OPEN ACCESS

Manuscript ID:
EDU-2022-10045174

Volume: 10

Issue: 4

Month: September

Year: 2022

P-ISSN: 2320-2653

E-ISSN: 2582-1334

Received: 27.05.2022

Accepted: 05.08.2022

Published: 01.09.2022

Citation:
Bayrak, Alp, and Seher Aslanci. "Realistic Mathematics Education: A Bibliometric Analysis." *Shanlax International Journal of Education*, vol. 10, no. 4, 2022, pp. 52–62.

DOI:
https://doi.org/10.34293/education.v10i4.5174

Realistic Mathematics Education: A Bibliometric Analysis[1]

Alp Bayrak
Ministry of National Education, Turkey
https://orcid.org/0000-0003-0263-5360

Seher Aslanci
Alanya Alaaddin Keykubat University, Turkey
https://orcid.org/0000-0002-5749-0958

Abstract
The aim of the study is to conduct a bibliometrical analysis on the published articles related to RME. Accordingly, Scopus database was scanned using the keywords "realistic mathematics education" or "realistic mathematic education" or "realistic maths" or "realistic mathematical education" and a total number of 1190 articles published on RME between 1986 and 2021 were obtained and anayzed bibliometrically. The data gathered was then analyzed utilizing "biblioshiny", which is a web interface app in the bibliometric R-Studio program package. The analyses were conducted in order to find out the sample of the articles' annual distributions; their 3-D area chart; the list of the journals that published the highest number of related articles; the authors and their institutions; source clusters obtained through Bradford's Law, the scientific productivity of the authors by years and their citation burst scores; the scientific productivity of the countries; the word cloud and word tree patterns of these articles; co-word analysis of the concepts, the collaboration networks of the authors and the conceptual structure mapping. The findings obtained as a result of the conducted analyses indicate that there has been an increase in the interest in RME research after 2016 and the journal with the highest number of published articles on RME is Journal on Mathematics Education. Also, the authors with the highest numbers of publications are Z. Zulkardi, S. Suparman and R. I. I. Putri, respectively,while Utrecht University has the highest number of publications on the topic. The countries with the highest rates of productivity in terms of publications on RME are found to be the USA, Indonesia, and the Netherlands, respectively. In addition, the most frequently used keyword by the researchers is found to be "realistic mathematics education",while "mathematics" is the most frequently utilized word in the titles of the analyzed articles. The overall findings of the study point out the need for further studies on RME as realistic mathematics education is considered to be a significant method in finding solutions to the problems in the field of mathematics education. Further theoretical contributions are also thought to be crucial as they could provide fundamental references for future research.

Keywords: Realistic Mathematics Education, Bibliometric Analysis, R-Studio, Scopus.

Introduction

Realistic mathematics education (RME) is a teaching and learning theory that emerged in the Netherlands at the end of 1960s (De Lange, 1987; Freudenthal, 1991; Gravemeijer, 1994; Streefland, 1991; Treffers, 1987; Van den Heuval-Panhuizen & Drijvers, 2014; Zulkardi, 2002). RME is shaped based on Freudenthal's two main principles for mathematics teaching and learning (Freudenthal, 1991). The first principle postulates the idea that mathematics must be a human activity. That is, learners should be given the opportunities to learn through experience (Van den Heuvel-Panhuizen, 2020a). The second principle maintains that learning in mathematics should be the result of human inventions and social activities (Freudenthal, 1968, 1973).

1. The present study is derived from Alp BAYRAK's master's thesis completed in 2022.

In other words, it is necessary to integrate learners' real world and their immediate environment into teaching practices (Effendi et al., 2018; Zulkardi & Putri, 2006). Mathematics should be closely relevant to learners, be composed of their daily problems and reflect their real life conditions (Putri, 2011; Alim et al., 2020). Developed by the Freudenthal Institute, this theory has been adopted and implemented in many countries, including Indonesia, South Africa, USA, Belgium, Singapur, China, South Korea, England, etc. (Van den Heuvel-Panhuizen, 2020b). It has also been reported that the implementation of these key principles helps learners to better understand mathematical concepts and results in elevated levels in learning outcomes (Adjie et al., 2021).

RME has been developed as a reaction to mechanical teaching and postulates that mathematics should not be introduced as a ready-made subject to the learner in teaching (Hadi, 2002). It claims that the learner should be in constant interaction while taking responsibilities at each learning step in order to achieve higher levels of retention in learning(Van den Heuvel-Panhuizen, 1994). At this point, the concept of mathematization emerges. Mathematization is distinguished between 'horizontal' and 'vertical' dimensions by Adri Treffers (Treffers, 1987). While in horizontal mathematization, the learner defines a problem and tries to solve it using their own strategies, in vertical mathematization, the learner tries to solve his or her strategies using mathematical language and tries to arrive at a formula or an algorithm (Treffers, 1987).

