

# A Bibliometric Analysis of Articles on Realistic Mathematics Education Published Between 2000-2021<sup>1</sup>

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### Abstract

*Realistic Mathematics Education (RME) is one of the topics that was introduced about fifty years ago and has been studied continuously since then. The purpose of this study is to bibliometrically analyze the articles on the subject of RME. Using the keyword "realistic mathematics education," 1056 articles were found related to the subject area of RME, which were scanned in the Scopus database in the "Social Science" publication type between 2000-2021. Retrieved articles were analyzed through the web interface page directed by bibliometrix, the R-Studio program package. With the analysis made, the following sub-titles were found: the number of articles produced by years, the authors and journals that published the most articles on the subject area, the most cited articles on a global basis, the annual average number of citations, the productivity of the authors over time, the citation burst values of the authors, the countries of the responsible authors and collaboration tendencies of these countries in terms of articles, word cloud, word tree map, collaboration network of authors, and joint citation network of journals. The results revealed that researchers' interest in the subject increased after 2012, and articles on RME were mostly published by three major journals, including Journal on Mathematics Education, Journal of Mathematical Behavior and Educational Studies in Mathematics. In addition, it has been determined that the authors with the most articles on RME were Zulkardi Z., Suparman S. and R. I. I. Putri, and the countries that published the most articles were USA, Indonesia and Netherlands. As a result of the relevant results, inferences were made for RME.*

**Keywords:** Realistic Mathematics Education, Bibliometric Analysis, R-Studio

### Introduction

Recently, an opportunity is given to the individual to make abstract facts concrete with examples from daily life situations and to play a more active role in the teaching-learning process. Many countries, including Turkey, accepted this logic and arrangements were made accordingly in the education system. Examples of some of these countries are: USA, Korea, Indonesia, China, United Kingdom, and South Africa (Van den Heuvel-Panhuizen, 2020). From this point of view, how learning is for the individual, what are the factors affecting the process and how these factors can be controlled are the questions for the leading research areas in the field of mathematics teaching and learning (Altun, 2006) where we come across with realistic mathematics education (RME). Since RME is one of the theories in which the individual takes an active role in the learning process, socializes and plays a leading role.

1. An early version of this paper was presented at "6th International Congress on Life, Social, Health Sciences in A Changing World" which was held in İstanbul on 2 July 2022

RME is one of the main trends in mathematics education. It was first introduced by the Dutch mathematician Freudenthal towards the end of the 1960s and was based on his views on mathematics (Van den Heuvel-Panhuizen & Drijvers, 2014). It has emerged as a field-specific learning and teaching theory for mathematics education (De Lange, 1987; Freudenthal, 1991; Gravemeijer, 1994; Streefland, 1991; Treffers, 1987; Van den Heuvel-Panhuizen & Drijvers, 2014). Freudenthal's view is that mathematics is a human activity (Freudenthal, 1968) and the individual gains experience and reaches mathematical inferences himself (Zulkardi, 2000). Thus, the individual will be able to discover the solutions they have gained from previous problems by making use of their experiences, and they will be able to use the solution by adapting it to more complex solutions in the future (Gravemeijer, 1994). Another view is that it is a product of the individual's discoveries and social activities (Freudenthal, 1968)-that is, mathematics should consist of daily life problems that are around and related to real life (Putri, 2011). Inclusion of rich, "realistic" situations in the learning process of the individual emerges as a feature of RME. The word "realistic" here means situations that the individual can imagine and visualize in their mind. Therefore, the problems faced by individuals in RME can come from the real world of the individual, as well as from the fantasy world of fairy tales or the formal world of mathematics, as long as it is real and experienced in the mind of the individual (Van den Heuvel-Panhuizen & Drijvers, 2014).

RME emerged as an opposition to memorization-based mechanical teaching because, according to RME, mathematics should not be presented to the individual in a systematic way during the teaching and learning phase (Hadi, 2002). In other words, the individual needs to be in interaction by taking part in these stages, and as a result, more permanent learning should take place (Van den Heuvel-Panhuizen, 1994). At this stage, we encounter the concept of mathematization. Treffers (1987) divides the concept of mathematization into two components: horizontal and vertical mathematization. Horizontal mathematization means the transition to the world of symbols based on real life problems, and vertical

mathematization means that the individual navigates the world of symbols and establishes relationships between concepts. That is, in the horizontal mathematization stage, the individual defines a problem and uses his own strategies to find a solution. In the vertical mathematization stage, they realize their own strategies when they use mathematical language or looks for a rule to solve these strategies. Although these two stages of mathematization seem separate from each other, they complete each other (Treffers, 1987).

