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Integrated Educational Research: A Bibliometric Analysis

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Abstract

This study aims to address the gap in integrated education research by uncovering the conceptual, intellectual, and social structure of the field, including the publication volume and recent developments in integrated education studies. For this purpose, the data were obtained from the Web of Science (WoS) and Scopus databases covering the years 1944-2023. 1486 data were accessed from 689 sources. The data were analyzed and visualized with the R-based Bibliometrix analysis and Vosviewer. In this study, citation analysis was used to identify prolific authors, important documents, and resources in the field of integrated education. In addition, co-authorship and co-citation analyses were used. The results of the study revealed that although there was not a great expansion in the first years of the publication of research on integrated education, there has been an increasing trend in this field in the last two decades. This study identified the contributions of countries, journals, authors, and widely cited articles to the field. The study concluded that many countries have made significant contributions to integrated education research, but most of the publications in this field have been published in the USA. In the analysis of the most productive journals, this study showed that journals publishing on medical education are more effective in this field. As a result, it is thought that the results of the study will provide a useful resource for researchers who want to conduct research in this field as it discusses both current research foci and research trends and research gaps.

Keywords: Integrated education, curriculum, bibliometric analysis, science mapping

Introduction

To respond best to the ever-changing needs of the 21st-century world, today's schools need to create an educational environment conducive to the development of 21st century skills by integrating knowledge from different disciplines and interdisciplinary skills through interdisciplinary education. However, traditional curricula present subjects separately with little connection to other subjects. This situation becomes a legitimate concern in terms of adapting the lessons to real life. As a response to this legitimate concern, an integrated curriculum has been a subject of debate since the early 20th century (Drake & Burns, 2004). In light of these debates, the idea of curriculum integration continues to re-emerge as one of the main themes of the twenty-first-century learning literature (Hipkins, Bolstad, Boyd & McDowell, 2014; Scott, 2015). This is because curriculum integration encompasses progressive pedagogical approaches such as allowing students to apply the knowledge they have acquired in one discipline while acquiring new knowledge in another discipline and making connections with the 'real world' beyond the classroom.

There are various definitions of an integrated curriculum (Jacobs, 1989). For example, an integrated curriculum is defined as "the combination of all subjects and experiences" according to the definition of the National Council of Teachers of English (NCTE) in 1935. Chernus and Fowler (2001) defined program integration as a teaching approach that combines key content from two or more disciplines. An integrated curriculum is seen by different researchers as a strategy for combining core subjects (Johnson, Charner & White, 2003) and is defined as a design in which different disciplines form the basis for topics related to the student's life (Beane 1997; Fraser 2000). According to these definitions, the aim of integrated teaching, which enables the establishment of interdisciplinary connections between subjects and the exploration of these connection paths, is to make the concepts related to a problem or situation more understandable, to develop students' higher-order thinking skills and to support the formation of different connections between themselves and the real world (Erickson 1995; Wall

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& & Leckie 2017). In addition to supporting deep learning, it also helps students specialize in core academic content (Drake & Burns, 2004; Martinez & McGrath, 2014).

Integrated curriculum design includes different interdisciplinary approaches based on progressive and reconstructivist principles (Czerniak, Weber, Sandmann & Ahern, 1999; Grossman, Wineburg & Beers, 2000). Within the framework of these approaches, the curriculum integration process can be classified as multidisciplinary integration, interdisciplinary integration, or transdisciplinary integration (Choi & Pak, 2006; Drake & Burns, 2004; Mathison & Freeman, 1997; Kysilka, 1998; McPhail, 2018). Multidisciplinary approaches bring subject areas together according to a theme determined in two or more subjects. In the interdisciplinary integration approach, teachers organize the curriculum around common topics across disciplines and bring together common learning embedded in disciplines to emphasize interdisciplinary skills and concepts. In the transdisciplinary integration approach, teachers organize the curriculum around students' questions and concerns. In this way, students develop life skills as they apply interdisciplinary and disciplinary skills in a real-life context. These approaches require a high degree of integrative restructuring, where subject boundaries are blurred and connections are made in a new framework. It also involves collaborative, student-centered, and problem-based teaching where the student's interest becomes the focus of learning (Drake & Burns, 2004; Jacobs, 1989, Klein, 2006; Vars, 1991).

Many studies have shown that integrated curriculum approaches contribute to students' academic achievement (Baker & Daumer, 2015; Beane, 1997; Bishop & Berryman, 2009; Cotton, 1982; Draghicescu, Gorghiu, Gorghiu & Petrescu, 2013; Fraser, 2000; Petroelje & Frambaugh-Kritzer, 2014; Drake, Savage, Reid, Bernard & Beres, 2015; Romance & Vitale, 2012). In the related literature, studies have shown that integrated teaching contributes to students' skill development and academic achievement (Drake & Reid, 2020; Ortiz-Revilla, Sanz-Camarero & Greca, 2021). For example, Geoghegan (1994) found that students who participated in an integrated lesson involving drama experienced a positive change in their levels of respecting others and valuing the opinions of others. In addition to this study, the literature includes studies investigating student participation in integrated lessons (LaMotte, 2018), the effects of integrated teaching on primary school learning (Benvegnen, Kottsieper, Lepareur, Morales Villabona & Ducrey Monnier, 2021; Hammond, 2017; Monteiro, Mata & Nóbrega Santos, 2021; Pasquini, 2021), the effects of integrated social studies lessons on students' knowledge and attitudes (Smith, Hodges Kulinnab, Vissicaroc & Fredrickson, 2016), and teachers' perceptions of integrated teaching approaches (Tudor, 2014). In light of these studies and the related literature, the results of these studies show that integrated teaching supports students in terms of knowledge and skills. In light of these findings, a literature review that will enable a systematic evaluation of integrated education research using quantitative methods is considered important.

Bibliometric analysis offers an analytical approach that contributes to the understanding of the volume and development of the knowledge base of studies in the field and trends in the field and guides future studies (Hallinger & Kovačević, 2021). In this way, it provides researchers with a perspective on the "basic dynamics" of a field of study that other literature reviews cannot provide (Van Leeuwen, 2006). Bibliometric research aims to present a broad picture of the literature rather than commenting on the quality of the research. This is because the bibliometric analysis can visualize the relationships between studies (and topics) through diagrams and tables by examining information such as abstracts, keywords, countries, organizations, journals, authors, and the number of citations (Donthu, Kumar, Mukherjee, Pandey & Lim, 2021; Singh & Dhir, 2019).

According to Zupic and Čater (2015), the most commonly used bibliographic methods in the literature are citation analysis, cocitation analysis, bibliographic matching, coauthor analysis, and common word analysis. Citation analysis is used to estimate the impact of publications, authors, or journals based on the number of citations received. Cocitation analysis is a measure based on the frequency with which two units are cited together. Cocitation analysis, which is currently the most widely used bibliometric method by researchers, shows the groups that make up the intellectual structure (Zupic & Čater, 2015). Bibliographic matching, which has recently gained popularity, is expressed by similarity in the reference lists of publications (Van Eck & Waltman, 2014) and occurs when two publications cite a third (Donthu et al., 2021; Habib & Afzal, 2019; Kessler, 1963). Coauthor analysis identified networks of collaborating authors. Coword analysis finds relationships between the concepts of the field by linking words that appear in the title, abstract, or keywords (Zupic & Čater 2015).

In this study, bibliometric indicators, including citation analysis, cocitation analysis, coauthor analysis, and common word analysis, proposed by Zupic and Čater (2015) were used to reveal the development process of the field from the past to the present. Although there is extensive literature in the field of integrated education, there is no comprehensive literature review that offers a holistic approach to a comprehensive understanding of the conceptual and intellectual structure of the field. Therefore, it is thought to be important to contribute to the growth,

productivity, and conceptual, social, and intellectual structure of key areas in integrated education research. At this point, the main purpose of this study is to fill this gap in integrated education research by revealing the publication volume and recent development of integrated education studies and the conceptual, intellectual, and social structure of the field. Thus, through the bibliometric analysis of the relevant literature, it is thought that determining the current research areas as well as the relevant research findings and revealing the new trends in the field will be important in terms of shedding light on future research.

This research aims to reveal the research trends in the field of integrated education published in WoS- and Scopus-indexed journals and to present the research in this field from a broader perspective with a bibliometric approach. In this context, the following questions were sought to be answered in the research.

RQ1: What are the emerging research trends in the field of integrated education?

RQ2: Which countries, journals, publications, and authors have contributed most to the field of integrated education?

RQ3: What is the intellectual, conceptual, and social structure of the field of integrated education?

Method

Research Design

In this study, a bibliometric analysis approach is adopted as the main research methodology. Bibliometric methodology is a quantitative approach that combines statistical and mathematical methods to analyze the connections between research in a particular discipline (Broadus, 1987; Hood & Wilson, 2001; Pritchard & Y Wittig, 1981). Bibliometric analysis offers an objective and systematic approach to discovering patterns of knowledge structure in the field, identifying prominent themes and trends, uncovering existing problems and challenges in the field, and thus contributing to the advancement of the field (Aria & Cuccurullo, 2017; Zupic & Čater 2015).