Furthermore, Gravemeijer (1994) mentions three key teaching principles for RME. The first principle is 'guided opportunity to re-invent mathematics. According to this principle, teachers should opt for the guiding role through learning activities, which implies the need for teachers to create learning opportunities for their learners to acquire knowledge through experience and by engaging actively in real-world-like activities (Gravemeijer & Doorman, 1999). Another principle is referred to as the Didactic Phenomology Principle, in which mathematical concepts are analyzed in order to be able to explain their emergence (Gravemeijer, 1994). In other words, learners are encouraged to decide on the methods they are going to use by utilizing mathematical tools to develop concepts and to learn the situations where they are expected to use these concepts (Treffers, 1987). The last principle, Models, suggests that the problems experienced by learners while learning mathematics result from the gap between their informal knowledge levels and their formal knowledge levels. Here, models meet the bridging function between the informal and the formal levels (Fauziah et al., 2017; Gravemeijer, 1994; Putri, 2011; Yilmaz, 2020).

The term Bibliometri was first introduced by Pritchard in 1969 and refers to a set of mathematical and statistical methods used for analyzing specific characteristics of scientific publications (Pritchard, 1969).The word 'bibliometrics' is composed of two words: the first is "biblio", which means 'book' in Greek; and the second is "Metricus" or "Metricos", referring to 'measure' in Greek (Osareh, 1996). Bibliometrical research enables researchers to conduct analyses to accumulate the publications in specific fields, to find out these publications' impacts, to identify the authors' productivity along with their tendencies for authoring and collaboration, to determine the scopes of the main and the secondary publications, to find out the distributions in literature and their recency, and to identify their citation scores (Tanuskodi & Venkatalakshmi, 2010). Moreover, it facilitates to conduct objective and reliable analyses (Aria & Cuccurullo, 2017).By creating networks, it makes it possible to conduct quantitative analyses on various properties of publications such as key words used, research published, references cited, journals, or authors and to present the obtained findings by structure mapping (Aria ve Cuccurullo, 2022a).

Method

Following a descriptive research model, the study aimed to identify the bibliometrical properties of the journal articles gathered from Scopus database by using the keywords "realistic mathematics education" or "realistic mathematic education" or "realistic maths" or "realistic mathematical education". Bibliometrical analyses in descriptive research help journals to perform internal evaluation and to shape their publication policies accordingly. Similarly, it enables researchers to access accumulated data on the

research areas they are interested in or plan to focus on in their future research (Al et al., 2010; Zupic & Čater 2015). Bibliometrical analysisis considered to be a very efficient method in identifying and evaluating journals, organizations, countries, subject areas and specific research topics (Huang et al., 2006).

Sampling

The data for the study was comprised of the articles published in "Social Science" and "Mathematics" journals between 1986 and 2021. The articles were identified by using "realistic mathematics education" or "realistic mathematic education" or "realistic maths" or "realistic mathematical education" keywords in Scopus database. However, only journal articles were included in the sample; while editorial materials, conference proceedings, books, book chapters, letters, notes and review articles were excluded in the analyses. The most eminent sources in bibliometrical analyses are considered to be Science Citation Index (SCI), Social Science Citation Index (SSCI) and Art & Humanities Citation Index (A&HCI) international citation indexes. Being one of the databases that provides access to these indexes and also being compatible with the bibliometrical analysis system run through the R-Studio program, Scopus was chosen as the database to conduct the present research (Aslancı, 2022; Bayrak, 2022; Güzeller & Çeliker, 2017; Kurtuluş & Bilen, 2021; Kurtuluş & Tatar, 2021a, 2021b).

Data Collection

For the purpose of the study, the Scopus database was scanned selecting all fields option and using "realistic mathematics education" or "realistic mathematic education" or "realistic maths" or "realistic mathematical education" keywords. As a result, a total of 2165 publications were obtained. In line with the aim of the study, only journal articles were selected and 1352 articles were accessed. Following this step, the research areas were determined to be limited to "Social Science" and "Mathematics", which yielded 1240 articles. As the final step, the time period was set to be between 1986 (since the first article found in the Scopus database was almost a decade older than the next article in the time line) and 2021 (as 2022 has not been completed yet). As a result of these limitations, the number of the obtained articles published between 1986 and 2021 was 1190.

This obtained sample of articles were analyzed to identify the results for the annual distributions; 3-D area chart; the list of the journals that published the highest number of related articles; the authors and their institutions; source clusters obtained through Bradford's Law, the scientific productivity of the authors by years and their citation burst scores;the scientific productivity of the countries; the word cloud and word tree patterns of these articles; co-word analysis of the concepts, the collaboration networks of the authors and the conceptual structure mapping.