Three basic educational design principles are stated in RME (Gravemeijer, 1994). The first one of these principles is directed rediscovery. Within the framework of this principle, the educator acts as a guide for the students with the activities, and thus a process is created in which the students gain experience and learn in real-life situations (Gravemeijer & Doorman, 1999). The second of these principles is didactic phenomenology. According to this principle, a mathematical concept is analyzed and thus the formation of the concept is defined (Gravemeijer, 1994). Freudenthal (1983), on the other hand, defines this principle as the investigation of the relationship between the phenomenon represented by the mathematical concept and the concept itself (Kwon, 2002). The last principle is evolving models. There is a gap between the daily life situations of the individual and their mathematical knowledge, and accordingly, some difficult situations are encountered during mathematics teaching (Gravemeijer, 1999). Models, on the other hand, fill the gap between the student's informal mathematical knowledge and formal mathematical knowledge in overcoming these difficulties (Gravemeijer, 1994, 1999; Putri, 2011). In this modeling process, the individual changes over time from a pre-existing model of activity ("model of") to a model that includes more advanced mathematical reasoning ("model for") (Gravemeijer & Doorman, 1999).

When the literature on GME is examined, it is seen that researches are carried out to comprehend subjects such as algebra (Kusumaningsih & Herman, 2018; Yuhariati et al., 2022), differential (Kwon, 2002; Ramussen & King, 2000), concept of equality (Theodora & Hidayet, 2018), function (Makonye, 2014; Noviani & Firmansyah, 2020), geometry

(Afthina & Pramudya, 2017; Ahmad, 2021; Fauzan, 2002; Le, 2006; Loc & Tien, 2020; Mahendra & Slamet, 2017), statistics (Paroqi et al., 2020; Uyen et al., 2021), linear (Amrina & Rosnawati, 2019), logarithms (Webb et al., 2011), fractions (Afriansyah, 2017; Cendekiawaty & Sugiman, 2020; Rangkuti, 2015; Streefland, 1986, 1991), ratio and proportion (Maryam & Samporno, 2021) addition and subtraction (Van Zanten & Van den Heuvel-Panhuizen, 2021) integers (Muslimin et al., 2020) and percentage (Van den Heuvel-Panhuizen, 2003). When it is desired to conduct research on RME, it is seen that scientific studies are increasing rapidly day by day, and accordingly, it becomes more difficult to fully examine the literature and to access the desired information. Therefore, bibliometric analyzes can be used to guide researchers by presenting the conceptual structure of the field.

The term bibliometrics is a concept first introduced by Pritchard in 1969 and is explained as a set of mathematical and statistical methods used in examining the characteristics of scientific studies (Pritchard, 1969). The focus of bibliometric studies is to make statistical analysis of scientific publications and accordingly, to see the structures of the studied field in its entirety (Egghe & Rousseau, 1990). The main function of bibliometrics is to reveal the development and change in any field and to examine the conceptual, social and intellectual structures of scientific publications in the field (Aria & Cuccurullo, 2022a). In addition, it provides unbiased and reliable analyzes (Aria & Cuccurullo, 2017) and by creating network structures, it provides quantitative analysis of many features such as keywords, publications, references, journals, authors in any subject area and mapping the obtained information (Aria ve Cuccurullo, 2022a).

When both national and international bibliometric studies in the field of education are examined, it is seen that the researches are in the following fields; mathematics education (Julius et al., 2021; Özkaya, 2018), science education (Comarú et al., 2021), distance education (Hebebei, 2021), Turkish education (Gökçen & Arslan, 2019), astronomy education (Taner et al., 2021) and environmental education (Kurtuluş & Tatar, 2021b). However, there is a gap regarding the studies in the field of

mathematics education (Drijvers et al., 2020) so it is necessary to conduct bibliometric studies that talk about RME, which is an important trend in mathematics education.