Data collection

In this study, both the Web of Science (WoS) and Scopus databases were used to obtain robust datasets. WoS and Scopus are bibliographic databases where researchers can access scientific literature. In addition to providing citation information, these two databases are highly recommended data sources for bibliometric studies, including a wide range of research in science, social sciences, and medicine (Burnham, 2006). According to Meho and Yang (2007), the overlap in citations between WoS and Scopus is limited. Therefore, using the Scopus database in addition to the WoS will help to provide a more accurate and comprehensive picture of the scientific impact of the research. For this reason, both databases were included in the study to ensure the integrity of the analysis. Thus, in this study, a scientific map of the field was drawn through bibliometric analysis of research on integrated education in journals indexed in Web of Science (WoS) and Scopus until January 2024 to explore the trend of research in the field of integrated education in recent years; to summarise the current research points, status and future challenges of the field; and to guide future research in this field.

One of the most important steps in bibliometric analysis is the creation of scientific maps. Scientific maps help to create visual representations of various factors, such as authors, sources, documents, and countries, and improve bibliometric analysis (Moral-Munoz, Herrera-Viedma, Santisteban-Espejo & Cobo, 2020). In this study, citation, word co-occurrence, cocitation, and coauthorship analyses were used as bibliometric methods. For the research process, first, the relevant literature was reviewed, and the keywords "integrated education", "integrated curriculum" and "integrated instruction" were used. Then, to investigate the trends towards integrated education, no restriction was made as the starting year of the scan, and it was decided to include the studies until 2024 in the study. Then, the article category related to the type of document to be researched was included in the scope of the research. Four high-quality indexes in WoS were included in the search: the Science Citation Index-Expanded (SCI-Expanded); the Social Sciences Citation Index (SSCI); the Arts & Humanities Citation Index (A&HCI); and the Emerging Sources Citation Index (ESCI). Finally, the category of "education/educational research" was determined for the WoS database, and the category of "social sciences" was determined for the Scopus database. No language restrictions were imposed during the search process.

After the research criteria were determined, first, a search was performed in the WoS database on 09.01.2024 to access scientific publications on integrated education. In this search, the keywords "integrated education" OR "integrated curriculum" OR "integrated instruction" were searched in the "abstract, title, keywords" fields. As a result of the first search, a total of 1834 documents were identified. Afterward, other criteria for the publications to be included in the research were applied. The search was repeated by selecting the article category related to the document type of the research and the education/educational research category for the research field. As a result, a total of 755 documents were included in

the study. Similarly, the keywords "integrated education" OR "integrated curriculum" OR "integrated instruction" were searched in the "abstract, title, keywords" fields in Scopus. As a result of the first search, a total of 2747 documents were identified in the Scopus database. Afterward, the search was repeated according to the criteria to be included in the publication, and a total of 1201 documents were identified. According to these search criteria, a total of 1956 documents were identified, 755 in WoS and 1201 in Scopus. The steps regarding the research methodology followed in this study are given in Figure 1.

Data Analysis

In this study, R Studio (Bibliometrix), VOSviewer software, and Microsoft Excel software were used to explore and visually present the scientific collaboration between studies, potential research foci, and trends in the field. In VOSviewer, units of analysis include journals, publications, citations, authors, or countries, depending on the focus of the analysis and the type of database. The circular nodes on the map represent the units of analysis. The size of the nodes is directly proportional to their ratio. The lines connecting the different nodes represent the relationships between the nodes, and the thickness of the

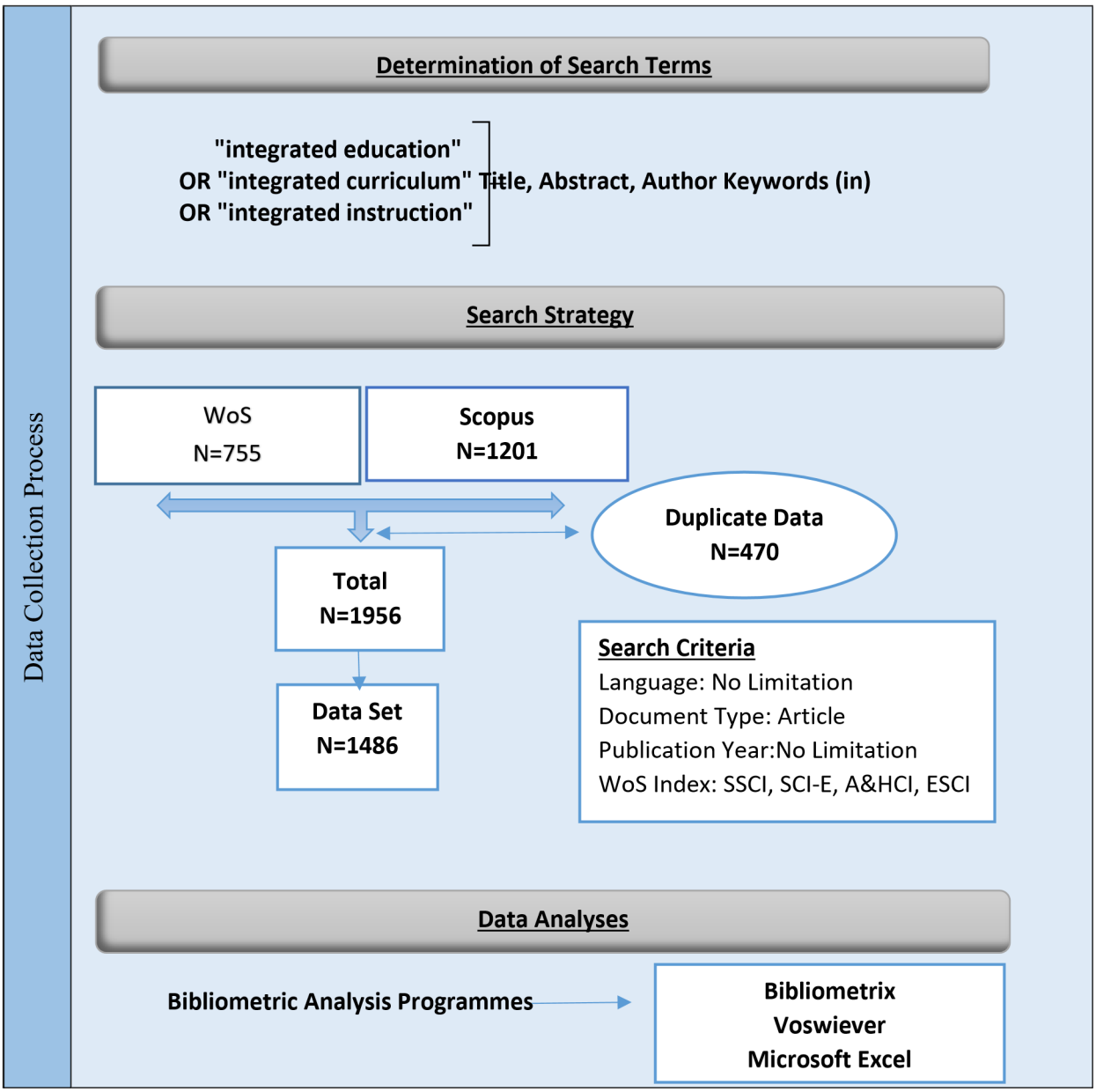

Fig. 1: Research Process

line indicates the strength of the relationship. In addition, the color of the nodes represents different clusters separated according to the degree of relationship between the nodes (Van Eck & Waltman, 2014). Bibliometrics, an open-source research tool for bibliometric quantitative research, is used to extract, analyze, and visualize bibliographic information such as cocitation networks of authors and collaboration networks of institutions (Aria & Cuccurullo, 2017; Dervis, 2019). These software programs were preferred because they can create and display bibliometric maps, are freely available, and are suitable for analyzing data obtained from the WoS and Scopus databases.

Before the analysis, the data were preprocessed. For this purpose, the data files were organized as RIS files for VOSviewer and Excel files for Bibliometrix in accordance with bibliometric software. A total of 1956 documents (755 documents in WoS and 1201 documents in Scopus) were merged using R Studio software, and 470 duplicate data points were removed. As a result, a total of 1486 documents constituting the dataset of our research were obtained. To determine whether the documents obtained as a result of the scanning were included in the scope of the study, the titles and summaries of the documents were examined by two evaluators. When the summary was not satisfactory, the related documents were also analyzed. After the documents were analyzed, the final bibliometric files were imported into VOSviewer and Bibliometric software. The information obtained from the analysis was visualized, and various scientific maps and network maps were created to present a comprehensible picture of the studies on integrated education research. The analyses performed within the scope of the study are given in Table 1.

Findings

Findings on Emerging Trends in Research in The Field of Integrated Education.

As a result of the bibliometric analysis of the studies conducted in the field of integrated education, a total of 1486 articles were identified. The findings regarding the general data obtained from the bibliometric analysis of the articles are given in Table 2.

