the information through practice (Ekici, 2016). In many studies, it has been proven that scientific inquiry helps to develop scientific understanding and the ability to reach information, and to find solutions to problems, active thinking at the secondary school level (Yang et al., 2017). It is a known fact that the studies conducted in the fields of education related to the concept of scientific inquiry are very important. In this direction, it has been determined that there are national and international studies on scientific inquiry with different sample groups in the literature (Akerson & Hanuscin, 2007; Aydeniz, Baksa & Skinner 2011; Ayyılmaz Çelik, 2019; Baykara, Yakar & Liu, 2018; Çiğdemoğlu & Köseoğlu, 2019; Doğan et al., 2020; Gaigher, Lederman & Lederman, 2014; Lederman, et al., 2019).

It is considered important to reveal what is happening in the literature and to know what the big picture of the literature is saying researchers. In addition, it is extremely important

to identify core publications with high impact value in the literature and conducting studies only for these in terms of making decisions and policies in the relevant field (Al, 2008; Yalçın, 2010). At the same time, there is a great need for the most cited article studies in order to see the gaps in the literature and the trends of the researches. Therefore, in recent years, it is frequently encountered in studies that examine the main articles produced in the literature and make judgments about them, in which bibliometric analyzes are made (Bozdoğan, 2020). In the literature, there are studies in which bibliometric analyzes are made in various science disciplines such as health, education, tourism, engineering, technology (Aktaş & Karamustafaoğlu, 2022; Çomaklı Sökmen & Yılmaz, 2021; Gülmez, Özteke & Gümüş, 2021; Orbay, Karamustafaoğlu & Miranda, 2021; Pinto, Fernández-Pascual et al., 2019; Ünal & Çelen, 2021; Winter & Origin, 2021; Yurdakul & Bozdoğan, 2022). In the study of Kutlu Abu (2023) it aimed to examine the research trends of inquiry-based science articles in the Web of Science database between 2000 and 2021. Saka and İnaltekin (2021) conducted a bibliometric analysis of academic studies in the last two decades on the inquiry-based teaching (ASBL) approach in the Web of Science (WoS) database. Ayaz and Küçükaydın Alkış (2021) conducted a bibliometric analysis of inquiry-based learning approach over WoS database in their study. Similarly, Aslancı (2022) analyzed 618 articles in the Scopus database in the field of inquiry-based learning between 1990 and 2019 using the bibliometric analysis method. Considering these studies, in the literature, there was no research that examines the studies published in the field of education related to scientific inquiry from a bibliometric perspective. In this context, starting from the gap in the literature, both bringing a new study method to the literature and giving direction to the study area in the context of different information, findings and suggestions to be produced from the study constitute the importance of the research.

1.1. Purpose of the Research

The purpose of this research was determined as "To examine the articles on scientific inquiry scanned in the Web of Science database in terms of bibliometric indicators". For this purpose, the problem sentence of the research was expressed as "What are the bibliometric features of the articles published on scientific inquiry scanned from the Web of Science database?". Based on this main problem statement, answers were sought for the following sub-problems:

1. What is the distribution of articles published on scientific inquiry according to publication years?
2. Which are the top 10 most cited articles from articles published on scientific inquiry?
3. What are the most frequently used keywords in articles published on scientific inquiry?
4. What are the most cited authors and number of publications within the scope of articles published on scientific inquiry?

5. What are the most cited journals within the scope of articles published on scientific inquiry?
6. What are the most cited countries within the scope of articles published on scientific inquiry?
7. Which publication languages are active within the scope of articles published on scientific inquiry?
8. What are the articles published in Türkiye on scientific inquiry?

2. METHOD

2.1. Research Design

The model of the research was determined as the bibliometric analysis method. The bibliometric analysis method is an important method that provides a macroscopic examination of the literature in a specific field and presents it to the reader in projection. Bibliometric analysis, which is one of the quantitative research methods, is characterized as descriptive and exploratory studies (Kurutkan & Orhan, 2018). Examining the development of academic studies on a certain field in terms of quality and quantity with the bibliometric analysis method is very important in the evaluation of the field (Law & Cheung, 2008; Temizkan, Çiçek & Özdemir, 2015). In this context, studies on scientific inquiry were examined using the bibliometric analysis method, which is a descriptive research technique.

2.2. Universe and Sample

The universe of the research consists of scientific studies written on scientific inquiry. The sample of the study consists of studies published in the "Education Educational Research" and "Education Scientific Disciplines" categories and article types in SCI-EXPANDED, SSCI, AHCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, and ESCI indexed journals in the WoS database between 1959-2022. In the study, 926 studies in the type of article searched with the word "Scientific inquiry" constitute the sample of the research.

2.3. Data Collection and Analysis

In this research, research titles were searched in the WoS database using the keyword "Scientific inquiry". The search process was carried out to cover the 64-year period between 1959 and 2022. The resulting publications were limited based on inclusion/exclusion (filtering) criteria. The categories "Education Educational Research" and "Education Scientific Disciplines" and article type were determined as inclusion criteria in the research. As a result of these criteria, bibliometric data of 926 academic studies from 3,444 results were used as the data set of the study. The recording of the data was carried out on November 15, 2022. In addition, in order to find an answer to the sub-problem of the studies conducted in Türkiye on scientific inquiry, 57 studies selected from the data set of 926 studies were accepted as the data set for the analysis of the sub-problems.

In the analysis of the data, first a total of 926 publications on scientific inquiry, which were published in the period from 1959 to 2022, were examined and categorized in terms of bibliometric indicators. Percentages and frequencies of categorized data were calculated. MS Excel application was used for these calculations. VOSviewer is a software tool for creating and visualizing maps based on network data (Rafols et al., 2012; Van-Eck & Waltman, 2010). For this reason, in the study, the social network analysis of the keywords, the citation network of the studies and the co-citation network analysis were visualized through the VOSviewer (Version 1.6.16) package program, which is one of the bibliometric analysis tools.

3. RESULTS

3.1. Findings Related to the First Research Problem

The first sub-problem of the research was determined as "*What is the distribution of articles published on scientific inquiry according to publication years*?". In order to find an answer to this sub-problem, 926 articles published on scientific inquiry were reached as a result of the search made in the WoS database. The distribution of the accessed articles according to the publication years is given in Table 1.