## Method

In the present study, in which the bibliometric analysis method was used, the bibliometric characteristics of the articles in the journals were determined by searching the keyword “realistic mathematic education” in the Scopus database. Bibliometric analysis shows the topics and focal points of the researchers who are interested in any field and want to do research, and provides an opportunity to evaluate the publications in the field (Zupic & Čater, 2015).

## Sample

The research data were obtained from the articles in the Scopus database, covering the years 2000-2021 and published in different journals in the subject area of “Social Science”, in which the key concept of “realistic mathematics education” is used. Editorial material, conference paper, letter, book and review working document types about the subject area were not included in the study. The most important sources in bibliometric studies are Science Citation Index (SCI), Social Science Citation Index (SSCI) and Art & Humanities Citation Index (A&HCI). Since it is one of the databases that provide access to these indexes, Scopus was chosen as the database to carry out this research. Moreover, the Scopus database and the bibliometric analysis system run through the R-Studio program are compatible (Aslançı, 2022; Bayrak, 2022; Güzeller & Çeliker, 2017; Kurtuluş & Bilen, 2021; Kurtuluş & Tatar, 2021a, 2021b; Taner et al., 2021).

## Data Collection

In the research, a total of 2077 studies were accessed by selecting the “all” option from the Scopus search section and using the key concept of “realistic mathematics education”. In the context of the purpose of the research, 1291 articles were reached by selecting only “article”. Then, the subject area was restricted to “Social Science” and 1169 articles were obtained. Finally, the year range of

the study was restricted regarding the keyword, and it was adjusted to cover the period after 2000, but 2022 was not included in the study because it was not yet completed. As a result, the time interval of the study was determined as between 2000-2021 and thus 1056 articles were reached. The “distribution of these 1056 articles by years”, “the average number of citations”, “the most published journals”, “the most published authors”, “the productivity status of the authors” and “the citation burst values”, “the scientific productivity of the countries”, the collaboration map of the countries”, “the most cited articles”, “word cloud”, “word tree map”, “authors collaboration network” and “common citation network of journals” were reached.

### Data Analysis

The R-Studio program was used to obtain the findings related to the publications examined in the research. The program provides many packages used for bibliometric analysis through its official repository <https://cran.r-project.org/>. For analysis, the data was transferred to Biblioshiny, the web interface of the Bibliometrix package, which is an R tool. This software is a bibliometric analysis application that combines the functionality of Bibliometrix with the easy usability of web applications that leverage the Shiny package (Aria & Cuccurullo, 2022b). The reason for choosing the R program for the bibliometric analyses to be made is that it allows more data and provides a more detailed representation of the data.

The data file, which was accessed from the Scopus database according to the criteria of the research,

was obtained as follows. The articles that came out as a result of all criteria were selected with the “all” option. As a result of this selection, the “export” option has been activated. Then, the “bibtex” format, which is the export method, is selected from the “export” option. The export process was completed by selecting “citation information, bibliographical information, abstract & keywords, funding details, other information” options on the relevant screen. Then, the “Bibliometrix” package was downloaded from the R-Studio program and run. Afterwards, the Biblioshiny Bibliometric analysis page, which is a web interface, was accessed through the R-Studio program. The “bibtex” file, which was downloaded by going to the data section of this website, was uploaded and analyzes were carried out.

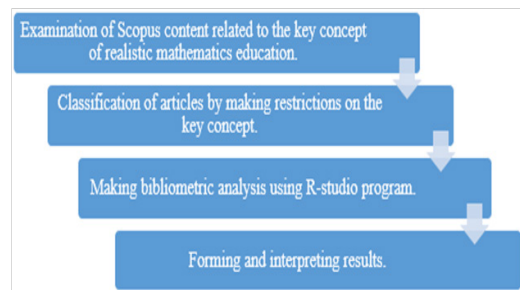


Figure 1 Data Analysis Process

### Findings

The statistical information of the data of a total of 1056 articles obtained as a result of the restrictions on GME is presented in Table 1.