As shown in Table 2, 1486 articles were published in 689 different journals between 1944 and 2023 in the field of integrated education. A total of 1486 articles analyzed within the scope of the study were written by 3631 authors, and 415 articles were written by a single author. The analyzed articles were published in 689 different journals, the publications showed an annual growth rate of 5.99%, and the average number of citations per article was 14.16. On the other hand,

Research Question	*Analysis Category*	Bibliometrix (Biblio shiny)	VOSviewer	Microsoft Excel
What are the emerging research trends in the field of integrated education?	Statistics of General Data		X	
	Total Publications and Average Number of Citations by Year	X		X
Which countries, journals, publications and authors have contributed most to the field of integrated education?	Country, Journal, and Article Statistics		X	X
	Statistics on the Number of Publications and	X		
	Citations of the Most Prolific Authors Authors' Productivity Over Time	X		
	Citation Analysis of Most Cited Publications	X		
What is the intellectual, conceptual and social structure of the field of integrated education?	Cocitation Analysis of Authors, Sources, and Documents.			X
	Co-Occurrence Analysis of the Most Frequently		X	
	Used Keywords Thematic Map of Keywords	X		
	Co-Authorship Analysis of Authors		X	
	Country Collaboration Maps	X		

a total of 24340 references were used in the analyzed articles. Although the rate of coauthorship per article is 2.8, the rate of international coauthorship is 6.12%. Figure 2 shows that the publication trend has continued to grow up to the current year.

According to Figure 2, when the integrated education research from 1944 to 2023 is analyzed in three stages, it is seen that in the first stage (1944-1990), research in the field of integrated education developed very slowly, with only a very limited number of annual publications and citations. In the second phase (1990-2012), the number of publications increased steadily. However, the annual average number of citations per article reached its highest value in 1991, at 152.17. In the third phase (2012-2023), rapid growth is observed in the number of publications per year. In particular, the highest number of publications was recorded in 2022, peaking at 106 articles. However, the average number of citations started to decrease after 2016.

Table 2: Descriptive General Data of the Included Studies

General Information About Data	*Results*
Time Interval	1944:2023
Sources (Journals, Books, etc.)	689
Document	1486
Annual Growth Rate %	5,99
Average Document Age	12,4
Average Number of Citations per Document	14,16
References	24340
Keywords Plus	1651
Author's Keywords	3141
Authors	3631
Single Authored Documents	388
Coauthors per Document	2,8
International Coauthorships %	6,12

Findings on the Countries, Journals, Publications, and Authors Who Contributed Most to the Field of Integrated Education

The number of articles, and collaboration status of the responsible authors in the field of integrated education according to their countries are given in Figure 3.

Figure 3 shows that the USA, with 424 articles (single country publication: 408; multiple country publication: 16); China, with 72 articles (single country publication: 65; multiple country publication: 7); and the United Kingdom, with 61 articles (single country publication: 51; multiple country publication: 10), are in the first three places. Although the USA ranks first in the number of articles, the level of international cooperation in the publications of the responsible authors is relatively low compared to the number of articles. According to these findings, US authors mostly prefer to publish with their colleagues in their own countries based on domestic productivity.

Since the subject of integrated education is a subject that has been researched in many countries, especially in the USA, studies have been published in 689 different journals. The 20 journals with the greatest number of publications and citations in the field of integrated education are given in Table 3.

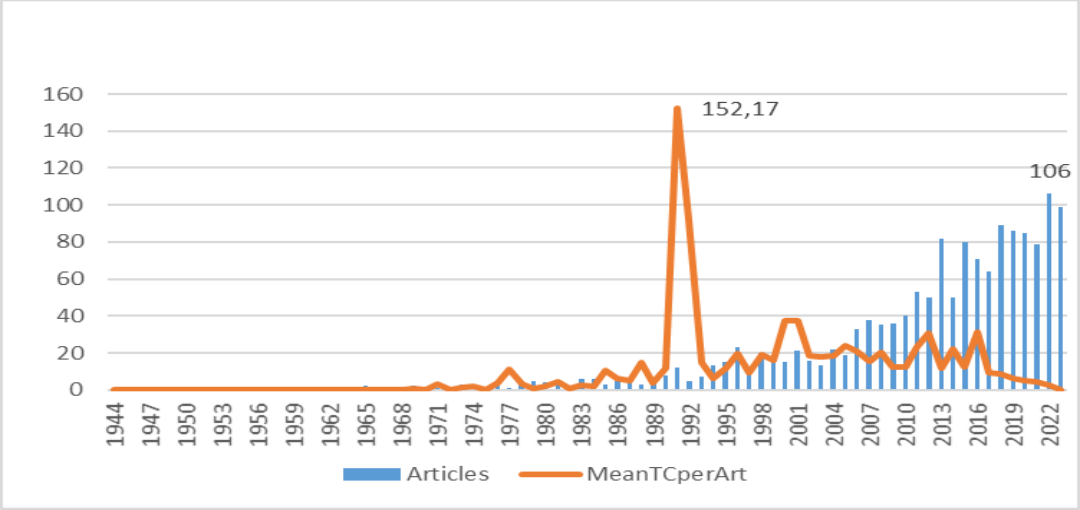

Fig. 2: Number of Publications and Average Citation by Year

According to Table 3, when the number of publications, h-indexes, and several citations of the journals publishing in integrated education is evaluated, the most productive journal is "Medical Teacher", with 42 articles, which is the journal with the greatest number of publications in this field. This journal is followed by "Medical Science Educator" (n=35) and "Anatomical Sciences Education" (n=28). "Medical Teacher" and "Anatomical Sciences Education", which rank

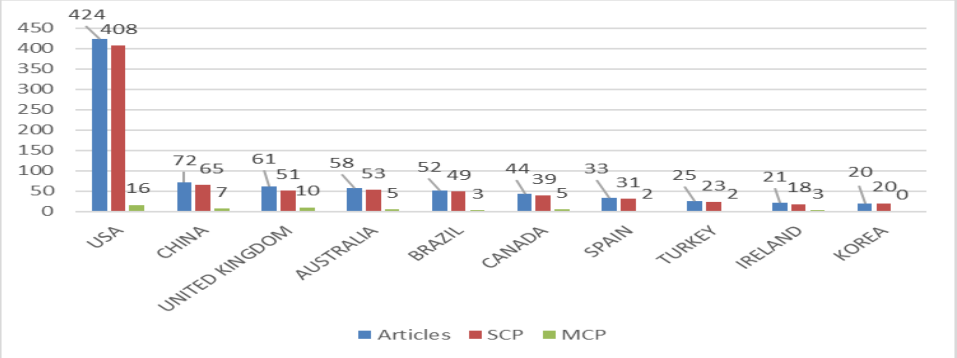

Fig. 3: Countries of Corresponding Authors and Number of Articles

Table 3: The Journals with the Most Publications and the Most Cited Journals by Subject Area

Journal Name	Number of Publications	Journal Name	H- Index	Citation Count
Medical Teacher	42	Cognition and Instruction	1	1659
Medical Science Educator	35	Medical Education	15	1154
Anatomical Sciences Education	28	Medical Teacher	15	1137
Bmc Medical Education	24	Anatomical Sciences Education	16	966
Academic Medicine	22	Computers and Education	1	905
Medical Education	22	Academic Medicine	14	697
The Journal of Nursing Education	16	British Journal of Educational Psychology	2	484
Currents In Pharmacy Teaching and Learning	13	School Science and Mathematics	9	450
Journal of Dental Education	13	Computers and Education	1	356
International Journal of Engineering Education	12	Journal For Research In Mathematics Education	8	350
School Science and Mathematics	12	Bmc Medical Education	10	348
American Journal of Pharmaceutical Education	11	Journal of Research In Science Teaching	8	307
Journal For Research in Mathematics Education	10	Journal of Educational Psychology	1	248
Education Sciences	9	Australasian Journal of Educational Technology	3	239
Eurasia Journal of Mathematics Science and Technology Education	9	Journal of Teacher Education	5	218
Advances In Health Sciences Education	8	Journal of Engineering Education	2	206
Advances In Medical Education and Practice	8	Eurasia Journal of Mathematics Science and Technology Education	6	195
Journal of Research In Science Teaching	8	Tesol Quarterly	2	194
Middle School Journal	8	Remedial and Special Education	4	185
Schole: A Journal of Leisure Studies and Recreation Education	8	Journal of Dental Education	8	161

first in the number of articles, also rank first in the h-index ranking and several citations and are the most influential journals in this field. In addition, "Medical Education", which has the second highest number of citations, with 1154 citations, is among the most influential journals, with 22 publications and 15 h-indexes. The most cited journal is "Cognition and Instruction", with 1659 citations. Despite the number of citations, this journal has only one publication. The high number of citations in this journal is due to the high number of citations of the articles published in this field.