Table 1. Distribution of Published Articles on Scientific Inquiry according to Years of Publication (N=926)

Years of Publication	Number of Publication (f)	Percentage (%)	Years of Publication	Number of Publication (f)	Percentage (%)
1959	1	0,11	2005	16	1,73
1962	1	0,11	2006	26	2,81
1972	1	0,11	2007	16	1,73
1977	1	0,11	2008	30	3,24
1985	1	0,11	2009	40	4,32
1989	1	0,11	2010	47	5,08
1992	2	0,22	2011	46	4,97
1993	2	0,22	2012	56	6,05
1994	3	0,32	2013	51	5,51
1995	4	0,43	2014	66	7,13
1996	4	0,43	2015	56	6,05
1997	4	0,43	2016	57	6,16
1998	5	0,54	2017	68	7,34
1999	4	0,43	2018	68	7,34
2000	9	0,97	2019	70	7,56
2001	3	0,32	2020	76	8,21
2002	4	0,43	2021	67	7,24
2003	8	0,86	2022	3	0,32
2004	9	0,97			

When the articles published on scientific inquiry were examined, it was observed that the highest number of articles was published in 2020 (76 articles). It was determined that this was followed by 2019 (70 articles), 2018 (68 articles) and 2017 (68 articles), 2021 (67 articles) and 2014 (66 articles), respectively. It is seen that 68.9 % (638 articles) of the published articles were published in the last ten years.

3.2. Findings Related to the Second Research Problem

The second sub-problem of the research was determined as "Which are the top 10 most cited articles from articles published on scientific inquiry?". As a result of the search made in the WoS database to find an answer to this sub-problem, 926 articles published on scientific inquiry were reached. The tags of the 926 articles in question were examined and it was seen that the total number of citations of the articles was 17472 and the average number of citations was 18.87. Knowledge on the top ten most cited articles from the articles published on scientific inquiry is given in Table 2.

Table 2. Top Ten Most Cited Articles Published on Scientific Inquiry (N=581)

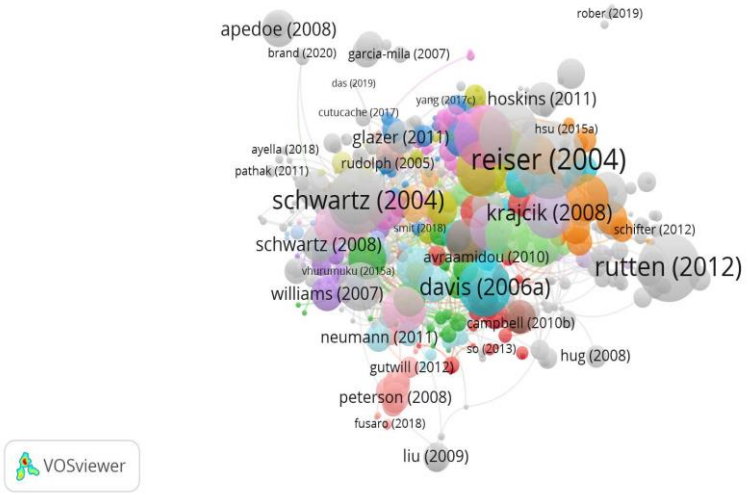
Article Title	Author/Authors	Years of Publication	Published Journal Title	Total Number of Citation	Number of Citation/Year
"Scaffolding complex learning: The mechanisms of structuring and problematizing student work"	Reiser, B.J.	2004	Journal of The Learning Sciences	476	25.05
"The learning effects of computer simulations in science education"	Rutten, N.; Joolingen, W.R. and Van der Veen, J. T.	2012	Computers & Education	364	33.09
"Developing views of nature of science in an authentic context: An explicit approach to bridging the gap between nature of science and scientific inquiry"	Schwartz, R.S.; Lederman, N. G. and Crawford, B.A	2004	Science Education	346	18.21
"Explanation-driven inquiry: Integrating conceptual and epistemic scaffolds for scientific inquiry"	Sandoval, W.A. and Reiser, B.J.	2004	Science Education	330	17.37

"Making Sense of Argumentation and Explanation"	Berland, L.K. and Reiser, B.J.	2009	Science Education	311	22.21
"Challenges new science teachers face"	Davis, E.A.; Petish, D. and Smithey, J.	2006	Review of Educational Research	259	15.24
"Just do it? Impact of a science apprenticeship program on high school students' understandings of the nature of science and scientific inquiry"	Bell, R.L.; Blair, L. M.; Crawford, B.A.A and Lederman, N.G.	2003	Journal of Research in Science Teaching	241	12.05
"Students' questions: a potential resource for teaching and learning science"	Chin, C. and Osborne, J.	2008	Studies in Science Education	236	15.73
"Learning-goals-driven design model: Developing curriculum materials that align with national standards and incorporate project-based pedagogy"	Krajcik, J.; McNeill, K.L. and Reiser, B.J.	2008	Science Education	198	13.20
"Recognizing mechanistic reasoning in student scientific inquiry: A framework for discourse analysis developed from philosophy of science"	Russ, R.S.; Scherr, R.E.; Hammer, D. and Mikeska, J.	2008	Science Education	182	12.13

The first published article on scientific inquiry is the study titled "Ideology and Utopia as Categories for Scientific Inquiry" published by Rislov, S. in the journal "Educational Theory" in 1959. When Table 2 is examined, the most cited article is the article titled "Scaffolding complex learning: The mechanisms of structuring and problematizing student work", which was published in the "Journal of The Learning Sciences" in 2004

with 476 citations. It was determined that this study was followed by the article published in the journal "Computers & Education" in 2012, which received 364 citations, and the article published in the journal "Science Education" in 2004, which received 346 citations. The citation network of published articles on scientific inquiry is presented in Figure 1.