Table 1 Statistics on Research Data

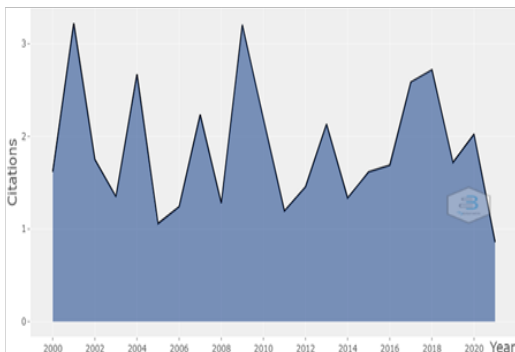
Key Findings of the Data	Results	Key Findings of the Data	Results
Timespan	2000-2021	Authors	2033
Sources (Journals)	236	Author Appearances	2770
Documents (Articles)	1056	Authors of Single-Authored Articles	188
Average Year from Publications	6.75	Authors of Multi-Authored Articles	1845
Average Citations per Articles	12.91	Single-Authored Article	219
Average Citations per Year per Articles	1.467	Article per Author	0.519
References	42161	Authors per Article	1.93
Keywords (ID)	357	Co-Authors per Article	2.62
Author's Keywords (DE)	2586	Collaboration Index	2.2

When Table 1 is examined, it is seen that it consists of 1056 articles published in 236 journals between 2000-2021 and has an average citations per articles of 12.91. It is seen that 2033 authors in the field have contributed to the field 2770 times and the number of articles per author is 0.519. In addition, it is seen that an average of 1.93 authors contributed to the production of each article and the number of co-authors per article was 2.62. The collaboration index in the field is determined as 2.2. The distribution of the total number of articles produced for the grouped years of 1056 articles in the subject area is given in Table 2.

**Table 2 Number of Articles Produced Regarding the Years**

Year	The Number of Articles (f)	Percentage (%)
2000-2005	76	7.19
2006-2011	166	15.72
2012-2017	316	29.93
2018-2021	498	47.16

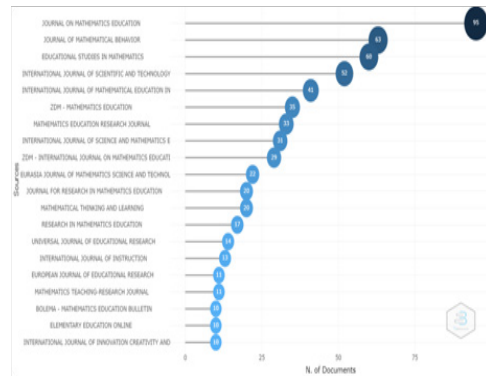
When Table 2 is examined, it is seen that the first article reached as a result of the restrictions was published in 2000 and the highest number of articles in the subject area was reached between 2018-2021 (f=498). Articles produced after 2012 constitute 77.09% of all articles produced. The average article citations per year for the subject area is shown in Graph 1.



**Graph 1 Average Article Citations per Year**

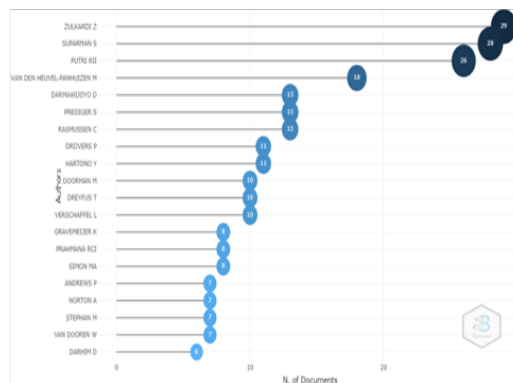
Looking at Graph 1, it is noteworthy that the highest average article citations per year was in 2001 (f=3.2) and 2009 (f=3.2). It was determined that the

highest average for each article was reached in 2001, with a citation average of 66.67. In Graph 2, which is below, the top 20 journals that have published the most articles on the subject area can be seen.



**Graph 2 The Journals Publishing the Most Articles in the Subject Area**

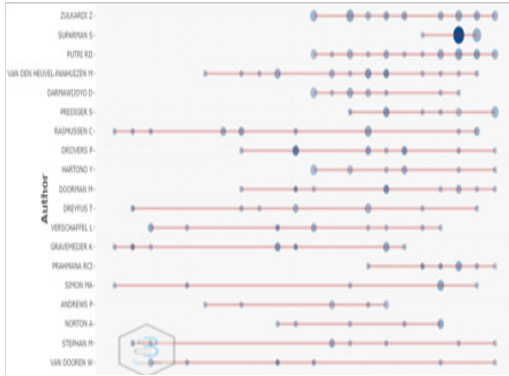
According to Graph 2, the journals “*Journal on Mathematics Education*” (f = 95), “*Journal of Mathematical Behavior*” (f = 63) and “*Educational Studies in Mathematics*” (f = 60) were found to be the top three journals that published the most articles on GME. It was determined that the *Journal on Mathematics Education* published approximately 9% of all articles. Below Graph 3 shows the top 20 authors who published the most articles on the subject area.