A total of 3631 authors were identified in the analysis of articles published on integrated educational research. The average number of coauthors per article was found to be 2,8. Most of the authors (3243) worked in collaboration with other authors and produced multiple-authored publications. A total of 388 of the authors produced single-authored publications. This may indicate that studies on integrated education are suitable for collaborative studies. Information on the number of publications, h-indexes of the publications, and total number of citations of the 20 authors who produced the greatest number of publications are given in Table 4.

Table 4 shows the top 20 authors who produced the most publications in the field of integrated education and the ranking of their publications according to their h-indexes. The "Hirsch index" or "h-index" designed by Jorge Hirsch is known as a unique and simple performance index that covers both the quantity and visibility of scientific publications (Hirsch, 2005). In other words, it is a scale for measuring the productivity and citation impact of publications at the author level (Bornmann & Daniel, 2007). Table 4 shows that the most productive authors are Bekerman Z., with 8 articles; Brenner J., with 7 articles; Lee S., with 6 articles; and Vantassel-Baskan J., with 6 articles. In addition, the earliest author among the 20 most productive authors who researched integrated education was Guthrie J. in 1978, while the latest author was Chen H. in 2021. Figure 4, which is based on the number of publications produced annually in the field of integrated education and total annual citations, is given below.

The size of the nodes in Figure 4 represents the number of publications of the author. The color of the nodes represents the total number of citations per year. From the size of the nodes, it is understood that Bekerman, Brennen, Lee and Vantassel-Baska are the most influential authors in terms of the number of publications. Although Brown started publishing in 2019, he has 4 publications and the highest number of citations among the top 20 most prolific authors. According to the figure, the field of integrated education as a developing field has attracted the attention of researchers, and

Table 4: *Information on the Number of Publications, H- Index and Total Number of Citations of the Most Prolific Authors*

Author name	*Number of publications*	*h-index*	*Total number of citations*	*Year of publication*
Bekerman Z.	8	7	110	2006
Brenner J.	7	6	96	2015
Lee S.	6	3	17	2020
Vantassel-Baska J.	6	5	189	1998
Boluk K.	5	3	21	2019
Gallagher T.	5	2	11	1994
Ginzburg S.	5	4	62	2015
Mcglynn C.	5	5	84	2003
Willey J.	5	5	78	2017
Arja S.	4	4	38	2018
Brown K.	4	3	461	2019
Chen H.	4	2	30	2021
Chavez O.	4	4	214	2008
Drake S.	4	3	39	1996
Fazio X.	4	2	13	2015
Ferri B.	4	4	169	2005
Guthrie J.	4	4	373	1978
Harwell M.	4	4	57	2007
Hughes J.	4	3	54	2006
Johnson C.	4	4	23	2013

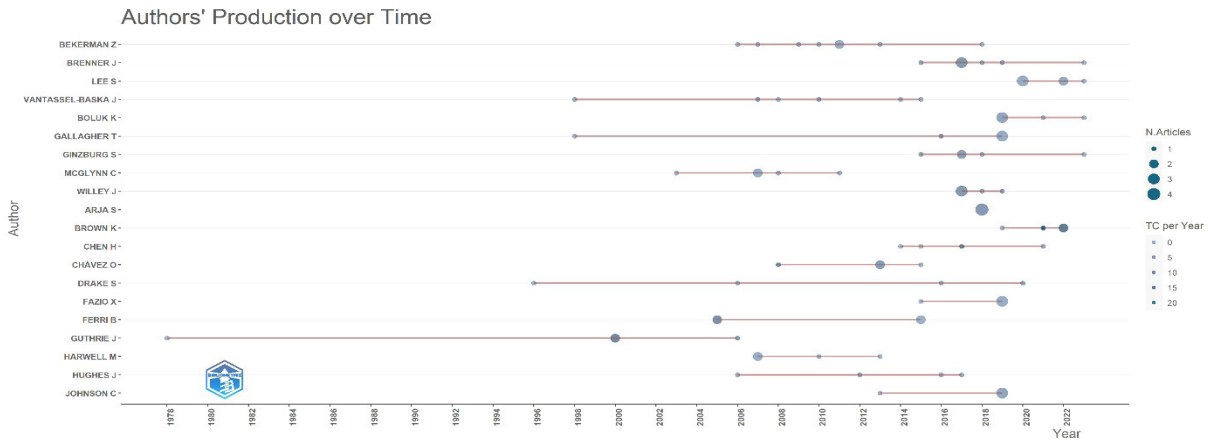

Figure 4. Authors' Productivity Over Time

Table 5: Information on Citation Analysis of Publications on Integrated Education

Authors	*Article title*	*Source*	*Total number of citations*	*Annual citation*
Chandler, P. & Sweller , J. (1991)	Cognitive Load Theory and the Format of Instruction	Cognition and Instruction, 8(4), pp. 293–332	1659	48,79
Sung, Y. T., Chang, K. E. & Liu, T. C. (2016)	The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis	Computers and Education, 94, pp. 252–275	905	100,56
Chandler, P. & Sweller, J. (1992).	The split- attention effect as a factor in the design of instruction	British Journal of Educational Psychology, 62(2), pp. 233–246	446	13,52
Yang, Y.T.C. & Wu, W. C.I. (2012).	Digital storytelling for enhancing student academic achievement, critical thinking.; Learning motivation: A year-long experimental study	Computers and Education, 59(2), pp. 339–352	356	27,38
McGaghie, W. C., Issenberg, S.B & Wayne, D. B. (2014).	A critical review of simulation-based mastery learning with translational outcomes	Medical Education, 48 (4), pp.375-385	348	31,64
Harden, R.M. (2001).	AMEE Guide No. 21: Curriculum mapping: A tool for transaprent and authentic teaching and learning	Medical Teacher, 23(2), pp. 123–137	302	12,58
Guthrie, J.T., Wigfield, A. & VonSecker, C. (2000).	Effects of integrated instruction on motivation and strategy use in reading	Journal of Educational Psychology, 92(2), pp. 331–341	248	9,92
Brauer, D. G. & Ferguson, K. J. (2015).	The integrated curriculum in medical education: AMEE Guide No. 96	Medical Teacher, 37 (4) , pp.312-322	240	24,00
Shih, R. C. (2011).	Can Web 2.0 technology assist college students in learning English writing? Integrating Facebook and peer assessment with blended learning	Australasian Journal of Educational Technology, 27(5), pp. 829–845	221	15,79

Authors	*Article title*	*Source*	*Total number of citations*	*Annual citation*
Drake, R. L, McBride, J. M. & Pawlina, W. (2014)	An Update on the Status of Anatomical Sciences Education in United States Medical Schools	Anatomical Science Education, 7 (4) , pp.321-325	186	16,91
Spada, N. & Lightbown, P.M. (2008).	Form-focused instruction: Isolated or integrated?	TESOL Quarterly, 42(2), pp. 181–207	161	9,47
McBride, J. M & Drake, R. L. (2018).	National survey on anatomical sciences in medical education	Anatomical Science Education, 11 (1) , pp.7-14	159	22,71
Tseng, K. H, Chang, C. C. & Chen, W. P. (2013).	Attitudes towards science, technology, engineering and mathematics (STEM) in a project-based learning (PjBL) environment	International Journal Of Technology And Design Education, 23 (1) , pp.87-102	157	13,08
Schmidt, H. G., Machiels-Bongaerts, M. & Boshuizen, H. P. A. (1996).	The development of diagnostic competence: Comparison of a problem-based, an integrated, and a conventional medical curriculum	Academic Medicine, 71 (6) , pp.658-6641	156	5,38
Tarr, J.E., Reys, R.E. , Reys, B.J., Shih, J. & Osterlind, S.J. (2008).	The impact of middle-grades mathematics curricula and the classroom learning environment on student achievement	Journal for Research in Mathematics Education, 39(3), pp. 247–280	153	9,00
Hirsh, D., Gaufberg, E., Ogur, B. & Pelletier, S., Bor, D. (2012).	Educational outcomes of the Harvard medical school-Cambridge integrated clerkship: A way forward for medical education	Academic Medicine, 87(5), pp. 643–650	149	11,46
Olds, B.M., Miller, R.L. (2004).	The effect of a first-year integrated engineering curriculum on graduation rates and student satisfaction: A longitudinal study	Journal of Engineering Education, 93(1), pp. 23–35	146	6,95
Czerniak, C.M., Weber, W.B., Sandmann, A. & Ahern, J. (1999).	A Literature Review of Science and Mathematics Integration	School Science and Mathematics, 99(8), pp. 421–430	129	4,96
Muller, J.H., Jain, S., Loeser, H. & Irby, D.M. (2008).	Lessons learned about integrating a medical school curriculum: Perceptions of students, faculty and curriculum leaders	Medical Education, 42(8), pp. 778–785	112	6,59
Frykholm, J. & Glasson, G. (2005).	Connecting Science and Mathematics Instruction: Pedagogical Context Knowledge for Teachers	School Science and Mathematic, 105 (3) , pp.127-141	109	5,45

the number of authors who started to work in this field has increased in the last decade.