Data Analysis

The articles gathered within the scope of the study were analyzed using the R-Studio program. The R program is provided at the official storage website of many bibliometric analysis packages at https://cran.r-project.org/. The package programs that are used for bibliometrical analyses are considered to be efficient in quantitative research (Aria & Cuccurullo, 2017). The data was first exported to biblioshiny, which is a web interface in the bibliometric R program package for analysis. This software is a bibliometrical analysis application that intersperses the functionality of bibliometrix with easy accessibility for web applications utilizing Shiny package (Aria & Cuccurullo, 2022b). In this regard, choosing the R program for bibliometrical analysis is thought to yield a greater variety of results with enriched details.

The data file gathered from Scopus database in line with the scope of the study was formed following several steps. First, the articles chosen based on all the criteria applied were selected using "All" option. And then, "export" option was activated. In the window opened as a result of the activation, "bibtex" format was chosen for exporting the files and "citation information, bibliographical information, abstract & keywords, funding details, other information" options were selected. After completing the exporting step, "bibliometrix" in the R program package was downloaded and was run.

In the next step, biblioshiny bibliometrical analysis page, which is a web interface app in the bibliometric R program package, was accessed. Then, "bibtex" file was uploaded to the data section and the analyses were performed. The procedures carried out during the data analysis process in the study are schematized in Figure 1.

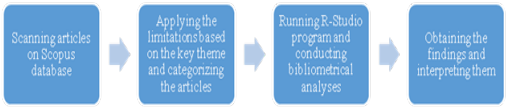


Figure 1 The Procedures Followed in Data Analysis Process

Compliance with Ethical Rules

In the present study titled "Realistic mathematics education: A bibliometric analysis", the open access data of the articles gathered in Scopus database as a result of the limitations set was used. Since the data used was available as open access, ethical permission was not deemed to be necessary. Still, all ethical codes were carefully complied with during all the steps taken throughout the research. All of the studies used within the scope of the present research were cited and included in the references.

Findings

The statistical results obtained after setting up the limitations regarding RME in the web interface biblioshiny in the bibliometric R program package are presented in Table 1.

Table 1 Statistical Results of Research Data

Key Findings of the Data	Results	Key Findings of the Data	Results
Timespan	1986-2021	Authors	2252
Sources (Journals)	257	Author Appearances	3085
Documents (Articles)	1190	Authors of Single-Authored Articles	220
Average Year of Publications	7.69	Authors of Multi-Authored Articles	2032
Average Citations per Article	14.99	Single-Authored Article	263
Average Citations per Year per Article	1.475	Article per Author	0.528
References	48156	Authors per Article	1.89
Keywords (ID)	428	Co-Authors per Article	2.59
Author's Keywords (DE)	2796	Collaboration Index	2.19

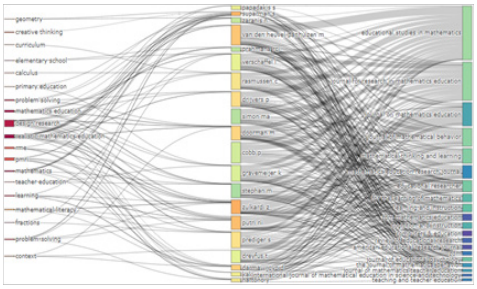
As can be seen in Table1, 1190 articles on RME were published in the period from 1986 to 2021 in 257 different journals. In addition, the number of authors publishing on RME has been found to be 2252 and the number of articles with a single author is 220 whilethe number for multiple authors is 2032. These results indicate that the average number of authors per article is 1.89 and the collaboration index is 2.19. The distribution of the 1190 articles published on the topic based on years is shown in Table 2.

Table 2 The Number of Articles by Years

Years	Numbers of Articles (f)	Percentage (%)
1986-1991	4	0.34
1992-1997	36	3.03
1998-2003	78	6.55
2004-2009	127	10.67
2010-2015	278	23.36
2016-2021	667	56.05

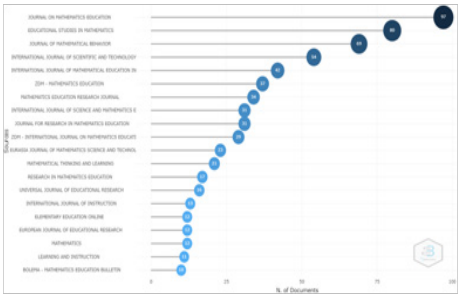
As Table 2 displays, among the articles obtained based on the criteria set for the study, the first article in the field was published in 1986 by Leen Streef land and was titled "Rational analysis of realistic mathematics education as a theoretical source for psychology. Fractions as a paradigm".Also, it can be seen that the articles published until 2010 comprise 20.59% of the all published articles on the topic whereas the articles published after 2016 up until 2021 make up for more than half of the total published articles.