Figure 1. The citation network of articles published on scientific inquiry



3.3. Findings Related to the Third Research Problem

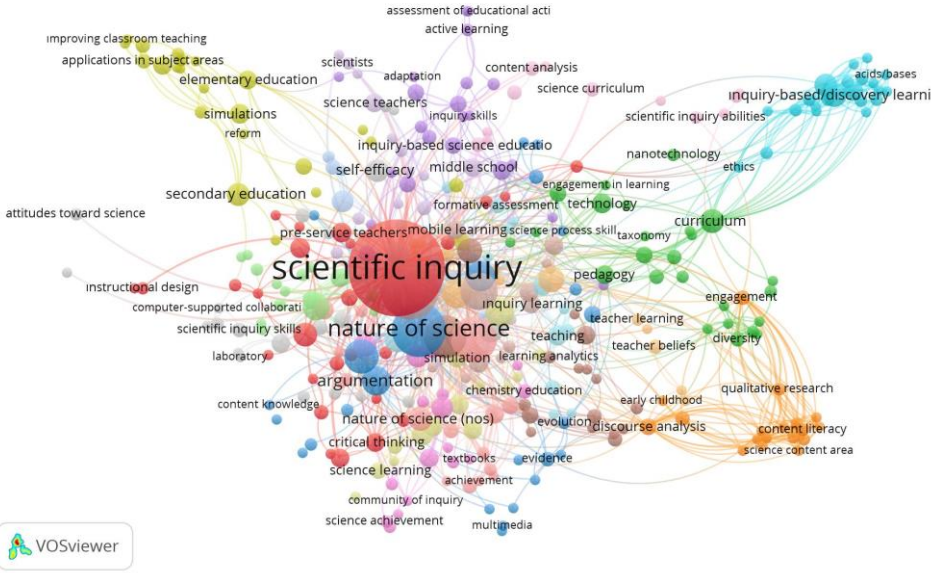
The third sub-problem of the research was determined as "What are the most frequently used keywords in articles published on scientific inquiry?". As a result of the search made in the WoS database to find an answer to this sub-problem, 926 articles published on scientific inquiry were reached. Frequency information for the 24 most frequently used keywords in the accessed articles is given in Table 3. Also, the minimum number of occurrences of a keyword option is set to 2 and 351 keywords are selected in the VOSviewer software tool. The map which was produced is shown in Figure 2.

Table 3. The Frequency Distribution of 24 Most Frequently Used Keywords in Articles Published on Scientific Inquiry

Keyword	f	Keyword	f
Scientific inquiry	155	Science inquiry	12
Science education	57	Science	12
Nature of science	50	Problem solving	11

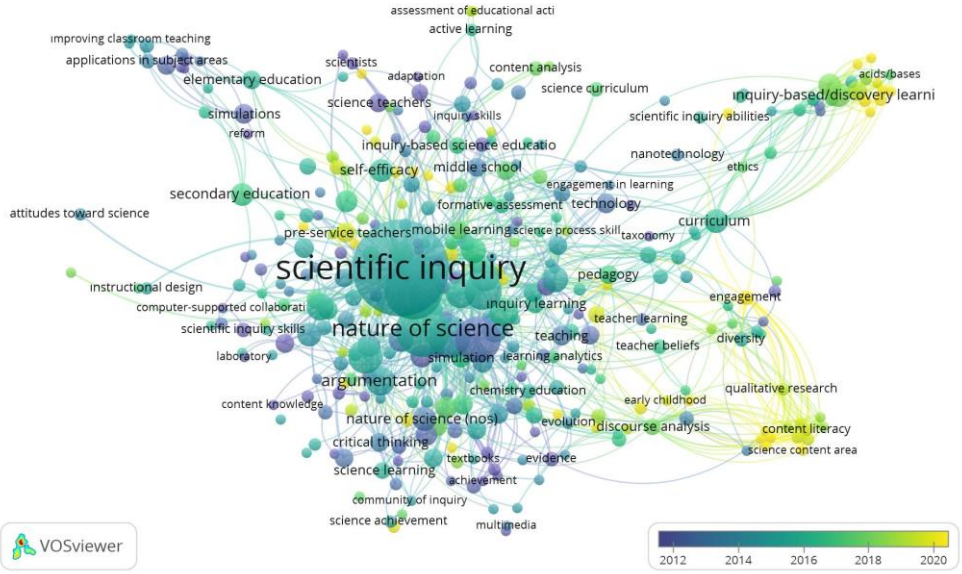
İnquiry	36	Science teaching	11
Inquiry	30	Inquiry based/discovery learning	10
Professional development	24	STEM	10
Scientific literacy	20	Curriculum	10
Assessment	16	Scaffolding	10
Teacher education	15	Nature of science (NoS)	10
Argumentation	14	High school/introductory chemistry	9
Inquiry-based learning	14	Self-efficacy	9
Scientific inquiry	13	Laboratory work	9

Figure 2. The most used keywords in articles related to scientific inquiry



When Table 3 and Figure 2 are examined, it is seen that the most used keyword in the articles published on scientific inquiry is "scientific inquiry" (f=155). It was determined that this keyword was followed by the keywords "science education" (f=57), "nature of science" (f=50), "inquiry" (f=36) and "inquiry" (f=30). The citation network showing the distribution of keywords used in articles published on scientific inquiry by years is given in Figure 3.

Figure 3. The citation network showing the distribution of keywords used in articles published on scientific inquiry by years

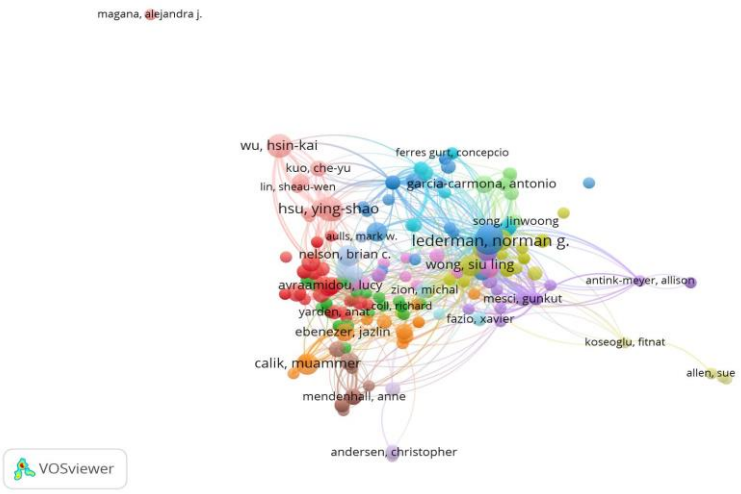


When Figure 3 is examined, it is seen that the average publication year of the keywords frequently used in the articles is “2016”. It has been determined that the average publication years of keywords such as “middle school science”, “inquiry”, “science teachers” and “inquiry learning” are 2012 and earlier.