To understand the development of a research field, it is important to know which of the most influential articles have influenced other studies. At this point, citation analysis is widely used to examine the underlying intellectual structure, and development dynamics of a research topic. To determine the most frequently cited articles in the field of integrated education and the relationships between them, the 20 most frequently cited articles were analyzed, and the results of the analysis are given in Table 5.

Table 5 shows the most cited articles at the global level among the 1486 articles analysed. Global citations include the citations made by all publications indexed in WoS and Scopus indexed in the scope of this research. Considering that the average number of citations per article is 14.6, these studies are quite effective. Accordingly, Chandler, P. & Sweller, J. (1991)'s article titled *"Cognitive Load Theory and the Format*

of Instruction", published in 1991, is the most cited study in the literature in this field, with 1659 global citations. In this study, Chandler & Sweller (1991) designed an experimental study in which they aimed to compare traditional instruction and integrated instruction over a period of several months in an industrial training environment. Sung, Chang & Liu's (2016) meta-analysis of the effects of integrated education with mobile devices ranks second, with 905 global citations. This study is also an important study that ranks first in terms of the average number of citations per year.

Findings on the Intellectual, Conceptual and Social Structure of the Field of Education

In this section, cocitation analysis, which measures the similarity of cocited authors, cocited articles, and cocited journals, was used to reveal the intellectual structure. Cocitation analysis refers to the frequency with which two studies are cited together (Aria & Cuccurullo, 2017). This type of cocitation analysis offers the opportunity to reveal the articles that stand out in a scientific field. Although the number of citations measures the relative impact of a publication, cocitation analysis is used to detect links between publications, identify networks, and identify significant changes in lines of thought or paradigms (Zupic & Čater, 2015). The authors' cocitation network is shown in Figure 5.

In the author cocitation network in Figure 5, the size of the nodes reflects the frequency of cocitation. The different colors and degrees of adjacency of the nodes in the network indicate different clusters. Accordingly, the authors are divided into seven different clusters, and the two authors with the highest cocitations are Harden and Drake, who are at the center of the green cluster. Harden has strong citation ties with Drake and Cooke within his cluster but also has citation ties with other clusters. The blue cluster is centered on anonymous publications, and Berkman has a large network of associates within the cluster. The green cluster is centered on Nielsen-Bohlman and consists of authors with lower cocitation numbers than the other two clusters. Network showing cross-source cocitation analysis (Figure 6).

Three clusters were formed in the network, as shown in Figure 6. Accordingly, the cluster with the highest number of cocitations is seen as the green cluster. The journal "Academic Medicine" is at the center of the green cluster. The "Thesis" journal is at the center of the red cluster, while the "Computer Education" journal is at the center of the blue cluster. The document cocitation network is presented in Figure 7.

In the document citation network in Figure 7, five different clusters were formed, and the central cluster was the green cluster. Brauer (2015) and Harden (2000), the documents with the highest number of cocitations, were located in the center of this cluster. While Bruner (1960) was at the center of the blue cluster, the red cluster was shaped around Drake (2004). The article by Muller (2008) is at the center of the purple cluster. The yellow cluster is centered around the articles of Czerniak (1999) and Pang (2000).

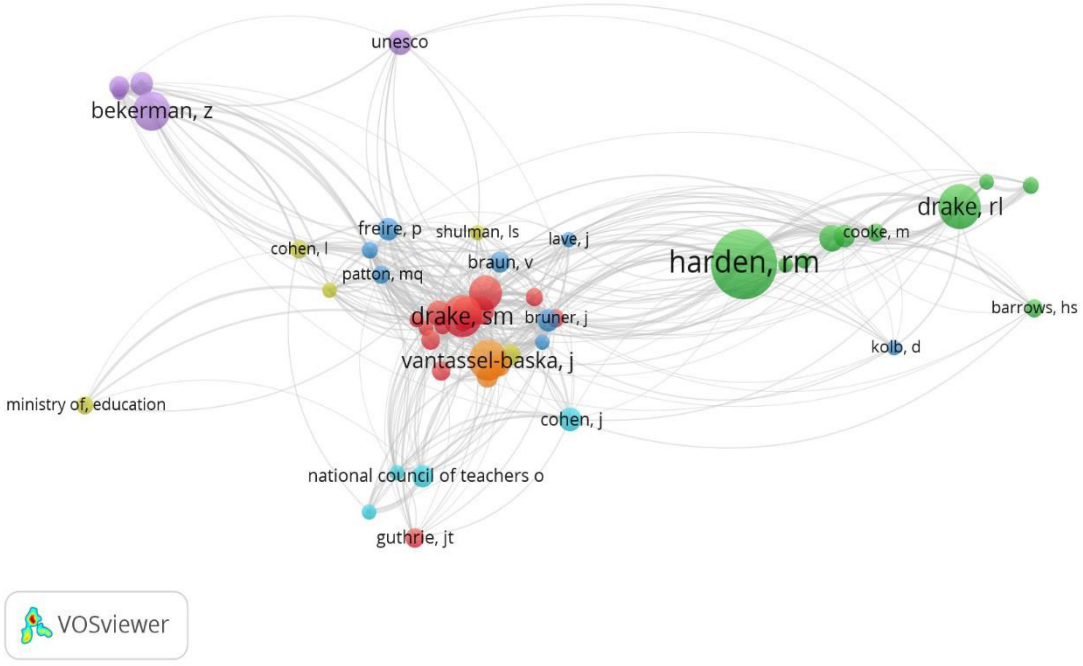

Fig. 5: Author Cocitation Network

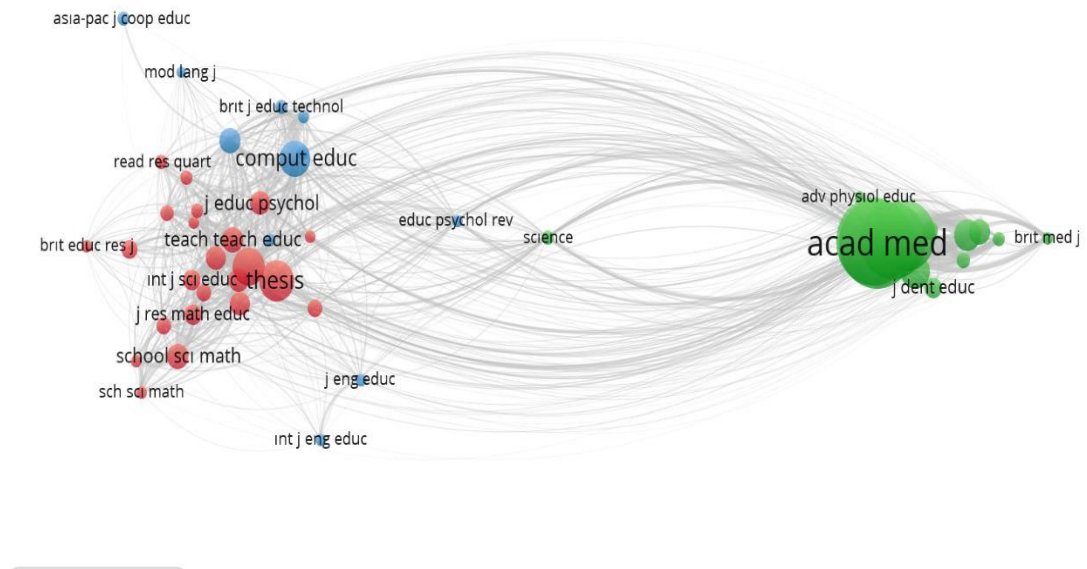

Figure 6. Source Cocitation Network

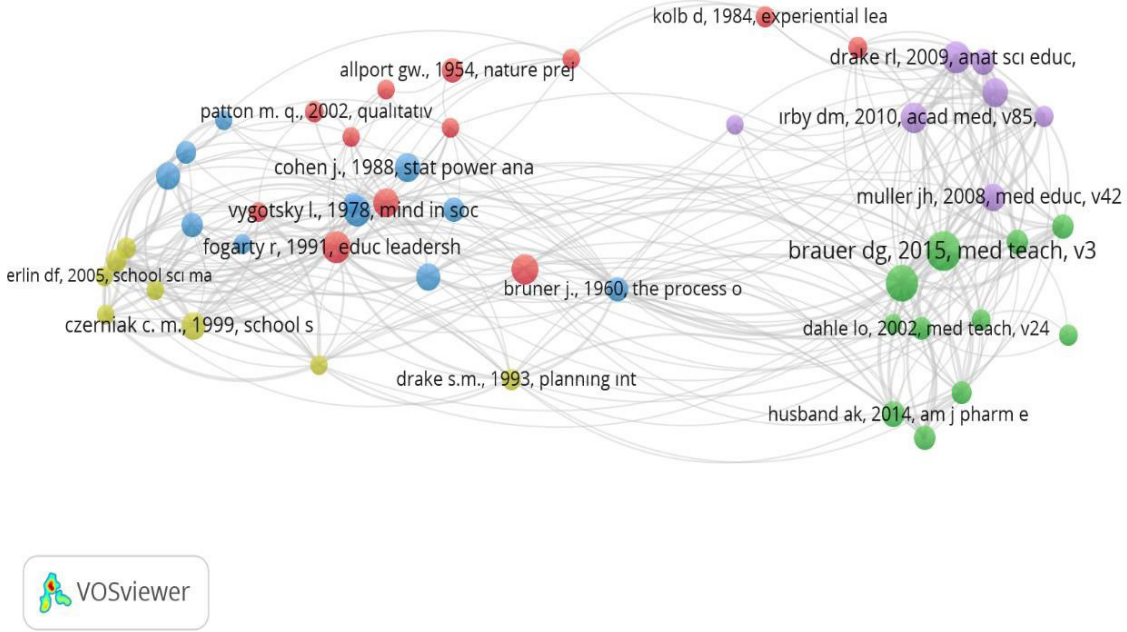

Fig. 7: Document Cocitation Network

The statistical information on the author, source, and document cocitations is given in Table 6.