Graph 1shows the findings on the matching scores and the relationships of the centralized meta data field with the other main meta data fields obtained using Sankey diagram.



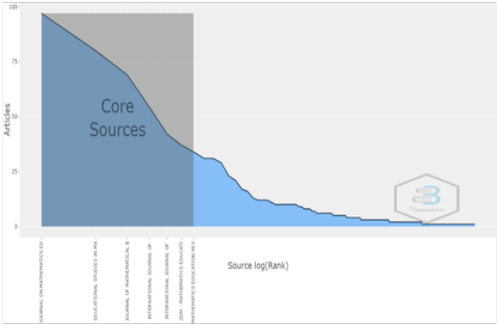
Graph 1 Tree Fields Plot

The gray links in Graph 1 indicate the connections between the most commonly used key words by the authors listed in the middle of the graph and the relationships of these authors with the best journals. Among the keywords listed in the left column, "realistic mathematics education" has the darkest colour, indicating that more than half of the authors have used it as a keyword. In addition, the rectangular boxes in the middle reflect the authors with articles published in prestigious journals; and accordingly, the highest size belongs to P. Cobb, with the highest rate of contribution to these journals. When analyzing the journals ranked on the right of the graph, it can be found that the journal Educational Studies in Mathematic is connected to most of the authors listed in the middle of the graph. Graph2 displays the top 20 journals with the highest rates of published articles on the topic.



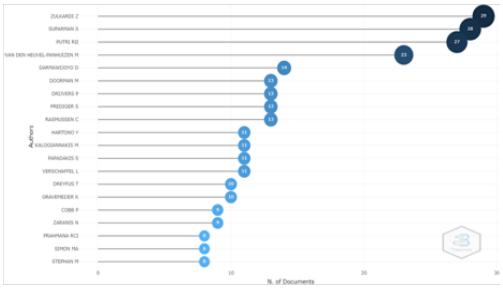
Graph 2 Journals with the highest number of published articles on RME

Graph 2 ranks the top 20 journals with the highest number of published articles on RME ordered from the highest number to the lowest. Accordingly, Journal on Mathematics Education (f=97) is the journal with the highest number of published articles on RME, with a total of 97 articles. Furthermore, the first seven journals have published 34.71 % of the total articles published on the topic. This finding can also be observed in the source clusters obtained through Bradford's Law as shown in Graph 3.



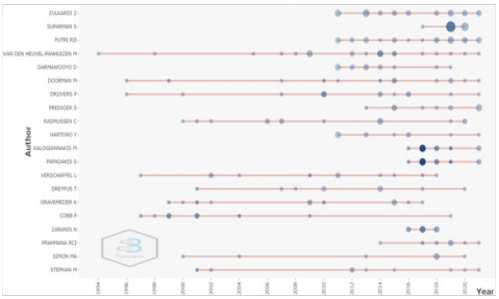
Graph 3 Source Clusters Obtained Through Bradford's Law

According to the clusters obtained, when all publications are sorted into three groups, it will be seen that the first one-third of all articles are published by the key journal group, the second one-third are published by a bigger journal group, and finally the last one-third are published by a far bigger journal group (Garfield, 1980). When Graph 3 is analyzed, it can be seen that *Journal on Mathematics Education, Educational Studies in Mathematics, Journal of Mathematical Behavior, International Journal of Scientific and Technology Research, International Journal of Mathematical Education in Science and Technology, Zdm-Mathematics Education and Mathematics Education Research Journal* are the first seven journals with the highest productivity rate, and thus form the key journal group. Compared with the findings presented in Graph 2, these seven journals have published a total of413 articles on RME, which comprises one-third of all the published articles and thus complies with Bradford's Law. Graph 4 displays the top 20 authors with the highest number of publications on the topic.



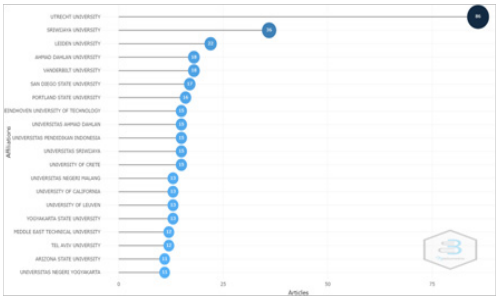
Graph 4 Authors with the Highest Numbers of Publications on RME

Graph 4 lists the authors with the highest numbers of publications ranked from the highest to the lowest. The author with the highest number of published articles on RME is Zulkardi Zulkardi (f=29) from Sriwijaya University in Indonesia. Following Zulkardi, we can see Suparman Suparman (f=28) and Ratu Ilma Indra Putri (f=27) ranked respectively. The productivity rates of these authors form 7.1 % of all the published articles on the topic. Graph5 presents the results of the productivity of the authors by years and their citation burst scores.