**Graph 3 Authors Publishing the Most Articles for the Subject Area**

According to Graph 3, it is seen that the authors who produced the most articles on RME were Zulkardi Zulkardi (f = 29). This author is followed

by Suparman Suparman( $f = 28$ ) and Ratu Ilma Indra Putri ( $f = 26$ ). It is seen that these three authors contributed 7.86% of the total articles in the field. In Graph 4, the productivity status of the authors over time and their citation burst values are given.



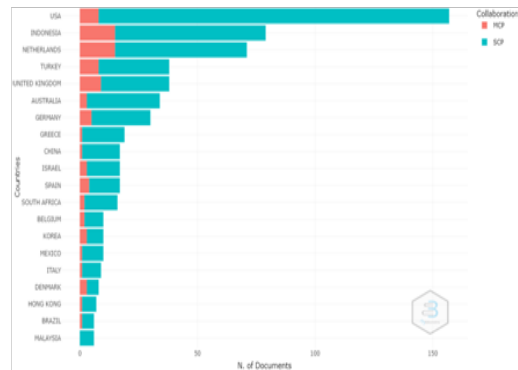
**Graph 4 Authors' Production over Time and Citation Burst Values**

The authors in Graph 4 are listed from top to bottom, from the author who produced the most articles in the field to the authors who produced the least. This is in agreement with Graph 3. In addition, the line length in each author's line in the chart represents the time period in which the relevant author was operating in the field. Each blue circle in the graph indicates the number of articles produced by the relevant author for each year, while the blue color indicates the highest total citation per article produced by the author in the relevant year. In this direction, when the productivity of the authors in Graph 4 is examined over time, the author with the highest citation explosion per year is S. Suparman ( $f=28.50$ ), who contributed to the field between 2017-2020 and has the largest circle with 18 articles produced in 2019. Although Suparman is not the most cited author, this is due to the fact that the author receives the highest number of citations per article published in the relevant year, which creates the citation burst value. In addition, considering Graph 4, C. Ramussen and M.A. Simon appears to be the longest-standing writer in the field. This is due to the fact that they are cited intermittently between the years mentioned. Table 3 shows the top six authors with the highest citation burst values.

**Table 3 Citation Burst Values by Authors and Start-End Interval**

Authors	Burst	Start	End
S. Suparman	28.50	2017	2020
P. Drijvers	16.23	2007	2021
K. Gravemeijer	12.05	2000	2016
M. Stephan	12.05	2001	2021
M. Doorman	12.00	2007	2021
M. Van den Heuvel-Panhuizen	12.00	2005	2020

When Table 3 is examined, it is seen that the highest citation burst value was S. Suparman's and then P. Drijvers has a higher value compared to other authors, but the high citation burst values of the other four authors were quite close to each other. Below Graph 5 shows the countries of the corresponding authors.



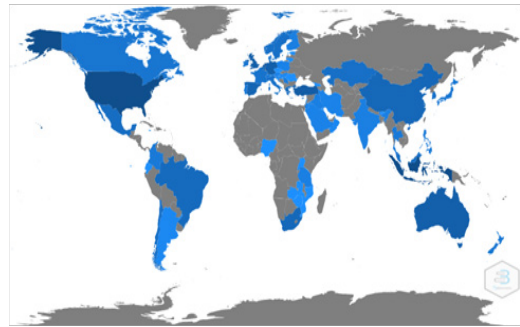
**Graph 5 Countries of Responsible Authors and Number of Articles**

When Graph 5 is examined, the blue color shows the SCP (Single Country Publications) value, which represents the number of articles produced by researchers living in the same country, while the red color shows the MCP (Multiple Country Publications) value, which represents the number of articles produced by researchers from different countries. Regarding the countries of the corresponding authors, the top three countries were USA (SCP: 149, MCP:8) with a total of 157 articles, Indonesia (SCP:64, MCP:15) with 79 articles, and Netherlands(SCP: 56, MCP:15) with 71 articles, respectively.