3.4. Findings Related to the Fourth Research Problem

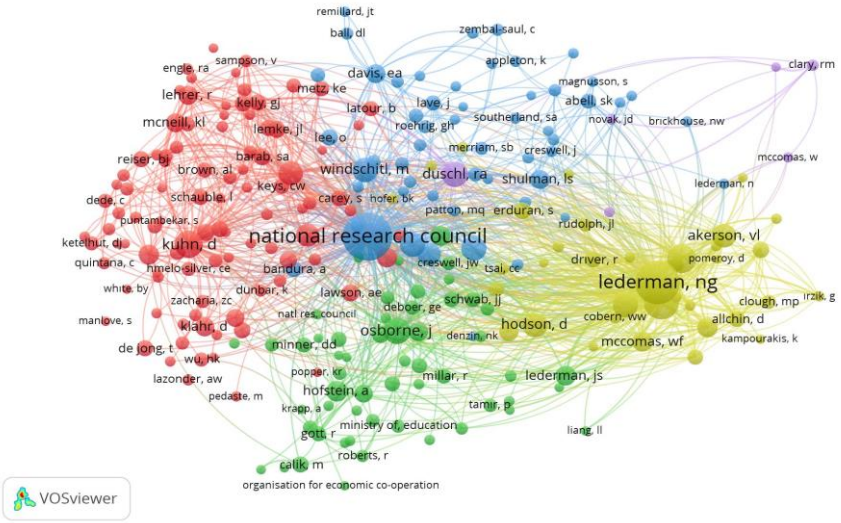
The fourth sub-problem of the research was determined as “What are the most cited authors and number of publications within the scope of articles published on scientific inquiry?”. As a result of the search made in the WoS database to find an answer to this sub-problem, 926 articles published on scientific inquiry were reached. The citation analysis network for the most cited authors in the articles reached is given in Figure 4.

Figure 4. The citation analysis network for top cited authors in articles published on scientific inquiry



When Figure 4 is examined, it is seen that "Reiser, B. J." is the most cited author within the scope of articles published on scientific inquiry (Publication=2; Citation =806). It has been determined that this author is followed by "Lederman, N. G.", "McNeill, K. L.", "Krajcik, J.", "Crawford, B. A." and "Lederman, J. S." authors. In addition, the co-citation analysis network for the most cited authors in the articles is shown in Figure 5.

Figure 5. The co-citation analysis network for top cited authors in articles published on scientific inquiry



When Figure 5 is examined, it is determined that the most cited authors as a result of the co-citation analysis conducted are "National Research Council" (Citation=647), "Lederman, N. G." (Citation=510), "Abd-El-Khalick, F." (Citation=302), "Schwartz, R.S." (Citation=206) and "Kuhn, D." (Citation = 193). The country and the number of citations for the 10 most cited authors within the scope of the study are presented in Table 4.

Table 4. The Countries and Citation Numbers of 10 Authors Who Contributed the Most to the Field in the Scope of Scientific Inquiry

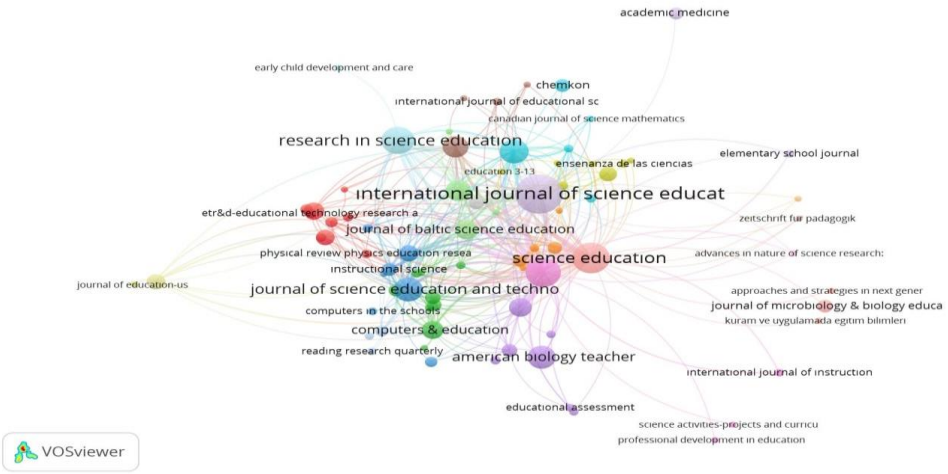
Author	Number of Citation
National Research Council	647
Lederman, N.G.	510
Abd-El-Khalick, F.	302
Schwartz, R. S.	206
Kuhn, D.	193
Osborne, J.	183
Duschl, R. A.	170
Bell, R.L.	158

Windschitl, M.	158
American Association for the advancement of science	157
Hodson, D.	153

3.5. Findings Related to the Fifth Research Problem

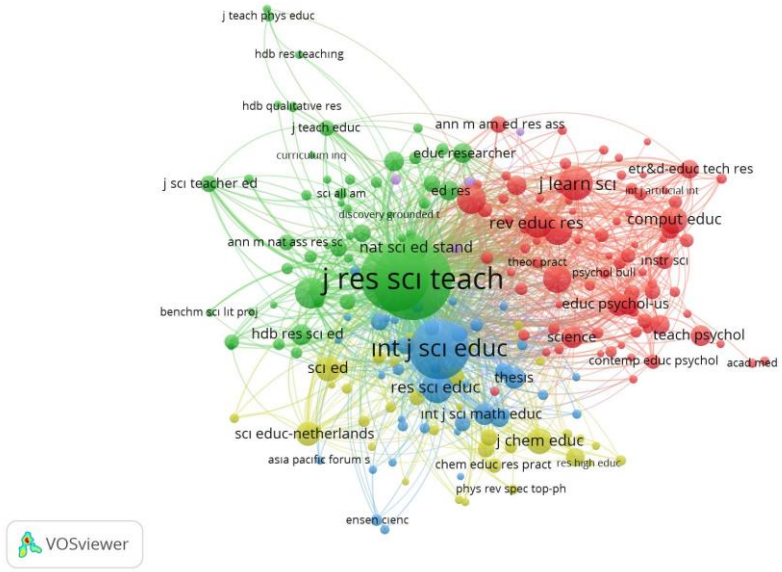
The fifth sub-problem of the research was determined as "What are the most cited journals within the scope of articles published on scientific inquiry?". As a result of the search made in the WoS database to find an answer to this sub-problem, 232 journals in which 926 articles were published on scientific inquiry were reached. The citation analysis network for the most cited journals is given in Figure 6.

Figure 6. The citation analysis network for the most cited journals in the scope of articles published on scientific inquiry



When Figure 6 is examined, it is seen that the most cited journal within the scope of articles published on scientific inquiry is "Science Education" (Publication= 54; Citation=3285). It has been determined that this journal is followed by "Journal of research in science teaching (Publication = 49; Citation = 2568)", "International Journal of Science Education (Publication = 94; Citation = 1928)", "Computer & Education (Publication =17; Citation = 997)" and "Journal of Learning Sciences (Publication = 6; Citation = 815)" journals. In addition, the common citation analysis network for the most cited journals is shown in Figure 7.