The conceptual unity of the studies analyzed in the research was determined by conceptual structure analysis, which provides an idea about the main themes of the field and their connections with each other. In this context, since there were a total of 3141 keywords in 1486 articles analyzed on integrated education, the condition that the keywords appear together at least five times was chosen as a condition to obtain more meaningful results. The network map of the density of the most frequently occurring terms among a total of 47 keywords that met this condition is given in Figure 8.

Table 6: Statistical Information on Author, Source and Document Cocitations

Cluster	Authors	Citation	Total link strenght	Cluster	Sources	Citation	Total link strenght	Cluster	Document	Cittaion	Total link Strenght
1	Drake, S.M.	50	211	1	Thesis	195	857	1	Braun V., 2006, Qualitative Research In Psychology	18	25
	Creswell, J.W.	40	120		J Res Sci Teach	177	2297		Drake S.M., 2004, M Standards Integrat	16	35
	Dewey, J.	37	164		School Sci Math	104	1178		Allport G.W., 1954, Nature Prejudice	12	3
	Beane, J.A.	32	184		Teach Teach Educ	103	1056		Cooke M., 2010, Ed Phys Call Reform	9	19
	Fogarty, R.	27	119		Am Educ Res J	98	1211		Kolb D, 1984, Experiential Learning	9	4
	Czerniak, C.M.	21	124		Educ Leadership	97	986		Patton M. Q., 2002, QualiTatiVe Evaluati	9	7
2	Harden, R.M.	88	167		J Educ Psychol	95	1152		Jacobs H.H., 1989, İnterdisci PliİnaryCu	8	23
	Drake, R.I.	52	119		Sci Educ	91	1260	2	Brauer Dg, 2015, Med Teach	30	68
	Brauer, D.G.	30	67		J Res Math Educ	78	534		Harden Rm, 2000, Med Educ	25	69
	IRby, D.M.	24	81		iNt J Sci Educ	75	863		Husband Ak, 2014, Am J Pharm Educ	13	36
	Cooke, M.	20	62	2	Acad Med	555	8121		Kulasegaram km, 2013, Acad Med	12	33
	Barrows, H.S.	19	17		Med Educ	546	8516		Cooke M, 2006, New Engl J Med	11	35
3	Vygotsky, L.	25	84		Med Teach	462	6358		Pearson Ml, 2012, Am J Pharm Educ	11	35
	Freire, P.	24	55		Anat Sci Educ	406	6759		Dahle L.O., 2002, Med Teach	10	32
	Braun, V.	23	64		Am J Pharm Educ	156	926	3	Vygotsky L., 1978, Mind İn Society	17	13
	Patton, M.Q.	19	84		Bmc Med Educ	135	2257		Cohen J., 1988, Stat Power Anal Beha	16	12
4	Bandura, A.	22	95		Clin Anat	101	2948		Beane J. A., 1997, Curriculum Integration	14	29
	Cohen, L.	19	48		J Dent Educ	76	535		Joyner J., 2000, Principles And Standards for School Math	14	35
5	Bekerman, Z.	46	175		Adv Health Sci Educ	72	1680		Bruner J., 1960, The Process of Education	12	36
	Unesco	27	22		Jama-J Am Med Assoc	58	833	4	Czerniak C. M., 1999, School Science And Mathematics	15	48
6	Cohen, J.	26	42	3	Comput Educ	168	2396		Frykholm J, 2005, School Sci Math	10	37
	NCTM	24	67		Rev Educ Res	102	1486		Drake S.M., 1993, Planning integrated	9	26
7	Vantassel-Baska, J.	48	232		AsiA-Pac J Coop Educ	50	31	5	Drake R.l, 2009, Anat Sci Educ	20	46
					BriT J Educ Technol	46	775		Irby D.M., 2010, Acad Med	17	39

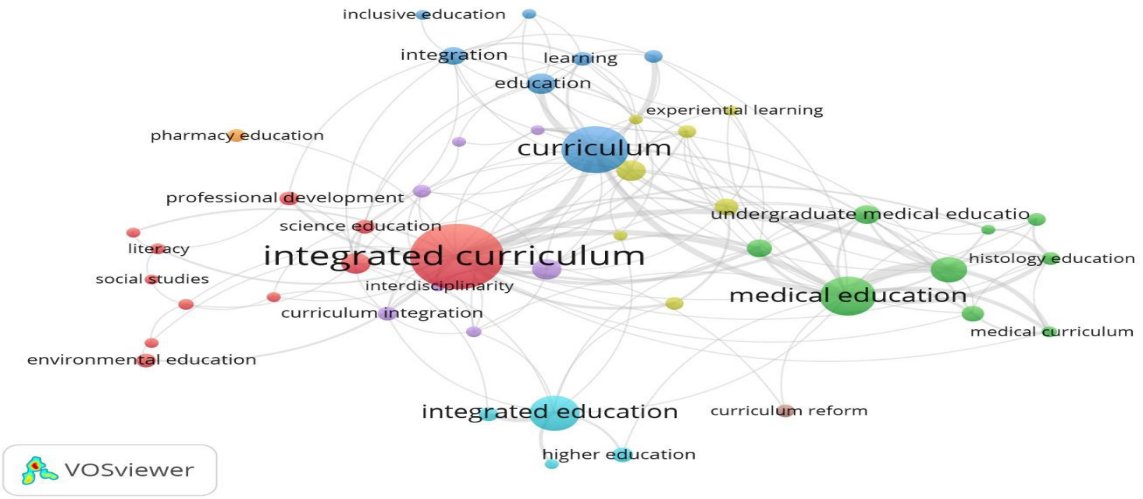

Fig. 8: Co-occurrence Network of the Most Frequently Used Keywords

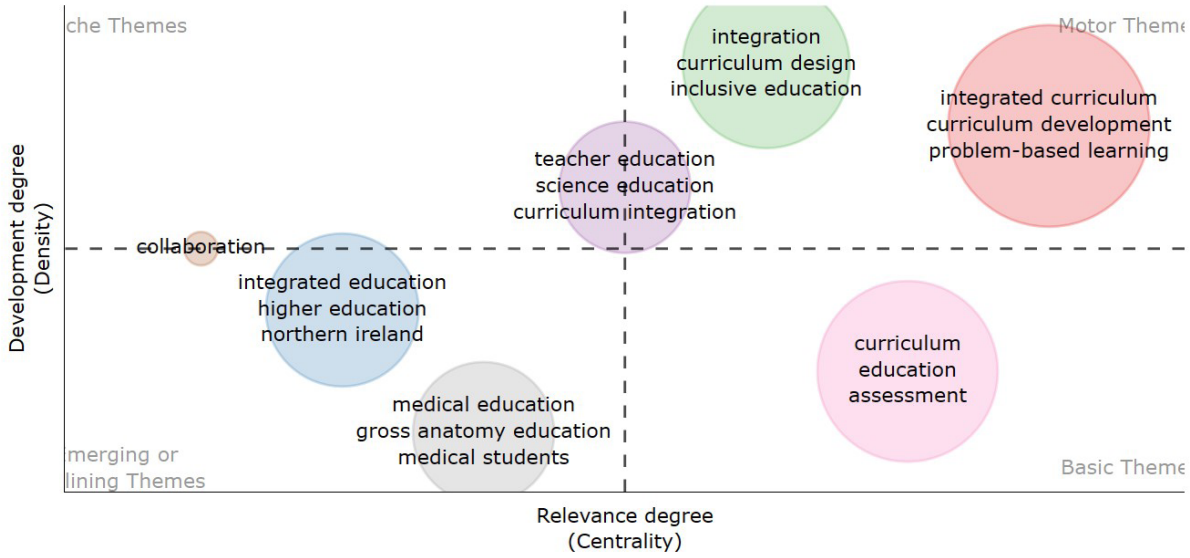

Fig. 9: Thematic Map of Keywords

In the co-occurrence analysis, which provides insight into the links and relationships between the keywords in Figure 8, 8 clusters, 169 links, and 291 total link strengths representing the co-occurrence frequency among the 47 keywords obtained were identified. These links show the connections between keywords and shed light on the relationships between keywords. The most frequently used keywords in the publications on integrated education were *"integrated curriculum"*, with 91 occurrences; *"curriculum"*, with 55 occurrences; *"medical education"*, with 41 occurrences; and *"integrated education"*, with 35 occurrences. These keyword clusters frequently overlap with each other and emphasize their strong relationship with integrated education.