**Table 4 Number of Articles, SCP and MCP Values regarding Countries**

Country	Article	Frequency	SCP	MCP	MCP Ratio
USA	157	0.23225	149	8	0.0510
Indonesia	79	0.11686	64	15	0.1899
Netherlands	71	0.10503	56	15	0.2113
Turkey	38	0.05621	30	8	0.2105
United Kingdom	38	0.05621	29	9	0.2368
Australia	34	0.05030	31	3	0.0882
Germany	30	0.04438	25	5	0.1667
Greece	19	0.02811	18	1	0.0526
China	17	0.02515	16	1	0.0588
Israel	17	0.02515	14	3	0.1765
Spain	17	0.02515	13	4	0.2353
South Africa	16	0.02367	14	2	0.1250
Belgium	10	0.01479	8	2	0.2000
Korea	10	0.01479	7	3	0.3000
Mexico	10	0.01479	9	1	0.1000
Italy	9	0.01331	8	1	0.1111
Denmark	8	0.01183	5	3	0.3750
Hong Kong	7	0.01036	6	1	0.1429
Brazil	6	0.00888	5	1	0.1667
Malaysia	6	0.00888	6	0	0.0000

When Table 4 is examined, the first 20 countries according to the number of articles are presented in the corresponding author's countries table. Among the 20 countries in the table, it is seen that the country with the highest MCP rate was Denmark ( $f=0.375$ ), followed by Korea ( $f=0.3$ ), United Kingdom ( $f=0.2368$ ) and Spain ( $f=0.2353$ ). In addition, as can be seen in the table, Denmark in the 17th place and Korea in the 14th place had the highest MCP ratio, although they were in the lower ranks regarding article production. From this, it can be concluded that the authors in Denmark and Korea are more open to international collaborative studies. Moreover, USA, which was in the top rank in terms of number of articles ( $f = 0.051$ ), had a very low MCP rate. Other countries with the lowest MCP rate were Malaysia ( $f=0$ ), Greece ( $0.0526$ ) and China ( $f=0.0588$ ). This shows that researchers in these countries are working towards studies in their own countries rather than international collaborative studies. Below you can see Figure 2 showing the scientific productivity of countries.

**Figure 2 Scientific Productivity of the Countries**

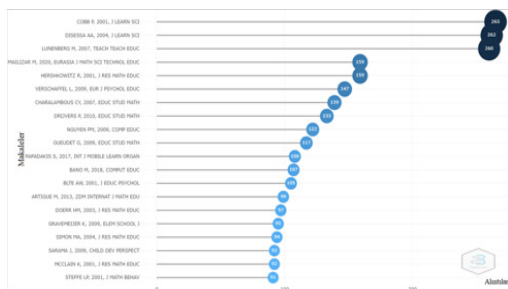
In Figure 2, the shades of blue on the map show the number of articles produced by countries in terms of GME subject area. Dark blue indicates the increase in the number of articles, while light blue tones indicate countries with less number of articles. In addition, the gray color shows the countries that do not have an article on this subject. When the quantitative data part of the map is analyzed, it is seen that Indonesia with 403 articles, USA with 359 articles and Netherlands with 172 articles were in the first three places, and Turkey was in the 4th place

with a contribution of 87 articles. In Figure 3 below, the collaboration intensity map of the countries is shown at the geographical level.



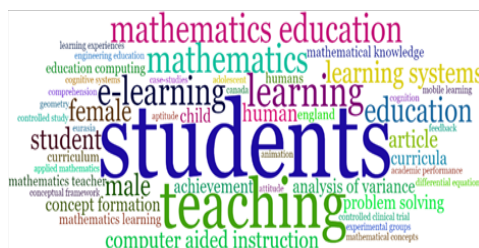
**Figure 3 Collaboration Map of the Countries**

In Figure 3, the countries that have the most collaboration in the relevant field have the darkest blue color, while it lightens as the number of collaboration decreases, and in the absence of it, the color gray dominates the region. The thickness of the red curves that provide the connections between the countries is proportional to the intensity of the collaboration established between the two countries. In this respect, when Figure 3 is examined, it is seen that USA, Indonesia and Netherlands are the three countries that established the most collaboration. Considering the intensity of connections between countries, it is seen that Indonesia and Netherlands (24 collaboration) are the countries with the most connections. It is also seen that Netherlands-Germany with 11 collaboration and USA-Turkey with 9 were the countries that collaborated the most. Graph 6 below shows the most cited articles on a global basis.