Figure 7. The common citation analysis network for most cited journals in the scope of articles published on scientific inquiry

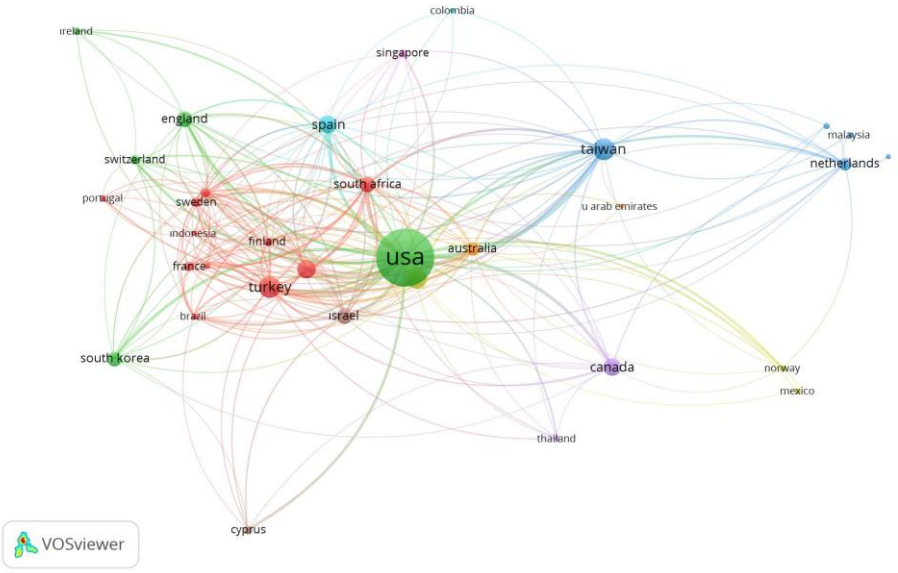


When Figure 7 is examined, it is seen that the most cited journals are “Journal of Research in Science Teaching” (Citation = 3448) and “Science Education” (Citation = 2474) and “International Journal of Science Education” (Citation = 1876) as a result of the common citation analysis.

3.6. Findings Related to the Sixth Research Problem

The sixth sub-problem of the research was determined as “What are the most cited countries within the scope of articles published on scientific inquiry?”. As a result of the search made in the WoS database to find an answer to this sub-problem, 61 countries in which 926 articles were published on scientific inquiry were reached. The citation analysis network for the most cited countries within the scope of the articles reached is given in Figure 8.

Figure 8. The citation analysis network for most cited countries within the scope of articles published on scientific inquiry



When Figure 8 is examined, as a result of the citation analysis carried out, it has been determined that the countries that are most active within the scope of the articles are "USA" (Publication = 471, Citation = 11798), "Taiwan" (Publication = 56, Citation = 680), "Netherlands" (Publication = 17, Citation = 671), "Israel" (Publication = 28, Citation = 666) and "Canada" (Publication= 36, Citation= 661). Within the scope of the study, the information on the number of publications and citations for the 20 most active countries in the field is presented in Table 5.

Table 5. The Number of Publications and Citations Regarding the 20 Most Active Countries on Scientific Inquiry

Country	Number of Publication	Number of Citation	Country	Number of Publication	Number of Citation
USA	471	11798	Singapore	8	291
Taiwan	56	680	Germany	42	276
Netherlands	17	671	Spain	36	235
Israel	28	666	Cyprus	8	229
Canada	37	661	South Africa	30	189
England	27	583	Ireland	6	173

P.R.China	50	577	South Korea	25	169
Australia	20	541	Sweden	11	160
Türkiye	56	438	Finland	7	148
New Zealand	9	296	Switzerland	11	116

3.7. Findings Related to the Seventh Research Problem

The seventh sub-problem of the research was determined as "Which publication languages are active within the scope of articles published on scientific inquiry?". As a result of the search made in the WoS database to find an answer to this sub-problem, 926 articles published on scientific inquiry were reached. The distribution of the reached articles according to the publication languages is given in Table 6.

Table 6. The Distribution of Articles Published on Scientific Inquiry by Publication Languages (N=581)

Publication Language	Number of Publication	Percentage (%)
English	879	0,9492
Spanish	20	0,0216
German	14	0,0151
Chinese	4	0,0043
Portuguese	3	0,0032
Turkish	3	0,0032
Polish	2	0,0022
Icelandic	1	0,0011

When Table 6 is examined, it is seen that the articles published on scientific inquiry are mostly published in English (879 articles). It was determined that Spanish (20 articles), German (14 articles) and Chinese (4 articles) languages followed respectively**.**

3.8. Findings Related to the Eighth Research Problem

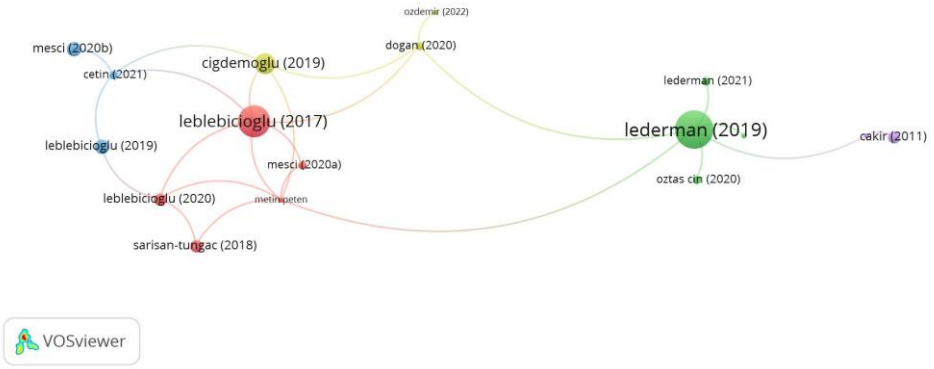
The eighth sub-problem of the research was determined as "What are the articles published in Türkiye on scientific inquiry?". As a result of the search made in the WoS database to find an answer to this sub-problem, 57articles published in Türkiye on scientific inquiry were reached. The tags of the 57 articles in question were examined and it was seen that the total number of citations of the articles was 439 and the average number of citations was 7.70. The information on the top five most cited articles on scientific inquiry published in Türkiye is given in Table 7.