Graph 5 Productivity Rates of the Authors by Year and Citation Burst Scores per Author

The ranking displayed in Graph 5 is in line with the order in Graph 3. Accordingly, Z. Zulkardi, who has the highest rate of contribution to the field between 2011 and 2021, which can be understood from the length of the red line. Furthermore, it can be observed that the author who contributed to the field for the longest duration by being actively producing and publishing articles from 1994 to 2021 is Marja Van den Heuvel-Panhuizen. On the other hand, S. Suparman, who has 18 articles published in 2019, is the author with the highest number of articles in one year, and thus, has the biggest circular diameter. Also, the authors Michail Kalogiannakis and Stamatios Papadakis have the circle in the darkest blue, indicating that they have the highest number of citations in one year with their 5 articles published in 2017, each of which has 48 citations. Graph 6 presents the top 20 universities with the highest number of articles.



Graph 6 The Universities with Highest Number of Published Articles on RME

According to the results presented in Graph 6, Utrecht University is the one with the highest number of articles on RME with 86 published articles. In addition, it can be observed that eight of the universities among these 20 are located in Indonesia, five of them are in the USA, and three in the Netherlands while Turkey, Greece, Belgiumand Israel are among the first 20 universities with one publication each.

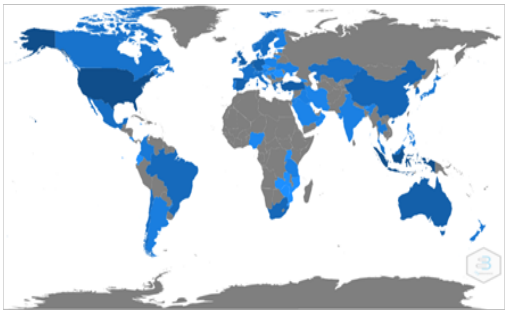


Figure 2 Scientific Productivity Rates of the Countries

On the map displayed in Figure 2, the darkness of the color blue reflects the rate of publications in the countries. Accordingly, the darker the blue

gets, the higher is the number of articles published and likewise the lighter the blue gets, the fewer the articles are. On the other hand, the grey color indicates the countries with no publications on the topic. As the findings show, the USA (f=426) has been the most productive country and followed by Indonesia (f=405) and the Netherlands (f=199), respectively. Figure 3displays the most commonly used words in the titles of the articles published on the topic.

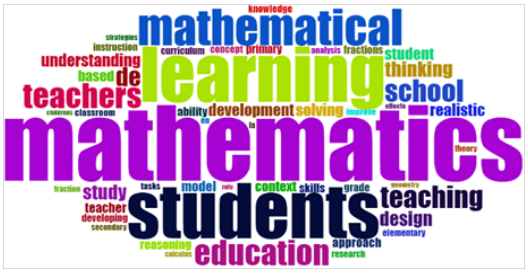


Figure 3 Word Cloud

Word Clouds, one of the text/data mining methods used to reveal the most frequently used words in a text, places the most frequently used words in the center atthe biggest sizes. As the sizes of the words decrease and their relative closeness to the center is placed further, it signals that the word is used less frequently. Figure 3 reveals that the words mathematics (f=393), learning (f=288), students (f=285), mathematical (f=189) and education (f=133) have been the most frequently used words in the titles of the articles. Figure 4shows the most frequently used keywords by the authors.

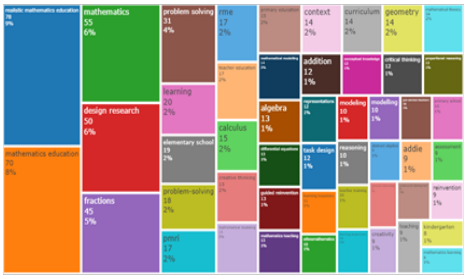


Figure 4 Word tree map

Word Tree Map, one of the other text/data mining methods, helps to identify the most frequently used words by dividing their percentile of usage among all the used words into rectangularspaces. Analyzing Figure 4, it can be seen that realistic mathematics education (f=%9) has the highest frequency of usage with 78,and thus, has the biggest rectangular area, indicating that it is the most frequently used keyword by the authors. It is followed by mathematics education (f=%8), mathematics (f=%6), design research (f=%6) and fractions (f=%5), respectively. Figure5presents the results for the authors' network of co-occurance based on the keywords used.