**Graph 6 The Most Cited Articles on a Global Basis**

When Graph 6 is examined, considering the data obtained using the key concept of “realistic mathematics education”, the most cited article on a global basis, with 265 citations in total, was the article of Cobb, P., Stephan, M., McClain, K., & Gravemeijer, K. (2001) titled as “Participating in Classroom Mathematical Practices.” Following this study, the article of Disessa, A.A. & Cobb, P. (2004) with the title “Ontological innovation and the role of theory in design experiments” was the second with 262 citations and Lunenberg, M., Korthagen, F., and Swennen, A. (2007) with their article “The teacher Educator as a role model” was the third with 260 citations. In Figure 4 below, the most frequently used keywords in the articles are given.



**Figure 4 Word Cloud**

The word cloud is one of the text mining methods and shows the most used words in a text. In addition, there is a relationship between the size and proximity of each word in the cloud and its frequency of use. It is understood that the word in the focus of the cloud and having the largest dimension denotes the most preferred word in the relevant subject area. When Figure 4 is examined, the words students ( $f=22$ ), teaching ( $f=14$ ) and learning ( $f=9$ ), which have the largest dimension and are closest to the focus, appear as the most used keywords, respectively. In Figure 5 below, the figure showing the most used words in the abstract of the articles is presented.



**Figure 5 Word Tree Map**

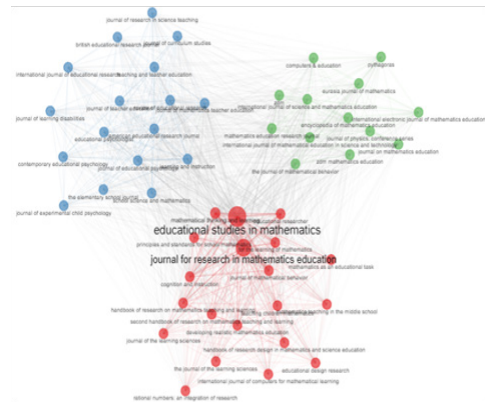


The word tree map is another text mining method and shows the most used words in any text by dividing them into large rectangular regions. The word tree map in Figure 5 shows the most used words in the abstract sections of the articles by scanning the key concept of “realistics mathematics education”. Examining Figure 5, it is seen that the words students ( $f=12\%$ ) with 2940 usages, mathematics ( $f=7\%$ ) with 1609 usages and learning ( $f=6\%$ ) with 1509 usages were the most preferred words in the abstract sections of the articles. It is noteworthy that these three words, which are used the most in the abstract sections, form 25% of the entire field. Figure 6 below shows the collaboration network of authors working on the subject.



**Figure 6 Authors Collaboration Network**

Figure 6 shows the most productive authors in the field and their collaboration. The size of the rectangle in which the author writes his name indicates the number of articles he produced in the field, while the lines indicate the intensity of the collaborations established among the authors. In addition, the authors located in the same color cluster produce studies on the same subject. In the light of this information, it is clearly seen that the author with the largest rectangle in the network is Zulkardi Z., and the author who collaborated most with Zulkardi Z. is R. I. I. Putri ( $f=13$ ). Figure 7 below shows the common citation network of the journals.



**Figure 7 Common Citation Network of Journals**

Journal common citation network occurs when two or more journals are cited in the bibliography section of the article at the same time in a produced article. According to Figure 7, each color bubble in the network represents a journal and the diameter of the balloon represents the citation weight of the journal, while the common citations established between journals are related to the lines and the strength of their relationship is related to the thickness of the lines. Considering Figure 7, it is understood that *Educational Studies in Mathematics* has the largest balloon diameter and is the most cited journal in the field. In addition, when the links of the journal are examined, it is seen that it is in the red color set, which has the widest network. It can be said that it is the journals with the most common references, together with the *Journal for Research in Mathematics Education*, which has the highest link thickness.

**Discussion, Conclusion and Recommendations**

In this study, a total of 1056 articles between the years 2000-2021 in the journals in the subject area of “Social Science” were accessed by scanning the keyword “realistic mathmematics education” in the Scopus database, and bibliometric analysis of these articles was carried out using the R-Studio program. As a result of the analysis, the annual distribution of the articles, the average number of citations, the journals and authors that publish the most relevant articles, the productivity status of the authors over time and the citation burst values, the countries and

scientific productivity of the responsible authors, the collaboration map of the countries, the articles with the highest rate of citation, word cloud, word-tree-map, collaboration network of authors and joint citation network of journals were reached.