Table 7. The Top Five Most Cited Articles on Scientific Inquiry Published in Türkiye (N=57)

Article Title	Author/Authors	Years of Publication	Published Journal Title	Total Number of Citation	Number of Citation/Year
"Research trends on argumentation in science education: a journal content analysis from 1998-2014"	Erduran, S.; Özdem, Y. and Park, J. Y.	2015	International Journal of STEM Education	49	6.13
"Preservice teachers' views about nature of scientific knowledge development: An international collaborative study"	Liang, L.L., Chen, S. F., Chen, X., Kaya, O. N., Adams, A.D., Macklin, M. and Ebenezer, J.	2009	International Journal of Science and Mathematics Education	40	2.86
"The Nature of Pre-service Science Teachers' Argumentation in Inquiry-oriented Laboratory Context"	Özdem, Y., Ertepınar, H., Çakıroğlu, J. and Erduran, S.	2013	International Journal of Science Education	39	3.90
"Engaging Students in Environmental Research Projects: Perceptions of Fluency with innovative Technologies and Levels of Scientific Inquiry Abilities"	Ebenezer, J., Kaya, O. N. and Ebenezer, D.L.	2011	Journal of Research in Science Teaching	39	3.25
"Effect of Technology-Embedded Scientific Inquiry on Senior Science Student Teachers' Self-Efficacy"	Çalık, M.	2013	Eurasia Journal of Mathematics Science and Technology Education	37	3.7

When Table 7 is examined, it is seen that the first article of Turkish origin on scientific inquiry was the article titled "Inquiry-Based Science Laboratories: An Analysis of Preservice Teachers' Beliefs about Learning Science through Inquiry and Their Performances" published by Tatar, N. in the journal "Journal of Baltic Science Education" in 2012. The most cited article is the article published in the "International Journal of STEM Education" in 2015 with 49 citations. It was determined that this study was followed by the article published in the "International Journal of Science and Mathematics Education" in 2009, which received 40 citations, and the article published in the "International Journal of Science Education" in 2013, which received 39 citations. The citation network of articles published in Türkiye on scientific inquiry is presented in Figure 9.

Figure 9. The citation network of articles published in Türkiye



4. CONCLUSION, DISCUSSION AND SUGGESTIONS

In this study, 926 articles in the categories of "*Education Educational Research*" and "*Education Scientific Disciplines*" and article type out of 3,444 results reached on scientific inquiry in the WoS database were analyzed in terms of different variables.

As a result of the research, it was determined that the most articles on scientific inquiry were published in 2020 (76 articles). It was determined that this was followed by 2019 (70 articles), 2018 (68 articles) and 2017 (68 articles), 2021 (67 articles) and 2014 (66 articles), respectively. As a matter of fact, Bozdoğan (2019) states in his study that "article" is the most preferred publication type because they provide concrete data in determining the productivity and academic activities of scientists. In addition, it was concluded that 68.9% (638 articles) of the articles published in the research were

published in the last ten years. This situation can be interpreted as a rapid increase in the number of studies on scientific inquiry in recent years. This may be due to the fact that the related approach also includes other different approaches such as constructivism (Anderson, 2002). When the relevant literature is examined, Ayaz and Alkış Küçükaydın (2021) found that the most publications were published in 2020 and the number of articles on the research-inquiry approach increased gradually after 2015. Similarly, in the study of Aslan (2022), the research determined that the studies on inquiry-based learning were published at the highest rate between 2015-2019 and the year in which the most studies were conducted was 2019.

The first published article on scientific inquiry is the study titled "*Ideology and Utopia as Categories for Scientific Inquiry*" published by Rislov, S. in the journal "*Educational Theory*" in 1959. When Table 2 is examined, the most cited article is the article titled "Scaffolding complex learning: The mechanisms of structuring and problematizing student work", which was published in the "*Journal of the Learning Sciences*" in 2004 with 476 citations. It was determined that this study was followed by the article published in the journal "*Computers & Education*" in 2012, which received 364 citations, and the article published in the journal "*Science Education*" in 2004, which received 346 citations. It has been determined that the most used keyword in the articles published on scientific inquiry is "scientific inquiry" (f=155). It was determined that this keyword was followed by the keywords "science education" (f=57), "nature of science" (f=50), "inquiry" (f=36) and "inquiry" (f=30). This data reveals that researchers should use these keywords when searching the WoS database related to this field. Keywords are very important for indexing and accessing research easily (Gürlen, Özdiyar & Şen, 2019). Within the framework of this study, it can be said that the "scientific inquiry" keyword stands out because it is the word that most clearly and best describes the content as a pattern in all fields.

Another result obtained from the research is that the most cited author within the scope of articles published on scientific inquiry is "Reiser, B. J." (Publication=2; Citation =806). It has been determined that this author is followed by "Lederman, N. G.", "McNeill, K. L.", "Krajcik, J.", "Crawford, B. A." and "Lederman, J. S." authors. In addition, it is concluded that the most cited authors as a result of the co-citation analysis conducted are "National Research Council" (Citation=647), "Lederman, N. G." (Citation=510), "Abd-El-Khalick, F." (Citation=302), "Schwartz, R.S." (Citation=206) and "Kuhn, D." (Citation = 193). It is determined that the most cited journal within the scope of articles published on scientific inquiry is "Science Education" (Publication= 54; Citation=3285). It has been determined that this journal is followed by "Journal of research in science teaching (Publication = 49; Citation = 2568)", "International Journal of Science Education (Publication = 94; Citation = 1928)", "Computer & Education (Publication =17; Citation = 997)" and "Journal of Learning Sciences (Publication = 6; Citation = 815)" journals. In addition, it is concluded that the most cited journals are "Journal of Research in Science Teaching" (Citation = 3448) and "Science Education" (Citation =

2474) and "International Journal of Science Education" (Citation = 1876) as a result of the common citation analysis. This may be an indication that the United States and England are the leaders in publishing articles in the field of science education and that important journals in the WoS database continue to publish in these countries. There are other studies in the literature that support the leading position of the USA in the field (Demir & Çelik, 2020; Demirgil, 2018; Liu et al., 2016). In their study, Ayaz and Alkış Küçükaydın (2021) concluded that the journals that included the most articles on this subject were "International Journal of Science Education", "Journal of Research in Science Teaching" and "Research in Science Teaching". Similarly, Saka and İnaltekin (2021) found in their study that the "International Journal of Science Education" resource has strongly fed other resources in recent years.

It has been determined that the most cited countries within the scope of articles published on scientific inquiry are "USA" (Publication= 471, Citation= 11798), "Taiwan" (Publication= 56, Citation= 680), "Netherlands" (Publication= 17, Citation= 671), "Israel" (Publication= 28, Citation= 666) and "Canada" (Publication= 36, Citation= 661). In their study, Ayaz and Alkış Küçükaydın (2021) stated that most of the studies on this subject originated in the USA; at the same time, they found that Türkiye is in the top 3 rankings. In their study, Saka & İnaltekin (2019) concluded that the institutions that contributed the most in this regard were based in the USA and England. Similarly, in the study of Aslan (2022), the research found that the countries with the most publications on inquiry-based learning were the United States, Türkiye and the United Kingdom, respectively. This situation confirms the view that the USA is one of the leading countries in the field of science education (Aksu & Güzeller, 2019; Demir & Selvi, 2018; Özkaya, 2019; Yu et al., 2016; Yurdakul & Bozdoğan, 2022). The fact that Türkiye ranks 9th out of 61 countries can be considered as an indication that many qualified publications have been made that will contribute to the field of scientific inquiry.