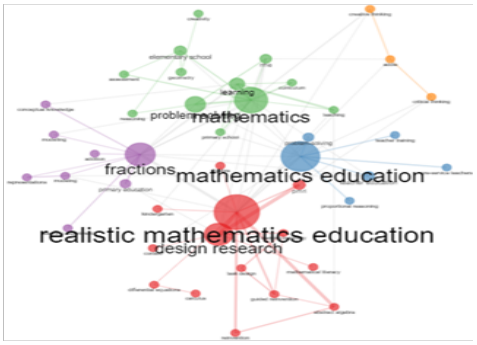


Figure 5 Co-occurrence Network

As Figure 5 shows, there are five different color groups. The size of each circle varies depending on the co-occurance frequency of the words within the collection of all words used by the researchers. According to the results, the most frequently used keyword, "realistic mathematics education",has the biggest size and the highest rate of pairing with the other used keywords. The ranking is followed by the keywords "mathematics education", "fractions", "mathematics" and "design research" as the other frequently paired keywords, respectively. Figure 6, displays the results of the network of collaboration of the researchers publishing articles on RME.

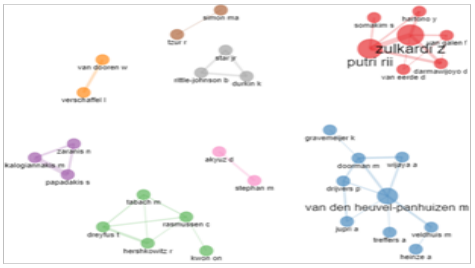


Figure 6 Network of Collaboration

Among the authors displayed in Figure 6, Zulkardi Zulkardi is the researcher with the biggest size of circle, suggesting to have the highest rate of collaboration. Following Zulkardi, Ratu Ilma Indra Putri and Marja Van den Heuvel-Panhuizen are the next researchers with high rates of collaboration. In addition, each color cluster in the map reveals the collaboration networks of the authors on the same research topics. Furthermore, the thickness of the grey lines indicate that the researchers Zulkardi-Putri and Kalogiannakis-Papadakis are in quite close collaboration. Figure 7shows the conceptual structure mapping on the topic.

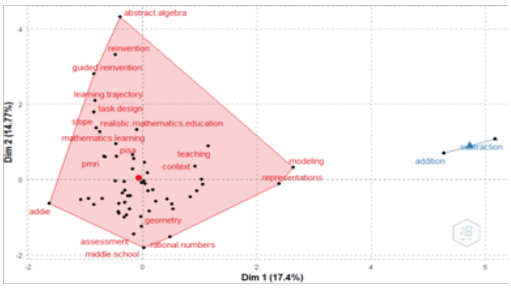


Figure 7 Conceptual Structure Mapping

Conceptual structure mapping enables researchers to reveal the conceptual structure of the field through factor analysis and the conceptual structural dynamics in the relevant field. In addition, it guides researchers to obtain information on the topics that are correlated, and accordingly decide on the keywords they need to focus on. InFigure 7, the results point out that the conceptual structure mapping of the keywords used by the researchers included in the analysis is comprised of two-colour clusters. The bigger red cluster shows the topics related to realistic mathematics and concepts, such as "realistic mathematics education", "mathematics learning", "mathematics", "pmri", "rme", and "guided reinvention". The smaller blue cluster, on the other hand, includes the keywords "addition" and "subtraction".

Discussion, Conclusion and Implications

In the study, a total of 1190 articles on RME published between 1986 and 2021 in the journals on "Social Science" and "Mathematics" fields were accessed using "realistic mathematics education" or "realistic mathematic education" or "realistic maths" or "realistic mathematical education"keywords in Scopus database and were analyzed using bibliometrical analysis in R-Studio program in order to determine the relationships in RME field. As a result of the conducted analyses, the results for the sample of the articles' annual distributions; 3-D area chart; the list of the journals that published the highest number of related articles; the authors and their institutions; source clusters obtained through Bradford's Law, the scientific productivity of the authors by years and their citation burst scores; the scientific productivity of the countries; the word cloud and word tree patterns of these articles; co-word analysis of the evolution of concepts and topics, the collaboration networks of the authors and the conceptual structure mapping were obtained.

The findings show that the first article published on RME was published in 1986 by Leen Streefland and titled "Rational analysis of realistic mathematics education as a theoretical source for psychology. Fractions as a paradigm". Also, the 667 articles published after 2016 comprised more than half of the total number of the articles in the field. This finding may indicate that there has been a growing interest in the topic, which has led to an increasing number of articles published. The requirement by the institution to have an article published in indexed journals could also be another factor contributing to this increase in the productivity on the topic.