As a result, it was seen that between 2018-2021, 498 articles were produced and they constituted 46.15% of all articles published on the subject. On a yearly basis, it was determined that the highest number of articles were produced in 2019 with 147 articles. In addition, the years with the highest average annual citation rate were 2001 and 2009, with an average of 3.2 citations, and in these years, 15 and 33 articles were published, respectively. It is seen that the most cited article was “Participating in Classroom Mathematical Practices”, which was written by P. Cobb, M. Stephan, K. McClain and K. Gravemeijer in 2001 and published in the *Journal of the Learning Sciences*. Considering all these data, it can be said that the interest in the field has increased as the years progressed, and therefore there has been an increase in the number of articles in the last few years.

It has been determined that the authors who have published articles on the subject have published in 236 different journals. It has been observed that the journal that has published the most articles on this subject was the *Journal on Mathematics Education*, which has been operating in the field since 2010 and has published 95 articles. In addition, it was seen that *Educational Studies in Mathematics and Journal for Research in Mathematics Education* were the journals with the most common citation. Therefore, it is predicted that it will be more beneficial for authors who plan to produce publications in the field in the future to choose these journals in order to highlight their work.

Considering the authors’ production of articles on the relevant subject, it has been seen that the author Zulkardi Zulkardi, with his contribution of 29 articles, was the author who published the most articles in the field. It has been determined that Zulkardi’s articles were mostly in the field of mathematics and were on topics such as fractions, mathematical literacy, geometric shapes, multiplication, volume and mathematical modeling. Considering the productivity and citation bursts of the authors over time, it was determined that the

author with the highest citation burst value was S. Suparman ( $f=28.50$ ). This situation was not related to the number of citations the article received, but to the density of the citations in the relevant year. In addition, C. Ramussen and M.A.Simon, the authors who were active in the field for the longest period of time with their intermittent studies. When the results of the collaboration network analysis between the authors were examined, it was found that the authors who contributed to the research together were in the same cluster. Zulkardi is one of the best-known authors and has 13 publications produced in collaboration with Putri. In addition, it was determined that the collaboration is generally gathered in the red colored cluster consisting of authors from the same countries. In this case, it is thought that the situation that causes these authors to be in a central position is that they produce a higher amount of articles compared to other authors in the field, and accordingly, it increases the desire of other authors in the field to publish with these authors.

On the basis of the countries of the corresponding authors, it was determined that the first country with 157 articles on RME was USA, and the authors in this country generally collaborated with the authors in their own countries. On the other hand, it has been observed that authors from Denmark were more open to collaboration with foreign countries in their studies. It has been determined that the country with the highest scientific production on RME was Indonesia with 403 articles. In addition, it was seen that Indonesia and Netherlands had 24 collaboration and they were the countries that collaborated the most.

According to word cloud and word tree maps, which are text mining methods, it was seen that the most used word in the keywords and abstracts of the articles about RME was “students”. Therefore, it is thought that this result would be useful when choosing keywords in the studies to be carried out on this subject area in the future.

As a result of the analysis, the essential keywords, publications, authors, journals and countries of the articles obtained as a result of the restrictions on RME were determined. The connections, relationships and collaborations among them guide the researchers. Finally, based on the findings of the present study,

some suggestions can be made for future research in the field.

1. Researchers can benefit from these studies by identifying main studies, leading authors or journals in the field by using different key concepts for the subject areas that they are interested in and can publish their studies in these journals.
2. Only the sources indexed in the Scopus database were used in the study. R-Studio program works in harmony with databases such as Scopus, WoS, Dimensions, Lens.org, PubMed, Cochrane Library. For this reason, these databases can be used in future studies. In addition, databases such as ProQuest, which contain mostly postgraduate theses, can also be used and the results obtained can be compared.
3. In the study, the document type was selected as “article”, and new studies can be carried out by choosing document types such as “thesis”, “book”, or “conference papers”.
4. In future studies, with different restrictions, analyses can be made only for certain journals, for certain years or for certain fields, and the results obtained can be compared.

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