It is concluded that the articles published on scientific inquiry are mostly published in English (879 articles). It was determined that Spanish (20 articles), German (14 articles) and Chinese (4 articles) languages followed respectively. It is thought that the use of English more than other languages in academic studies is due to its universality. There are studies in the literature that reveal this result (Bozdoğan, 2019; Demir & Çelik, 2020; Diaz-Puente, Cazorla & Dorrego, 2007; Jiménez-Fanjul et al., 2013; Yurdakul & Bozdoğan, 2022). The fact that Turkish is ranked 6th among eight languages with 3 publications can be interpreted as that articles written in Turkish are not effective in directing the field.

It is determined that the first article of Turkish origin on scientific inquiry was the article titled "*Inquiry-Based Science Laboratories: An Analysis of Preservice Teachers' Beliefs about Learning Science through Inquiry and Their Performances*" published by Tatar, N. in the journal "Journal of Baltic Science Education" in 2012. The most cited article is the article published in the "International Journal of STEM Education" in 2015 with 49 citations. It was determined that this study was followed by the article published in the

"International Journal of Science and Mathematics Education" in 2009, which received 40 citations, and the article published in the "International Journal of Science Education" in 2013, which received 39 citations.

Suggestions regarding the study findings are listed below:

- In this study, articles on scientific inquiry were searched in the WoS database. The literature in this field can be revealed on a larger scale by scanning different types of publications (paper, book, book chapter, reports, etc.) in the same field. However, to give an idea to the researchers who will study in this field, national and international postgraduate theses can be scanned to reveal the trend in this field.
- Since the study is limited to WoS data, studies on the subject can be examined in international databases such as SCOPUS or national databases such as ULAKBİM and Dergipark.
- The study includes studies in the categories of "Education Educational Research" and "Education Scientific Disciplines" and article type between 1959-2022. For this reason, trends in the field can be determined by conducting similar studies at certain periods.
- Bibliometric studies are important for researchers to closely follow the studies and developments in that field. For this reason, it may be recommended to conduct bibliometric studies in different fields.

Declaration of Research and Publication Ethics

In all processes of the article, the research and publication ethics principles of Manisa Celal Bayar University Social Sciences Institute Journal were followed.

Authors' Contribution Rates to the Article

The entire article was written by Barış ÖZDEN

Declaration of Interest

The author has no conflict of interest with any person or organization.

References

Akerson, V. L., & Hanuscin, D. L. (2007). Teaching nature of science through inquiry: Results of a3-year professional development program. *Journal of Research in Science Teaching, 44*(5), 653- 680.

Aksu, G., & Güzeller, C. O. (2019). Analysis of scientific studies on item response theory by bibliometric analysis method. *International Journal of Progressive Education, 15*(2), 44-64. https://doi.org/10.29329/ijpe.2019.189.4

Aktaş, İ., & Karamustafaoğlu, O. (2022). Evaluation of the published articles in educational field: A bibliometric analysis. *Hacettepe University Journal of Education, 37*(3), 1037-1050.

Al, U. (2008). *Turkey's scientific publication policy: A bibliometric approach based on citation indexes.* [Unpublished doctoral dissertation thesis]. Hacettepe University Institute of Social Sciences, Ankara.

Anderson, R. D. (2002). Reforming science teaching: What research says about inquiry. *Journal of Science Teacher Education*, *13*(1), 1-12. https://doi.org/10.1023/A:1015171124982

Aslancı, S. (2022). Inquiry-based learning: a bibliometric analysis. *Scientific Educational Studies, 6*(1), 1-25.

Ayaz, E., & Küçükaydın Alkış, M. (2021). Investigation of inquiry-based learning approach studies: a bibliometric analysis. *Paper presented at the meeting of the 3. International Conference on Science, Mathematics, Entrepreneurship and Technology Education*, Denizli.

Aydeniz, M., Baksa, K., & Skinner, J. (2011). Understanding the impact of an apprenticeship-based scientific research program on high school students' understanding of scientific inquiry. *Journal of Science Education and Technology, 20*(4), 403-421. http://dx.doi.org/10.1007/s10956-010-9261-4

Ayyılmaz Çelik, H. (2019). *Knowledge and views of secondary school science teachers and prospective science teachers about the nature of science and scientific inquiry.* [Unpublished master thesis]. Aydın Adnan Menderes University Institute of Science and Technology, Aydın.

Baykara, H., Yakar, Z., & Liu, S. Y. (2018). Preservice science teachers' views about scientific inquiry. *European Journal of Education Studies, 4(*10), 128-143.

Bozdoğan, A. E. (2020). A bibliometric evaluation of published educational research papers on "planetariums" based on web of science database. *OPUS Journal of Society Research, 16*(27), 150-173.

Chadegani, A. A., Salehi, H., Yunus, M., Farhadi, H., Fooladi, M., Farhadi, M., & Ebrahim, N. A. (2013). A comparison between two main academic literature collections: web of science and scopus databases. *Asian Social Science, 9*(5), 18-26.

Çiğdemoğlu, C., & Köseoğlu, F. (2019). Improving science teachers' views about scientific inquiry. *Science & Education, 28,* 439-469. https://doi.org/10.1007/s11191-019-00054-0

Çomaklı Sökmen, Ö. & Yılmaz, M. (2021). Bibliometric analysis of the studies performed in operations research field. *European Journal of Science and Technology Special Issue (28), 940-946*.

Demir, E., & Çelik, M. (2020). Bibliometric Profile of Scientific Studies in the Field of Science Curriculum. *Journal of Turkish Chemical Society Section C: Chemistry Education, 5*(2), 131-182.

Demir, H., & Selvi, S. (2018). Bibliometric analysis of scientific publications on resource dependency approach in the field of health. *17. Business Congress with International Participation, 26-28 April, (p. 1-14), Izmir Katip Celebi University*, İzmir.

Demirgil, H. (2018). Scientific concentration fields and bibliometrics networks in Süleyman Demirel university publications. *Süleyman Demirel University Faculty of Arts and Sciences Journal of Science, 13*(2), 36-53.