The total number of the researchers having contributed to the field by publishing articles is 2252, and among them, Prof. Dr. Zulkardi Zulkardi (f=29) from Sriwijaya University in Indonesia has been the author with the highest number of articles. When Z. Zulkardi's studies are analyzed, it can be seen that they focus on issues such as angles, multiplication, extraction, geometric shapes, volume, fractions, mathematics literacy and mathematical modelling. Following Zulkardi, the authors that have contributed to the field most are Suparman Suparman (f=28) and Ratu Ilma Indra Putri (f=27), respectively. The findings also reveal that the researcher who has been actively contributing to the field for the longest period, between 1994 and 2021, is Marja Van den Heuvel-Panhuizen. This could result from the higher

rates of impact of the researchers who started to work on the topic earlier when compared to the researchers starting in the later periods. Also, it is more likely for the researchers beginning to produce on the topic earlier to have higher rates of collaboration with other research groups. However, as the citation rates of the researchers starting in the later periods are expected to increase in the coming periods, their index impact levels are anticipated to move up. As for the collaboration networks of the researchers, the results of the analyses reveal some multitudinous collaboration clusters; and among these, it has been found that there are close collaborations between Z. Zulkardi and R. I. I. Putri as well as between M. Kalogiannakis and S. Papadakis. This finding suggests that the researchers included are quite inclined to produce articles with multiple authors and are more open to exchanging information. The results also unveil the most frequently used keywords; namely, realistic mathematics education, mathematics education, mathematics, respectively. Similarly, the most commonly used words in the titles of the articles analyzed are found to be mathematics, learning, students, mathematical and education. These findings could guide researchers in deciding on the key words to be included in the titles of their articles and in selecting the keywords for their articles.

Regarding the findings related to the names of the journals with higher rates of published articles on RME, it has been identified that *Journal on Mathematics Education* (f=97), which publishes articles related to mathematics education,has the highest number. Furthermore, the top seven journals have published 413 articles on the topic, which comprises one third of the total number of published articles. These core journals are *Journal on Mathematics Education, Educational Studies in Mathematics, Journal of Mathematical Behavior, International Journal* of Scientific and Technology Research, International Journal of Mathematical Education in Science and Technology, Zdm-Mathematics Education and Mathematics Education Research Journal. Based on this finding, it could be suggested that the researchers who want to bring their work into the forefront and to increase their impact power could choose these journals for their future publications.

Another finding of the present study is that the university with the highest number of published articles related to RME is Utrech University (f=86) in the Netherlands, followed by Sriwijaya University (f=36) and Lieden University (f=22), respectively. The reason for these three universities to have the highest contribution rates could be their having the leading researchers on RME among their faculty members. As forthe countries with the highest rates of published work, the USA (f=426) is found to be the leading country, which is followed sequentially by Indonesia (f=405) and the Netherlands (f=199). It could be claimed that these top three countries function as a bridge in establishing and maintaining scientific relationships as well as enhancing productivity in the field.

The overall results of the analyses conducted with the articles selected as a result of the limitations set for RME have made it possible to determine the keywords, the publications, the authors, the institutions, the journals and the countries that are significant in the field. The findings in terms of the connections, the relationships and the collaboration networks are meant to contribute to the related literature and also to provide insights for researchers interested in the field. In conclusion, several suggestions for future research could be drawn based on the findings of the study:

1. While the present study included only Scopus database, the R-Studio program is compatible with other databases such as WoS, Dimensions, Lens.org, PubMed, Cochrane Library. Therefore, further studies could be conducted with a larger scope covering other indexes. Also, ProQuest and YOK Dissertation databases, which cover mostlyother publication types such as theses, could be included in the analyses and the results could be compared.
2. The findings of the present study are limited to published articles on RME. Further research could include other types of publications such as books, chapters in books, theses, reviews, conference papers, editorial materials, etc.
3. The articles analysed in the study were limited to the 1986-2021 time period. Future studies could be conducted choosing different time periods of publication and the results could be compared.

4. The present study included the articles published only in "Social Science" and "Mathematics" fields. Further research could be carried out choosing different field limitations or preferences and more detailed analyses for more comprehensive comparisons of the results could be conducted. Also, the journals that would be interested in publishing such papers could be determined.
5. As the collection of the publications on the topic will be changing, future bibliometrical analyses could be conducted and the results could be compared to identify the changes in the field.

References

Adjie, Nahrowi, et al. "Improvement of Basic Math Skills through Realistic Mathematics Education (RME) in Early Childhood." *Journal of Obsession: Journal of Early Childhood Education*, vol. 6, no. 3, 2021, pp. 1647-57.

Al, Umut, et al. "An Evaluation of Bibliometric Features of bilig." *Bilig*, no. 55, 2010.