Thematic map analysis based on author keywords was conducted to examine the importance and development of study topics focusing on the field of integrated education. The x-axis in the thematic map represents centrality, and the y-axis represents intensity. Centrality refers to the importance of the selected topic, and intensity refers to the development of the related theme. The diagram is divided into four different sections according to the nature of the themes. The themes in the lower left part of the diagram have low centrality and low intensity. These themes are called emerging or declining

themes. The themes in the right subsection are themes with low intensity and high centrality and are called basic themes. These are themes that are important for the research area but are not sufficiently developed. The themes in the upper right section are called motor themes representing high intensity and high centrality. In addition to being developed, these are important themes in terms of structuring the research area. The themes in the upper left section are highly developed but isolated themes and are called niche themes. They are characterized by high density and low centrality. These themes have only marginal importance, as they do not have significant external links (Cahlik, 2000; Callon, Courtial & Laville, 1991; Cobo, López-Herrera, Herrera-Viedma & Herrera, 2011). For the thematic analysis, the number of keywords was 250, the minimum cluster frequency was 5, and the clustering algorithm was Fast Greedy. The results of the analysis are given in Figure 9.

Figure 9 shows that a total of seven clusters are formed in the four themes of the diagram. There are three different keywords representing each cluster in the diagram. Two clusters, which are considered important in the development and structuring of the integrated education field, are located in the motor theme, and one cluster is located at the intersection of the motor theme and the niche theme. The first cluster in the motor theme consists of the keywords *"integrated curriculum"*, *"curricular development"* and *"problem-based learning"*, while the second cluster consists of the keywords *"integration"*, *"curricular design"* and *"inclusive education"*. These clusters constitute the focal topics of the field of integrated education and play an important role in the development of the field. The cluster at the intersection of the niche theme and the motor theme included the keywords *"teacher education"*, *"science education"* and *"curricular integration"*. This cluster focuses more on teacher education, science education, and curriculum integration; however, although it is important for the development of the field, it is relatively understudied and insufficiently developed. There are also two clusters within the emerging or declining themes. The first cluster included the keywords *"integrated education"*, *"higher education"* and *"northern Ireland"*; the second cluster included the keywords *"medical education"*, *"gross anatomy education"* and *"medical students"*. These clusters cover topics related to medical education and higher education. These clusters represent topics that have emerged relatively recently or have started to lose their importance in terms of the field of integrated education. In the cluster in the basic theme, the keywords *"curriculum"*, *"education"* and *"assessment"* stand out. This theme, which covers topics such as curriculum and assessment, can be considered a theme that has special importance for the field and whose development process continues, although it is intensively studied.

The social structure of integrated educational research is analyzed through networks of collaboration between authors and countries. Coauthorship analysis, which helps to show the cooperation between authors according to the number of coauthored articles, was performed in VOSviewer. Accordingly, a network map was created by determining at least 1 publication criterion to determine the most connected and collaborating authors. The results of the analysis are given in Figure 10.

Figure 10 shows the coauthorship map, where the size of the nodes represents the number of publications of the researchers. A total of 3,771 authors were included in the coauthorship map presented in Figure 10. To obtain a clearer map, only linked authors are shown in the figure. According to the analysis, 33 authors are merging in 6 clusters and 114 links in total. When the total link strength is analyzed, Judith Brenner has the highest impact, with 17 total link strengths. Samara Ginzburg and Doreen Olvet were the authors with the second highest impact,

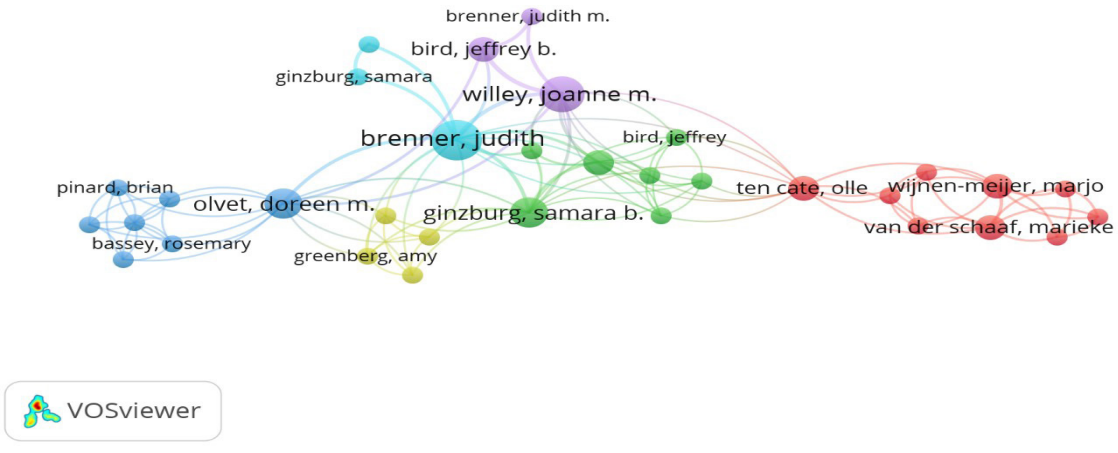

Fig. 10: Co-operation Between Authors

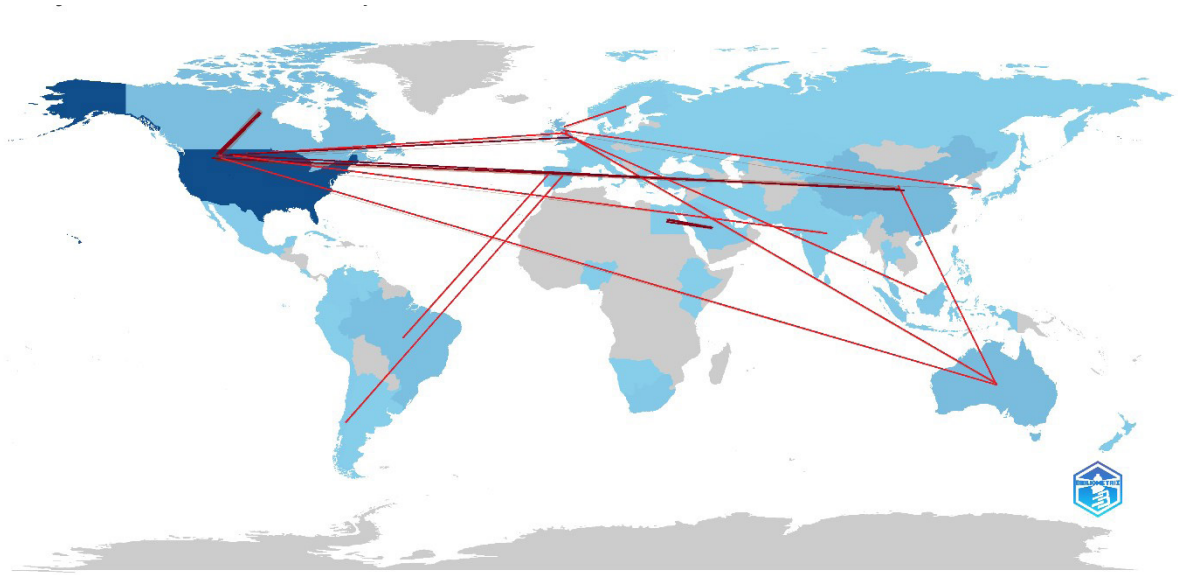

Fig. 11: Cooperation Map of Countries

with 14 total link strengths. Olle Ten Cate ranked third in terms of influence, with 13 total link strengths.

Collaborations between countries are visualized in Figure 11. The color of the countries on the map shows th1e number of publications produced by the authors in that country. The dark blue color represents a high number of publications. The darkness of the links shown in red represents the frequency of cooperation between countries.

According to Figure 11, the countries with the greatest number of collaborations in the field of integrated education are the USA, the UK, China, Australia, Canada, and Brazil. The countries with the greatest number of collaborations are the USA and Canada (9 articles), the USA and China (4 articles), and Saudi Arabia and Egypt (4 articles). In terms of the integrated education literature, Turkey has collaborated the most with the USA with 2 articles.

Discussion

This study aims to explore the general trends in integrated education research, the countries, journals, publications, and authors that have contributed most to the field, and the evolution of the intellectual, conceptual, and social structure of the field. This analysis included 1486 scientific publications obtained from the WoS and Scopus databases. To provide a systematic, objective, and comprehensive review of integrated education research, the data obtained were analyzed using Bibliometrix and VOSviewer software and visual mapping techniques to reveal the overall performance, intellectual structure, conceptual structure, and social structure of the field of integrated education.