Diaz-Puente, J.M., Cazorla, A. & Dorrego, A. (2007). Crossing National, Continental, and Linguistic Boundaries Toward a Worldwide Evaluation Research Community in Journals of Evaluation. *American Journal of Evaluation,28*(4), 399-415.

Dogan, N. (2017). Blending problem based learning and history of science approaches to enhance views about scientific inquiry: New wine in an old bottle. *Journal of Education and Training Studies, 5*(10), 99-112. https://doi.org/10.11114/jets.v5i10.2646

Doğan, N., Han-Tosunoglu, Ç., Özer, F., & Akkan, B. (2020). Middle school students' understanding of scientific inquiry: an investigation of gender, grade level and school type. *Pamukkale University Journal of Education, 49,* 162-189. https://doi.org/10.9779/pauefd.515080

Ekici, D. (2016). An investigation on the factors affecting the scientific inquiry skills perceptions of secondary students. *Kastamonu Journal of Education, 25*(2), 497-516.

Gaigher, E., Lederman, N., & Lederman, J. (2014). Knowledge about inquiry: A study in South African high schools. *International Journal of Science Education*, *36*(18), 3125-3147. https://doi.org/10.1080/09500693.2014.954156

Gülmez, D., Özteke, İ., & Gümüş, S. (2021). Overview of educational research from Turkey published in international journals: A bibliometric analysis. *Education and Science*, *46*(206), 213-239.

Gürlen, E., Özdiyar, Ö., & Şen, Z. (2019). Social network analysis of academic studies on gifted people. *Education and Science*, *44*(197), 185-208.

Jiménez-Fanjul, N., Maz-Machado, A., & Bracho-López, R. (2013). Bibliometrıc analysis of the mathematics education journals in the SSCI. *International Journal of Research in Social Sciences, 2*(3), 26-32.

Kurutkan, M.N., & Orhan, F., (2018). *Bibliometric analysis of quality principles by visual mapping technique.* Sage Publishing.

Kutlu Abu, N. (2023). Bibliometric Analysis of Inquiry-Based Science Research During 2000-2021. *Shanlax International Journal of Education*, *12*(1), 70-85.

Law, R., & Cheung, P. (2008). An analysis of publications in leading tourism journals and its ımplications. *Journal of China Tourism Research*, *4*(1), 78-97.

Lederman, J. S., Lederman, N. G., Bartos, S. A., Bartels, S. L, Meyer, A. A., & Schwartz, R. S. (2014). Meaningful assessment of learners' understandings about scientific inquiry-the views about scientific inquiry (VASI) questionnaire. *Journal of Research in Science Teaching, 51*(1) 65-83. https://doi.org/10.1002/tea.21125

Lederman, J., Lederman, N., Bartels, S., Jimenez, J., Akubo, M., Aly, S., Bao, C., Blanquet, E., Blonder, R., Soares de Andrade, M. B., Buntting, C., Cakir, M., EL-Deghaidy, H., ElZorkani, A., Gaigher, E., Guo, S., Hakanen, A., Hamed Al-Lal, S., Han-Tosunoglu, C., ... Zhou, Q. (2019). An international collaborative investigation of beginning seventh grade students' understandings of scientific inquiry: Establishing a baseline. *Journal of Research in Science Teaching*, *56*(4), 486-515. https://doi.org/10.1002/tea.21512

Liu, X., Zhang, L., & Hong, S. (2011). Global biodiversity research during 1900–2009: A bibliometric analysis. *Biodiversity and Conservation, 20*(4), 807-826.

Orbay, M., Karamustafaoğlu, O., & Miranda, R. (2021). Analysis of the journal impact factor and related bibliometric indicators in education and educational research category. *Education for Information, 37*(3), 315-336.

Özkaya, A. (2019). Bibliometric analysis of the publications made in STEM education area. *Bartın University Journal of Faculty of Education, 8*(2), 590-628.

Pinto, M., Fernández-Pascual, R., Caballero-Mariscal, D., Sales, D., Guerrero, D., & Uribe, A. (2019). Scientific production on mobile information literacy in higher education: A bibliometric analysis (2006–2017). *Scientometrics, 120*(1), 57–85. https://doi.org/10.1007/s11192-019-03115-x

Rafols, I., Leydesdorff, L., O'Hare, A., Nightingale, P., & Stirling, A. (2012). How journal rankings can suppress interdisciplinarity. The case of innovation studies and business and management. *Research Policy, 41*(7), 1262–1282.

Saka, T. & İnaltekin, T. (2021). Bibliometric analysis of academic studies regarding inquiry-based teaching (2000- 2020). *OPUS International Journal of Society Researches, 18*(40), 2408-24491.

Saka, Y, Yaman, S, Tunç Şahin, C, Pekbay, C., & Gerçek, Z. (2012). The effects of structured laboratory activities on middle school students' views of scientific inquiry. *Manisa Celal Bayar University Journal of the Faculty of Education, 2*(1), 1-19.

Schwartz, R. S., Lederman, N. G., & Lederman, J. S. (2008). An instrument to assess views of scientific inquiry: The VOSI questionnaire. *Paper presented at the meeting of the National Association for Research in Science Teaching (NARST)*, Baltimore, MD.

Senler, B. (2015). Middle school students' views of scientific inquiry: An international comparative study. *Science Education International, 26*(2), 166-179.

Temizkan, S. P., Çiçek, D., & Özdemir, C. (2015). Bibliometric profile of articles published on health tourism. *International Journal of Human Sciences, 12*(2), 394-415.

Ünal, A., & Çelen, O. (2021). A study on the analysis of published bibliometric studies on tourism in Turkey. *Pearson journal, 6*(16), 267–295. https://doi.org/10.46872/pj.429

Van Eck, N., & Waltman, L. (2010). Software survey: 'VOSviewer, a computer program for bibliometric mapping. *Scientometrics, 84*(2), 523-538.

Yalçın, F. (2010). *A study on the determination of knowledge levels and misconceptions of primary school students about global warming and greenhouse effect.* [Unpublished master thesis]. Gazi University Institute of Educational Sciences, Ankara.

Yang, I. H., Park, S. W., Shin, J. Y., & Lim, S. M. (2017). Exploring Korean middle school students' view about scientific inquiry. *Eurasia Journal of Mathematics Science and Technology Education, 13*(7), 3935-3958.

Yaşar, Ş., & Duban, N. (2009). Students' opinions regarding to the inquiry-based learning approach. *İlköğretim Online, 8*(2), 457-475.

Yurdakul, M., & Bozdoğan, A. E. (2022). Bibliometric Evaluation Based on Web of Science Database: Articles on Science Education. *Turkish Scientific Researches Journal, 7*(1), 72-92.