To determine the trends in research in the field of integrated education, general data on the field and the change in the number of publications and citations over the years were analyzed. The analysis revealed that the first study that laid the foundations of integrated education was conducted in 1944. Therefore, the studies within the scope of the research extend from the first article scanned in WoS and Scopus in the field of integrated education to the present day. According to the general findings of the data, 1486 articles were published in 689 different journals. An analysis of the distribution of the number of articles by year revealed an increasing trend in the field of integrated education, especially in recent years, and the fastest increase was recorded between 2012 and 2023. As a result of the analyses, the annual number of publications and citations in the literature on integrated education has increased significantly. Therefore, both the number of publications and citations and the increase in the number of researchers addressing the subject indicate that integrated education research has become an interesting field of study, especially in the last 25 years.

Among the countries that have contributed the most to the field of integrated education about performance analysis, the USA, China, the United Kingdom, Australia, Brazil, Canada, Spain, Turkey, Ireland, and Korea are among the top ten. The US's and Canada's growing interest in integrated curricula dates back to the early 1990s (March & Willis, 2007). In addition, the USA has experienced a transition from a discipline-based course curriculum to an integrated curriculum with significant curriculum changes in medical education (Drake, 2007; Fishleder, Henso & Hull, 2007). These developments are seen as the reason why the USA

has a significant superiority in the literature on integrated teaching. In this research, East Asian countries such as China and Korea, which are among the most productive countries, tend to integrate as a means of preparing students for the global economy as well as developing international awareness and general skills (Lam, Alviar-Martin, Adler & Sim, 2013). In addition, Drake and Savage (2016) stated that many of the countries ranked high in the PISA rankings include policy provisions for curriculum integration. For example, Finland applies the project-based learning approach, which is interdisciplinary (Halinen, 2016). Canada has a long history of government-supported integrated approaches (Clausen & Drake, 2010). Korea's education policy has elements of an integrated curriculum (Ministry of Education Republic of Korea, 2009).

When the publications evaluated in this study were analyzed in terms of the productivity of the journals, "Medical Teacher", "Medical Science Educator" and "Anatomical Sciences Education" journals came to the fore. Medical Teacher and Anatomical Sciences Education journals are also among the most effective journals in this field, ranking first in terms of the h-index and number of citations. These journals make a significant contribution to the integrated education literature in terms of publications. One of the striking findings in the performance analysis of the studies in the field is that the journals with the highest number of publications are from the field of medical education. In this case, it can be said that the USA's orientation towards an integrated curriculum in medical education has an effect. In the analyses performed on the axes of the authors who contributed the most to the field, it was determined that the most productive authors were Bekerman, Brenner, Lee, and Vantassel-Baska. In addition, Brown has 4 publications and the most citations among the top 20 most productive authors, despite starting publication in 2019. When the most cited publications at the global level were analyzed in this study, Chandler, P. & Sweller, J. (1991), Sung, Chang & Liu (2016), and Chandler, P. & Sweller, J. (1992) were found to be the pioneering studies in this field.

Seven different clusters were identified in the findings of the author cocitation network analysis conducted to determine the intensity and strength of the relationships among authors, sources (journals), and documents (articles) to reveal the intellectual structure of the field of integrated education. Based on the assumption that the most frequently cited authors in these clusters have the highest node density, Harden, Drake, Vygotsky, Bandura, Bekerman, Cohen, and Vantassel-Baska were found to be at the forefront. Considering that these authors have carried out important studies in the field of integrated education, it is thought that they have the quality of reference for researchers who want to work in this field. When the cocitation analysis at the journal level is examined, it can be seen that the clusters are clustered around three main journals. These journals are Academic Medicine and Computer Education. In the document cocitation analysis, approximately five articles were clustered, and the articles with the highest number of cocitations were the articles of Brauer (2015), Bruner (1960), Drake (2004), Muller (2008), and Czerniak (1999).

The co-occurrence network and thematic map of the keywords were analyzed to determine the clustering and co-occurrence of the most frequently used keywords related to the integrated education literature to reveal the conceptual structure of the field. As a result of the analysis, 8 clusters, 169 links, and 291 total link strengths representing the co-occurrence frequency among 47 keywords were identified. The most frequently used keywords in the integrated education literature were "integrated curriculum", "curriculum", "medical education", and "integrated education". The thematic map analysis revealed that the keywords "integrated curriculum", "curricular developer", "problem-based learning", "integration", "curricular design" and "inclusive education" in the motor theme, which are considered important in the development and structuring of the field of integrated education, constitute the focus topics of the field of integrated education and play an important role in its development. However, the keywords "teacher education", "science education" and "curricular integration", which are isolated themes and important for the development of the field, were relatively less studied. The keywords "integrated education", "higher education", "northern Ireland", "medical education", "gross anatomy education" and "medical students" were included in the rising or falling themes. These words cover topics related to medical education and higher education and are relatively new to the field of integrated education. This may be due to the adoption of a teaching program based on an integrated curriculum approach in medical education and thus higher education in the USA.

To determine the social structure of the integrated education literature, cooperation between authors and countries was analyzed. As a result of the coauthorship analysis, 33 authors and a total of 114 links were identified in 6 clusters. According to the analysis, Judith Brenner, Samara Ginzburg, Doreen Olvet, and Olle Ten Cate are the authors with the strongest collaboration in the collaboration network map. In the analysis of cooperation between countries, the USA, the UK, China, Australia, Canada, and Brazil come to the fore. In light of these results, the issue of integrated education may have been studied by different countries in the international arena.

Conclusion

This study revealed important findings regarding the field of integrated education. The overall analysis shows that the topic has a wide range of issues across many countries, sources, and authors. Although it has a history of nearly a hundred years, it has shown that it still maintains its currency and has become an important research area in recent years. Trend analysis has shown that integrated educational research has gained popularity and increased importance in recent years.

Country and resource analyses have revealed that developing countries as well as developed countries, especially the USA, contribute to this field and that research in the field has been published in various journals covering different disciplines. In addition, it has been shown that journals that publish in medical education are more effective. Author and document analysis revealed that the most productive authors were Bekerman, Brenner, Lee, and Vantassel-Baska.

As a result, this study emphasizes the importance of integrated education and reveals trends in the literature. In addition, it offers preliminary preparation for researchers who want to reveal the intellectual, conceptual, and social structure of the subject of integrated education and to gain a general understanding of this field. Research results show that the number of academic studies in the field of integrated education has increased quantitatively and that research in this field has diversified in different disciplines and at the global level. On the other hand, although the literature in the field of integrated education has a history of almost 100 years, it shows that this area will continue to be studied in the future. In today's world, where we live integrated with technology, a curriculum that connects school to life with an interdisciplinary approach such as integrated education plays a critical role.

Strengths, Limitations and Recommendations

The most important feature of this study is that it is the first bibliometric analysis in the field of integrated education. In addition, the R Studio and Biblioshiny programs were used to reveal the descriptive characteristics of the literature, annual scientific production, and the most commonly used words and trends in the field. VOSviewer software was used to reveal the collaboration and relationships between key concepts, authors, and citations through visual mapping and to clarify the interdisciplinary nature of the research. Therefore, two different analysis programs were used in the study, providing diversity in terms of data analysis tools. In this way, many data in the field were analyzed simultaneously, and both the statistical and intellectual, conceptual, and social structures of the results were better presented through visual mapping. In this way, the current research makes significant contributions to the literature in terms of revealing the general situation of the field of integrated education and the conceptual, intellectual, and social structure of the field with the help of bibliometric analysis and visual mapping. Thus, it is thought that this study will provide other researchers with a general perspective on which studies stand out in the field of integrated education, the current situation, and future trends in the field. In this respect, it is thought that this study will also shed light on future research by analyzing and discussing the hot spots in this field.

Despite these strengths, this study has limitations related to its use of bibliometric analysis tools. This is because it is not possible to create a search query that covers almost everything in bibliometric research. The first limitation of this study is that it is limited to publications listed in the Web of Science and Scopus databases. Although these two databases are among the top global databases, they do not cover all publications in the field of integrated education. The second limitation of the study is that only journal articles were included in the analysis, excluding other relevant publications in the field, such as book chapters and conference proceedings. The third limitation is that the literature retrieved from both databases through specific search strings was limited to the English language. This limits the generalisability of the findings. This study also excluded important research in other languages. In addition to these limitations, since bibliometric analysis addresses quantitative data in terms of methodology, the inability to comment on the content or quality of publications is an important limitation (Dunk & Arbon, 2009). That is, citation analysis represents an objective and quantitative measure of research but does not provide information about its quality or impact on clinical practice. Nevertheless, when interpreting the analysis, it is assumed that the more an article is cited, the greater its impact on scientific research (Fortuna, Aria, Iorio, Mignogna & Klasser, 2020).

This study is limited to journals scanned in the WoS and Scopus databases. It may be recommended that similar studies be applied to different databases to be conducted in the future and that broader literature reviews be conducted in the field by eliminating limitations such as language, document type, and research area. In addition, it may also be recommended to narrow the research focus in general and to conduct studies such as content analysis, meta-analysis, or review studies that reveal the effect of integrated education on school success.

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