Alim, Jesi Alexander, et al. "Model of Geometry Realistic Learning Development with Interactive Multimedia Assistance in Elementary School." *Journal of Physics: Conference Series*, 2020.

Aria, Massimo, and Corrado Cuccurullo. "Bibliometrix: An R-tool for Comprehensive Science Mapping Analysis." *Journal of Informetrics*, vol. 11, no. 4, 2017, pp. 959-75.

Aria, Massimo, and Corrado Cuccurullo. "Biblioshiny Bibliometrix for No Coders." *Bibliometrix.org*, 2022b.

Aria, Massimo, and Corrado Cuccurullo. "Science Mapping Analysis with Bibliometrix R-package: An Example." *Bibliometrix.org*, 2022a.

Aslancı, Seher. "Inquiry-Based Learning: A Bibliometrical Analysis." *Scientific Educational Studies*, vol. 6, no. 1, 2022.

Bayrak, A. *A Bibliometrical Analysis on Realistic Mathematics Education*. Alanya Alaaddin Keykubat University, 2022.

De Lange, J. *Mathematics, Insight and Meaning*. Utrecht University, 1987.

Effendi, K.N.S., et al. "The Development of Mathematics Student Worksheet for School Literacy Movement." *Journal of Physics: Conference Series*, 2018.

Fauziah, A., et al. "The Roster Context in Angle Learning for Primary School Pre-service Teacher." *Journal of Physics: Conference Series*, 2019.

Freudenthal, Hans. *Mathematics as an Educational Task*. Springer, 1973.

Freudenthal, Hans. *Revisiting Mathematics Education*. Kluwer Academic Publishers, 1991.

Freudenthal, Hans. "Why to Teach Mathematics so as to be Useful." *Educational Studies in Mathematics*, vol. 1, 1968, pp. 3-8.

Gravemeijer, Koeno, and Michiel Doorman. "Context Problems in Realistic Mathematics Education: A Calculus Course as an Example." *Educational Studies in Mathematics*, vol. 39, 1999, pp. 111-29.

Gravemeijer, Koeno. *Developing Realistic Mathematics Education*. CD-Beta-Press, 1994.

Güzeller, Cem Oktay, and Nuri Çeliker. "Gastronomy from Past to Today: A bibliometrical Analysis." *Journal of Tourism and Gastronomy Studies*, 2017, pp. 88-102.

Hadi, Sutarto. *Effective Teacher Professional for the Implementation of Realistic Mathematics Education in Indonesia*. University of Twente, 2002.

Huang, Ya-Li, et al. "Bibliometric Analysis of Nursing Research in Taiwan 1991-2004." *Journal of Nursing Research*, vol. 14, no. 1, 2006, pp. 75-81.

Kurtuluş, Muhammed Akif, and Kadir Bilen. "A Bibliometric Analysis on Nature of Science: A Review of the Research between 1986-2019." *Scientific Educational Studies*, vol. 5, no. 1, 2021, pp. 47-65.

Kurtuluş, Muhammed Akif, and Nilgun Tatar. "A Bibliometrical Analysis of the Articles on Environmental Education Published between 1973 and 2019." *Journal of Education in Science Environment and Health*, vol. 7, no. 3, 2021b, pp. 243-58.

Kurtuluş, Muhammed Akif, and Nilgun Tatar. "An Analysis of Scientific Articles on Science Misconceptions: A Bibliometric Research." *Elementary Education Online*, vol. 20, no. 1, 2021a, pp. 192-207.

Osareh, Farideh. "Bibliometrics, Citations Analysis and Co-Citation Analysis: A Review of Literature I." *LIBRI*, vol. 46, no. 3, 1996, pp. 149-58.

Pritchard, A. "Statistical Bibliography or Bibliometrics." *Journal of Documentation*, vol. 25, 1969, pp. 348-49.

Putri, Ratu Ilma Indra. "Learning to Build Flat Materials through Stories Using the Indonesian Realistic Mathematics Education Approach (PMRI) in Elementary Schools." *Journal of Education and Learning*, vol. 18, no. 2, 2011, pp. 234-39.

Streefland, Leen. *Fractions in Realistic Mathematics Education: A Paradigm of Developmental Research*. Kluwer Academic Publishers, 1991.

Streefland, Leen. "Rational Analysis of Realistic Mathematics Education as a Theoretical Source for Psychology. Fractions as a Paradigm." *European Journal of Psychology of Education*, vol. 1, 1986, pp. 67-82.

Thanuskodi, S., and V. Venkatalakshmi. "The Growth and Development of Research on Ecology in India: A Bibliometric Study." *Library Philosophy and Practice*, 2010.

Treffers, Adrian. *Three Dimensions: A Model of Goal and Theory Description in Mathematics: The Wiskobas Project*. Springer, 1987.

Van den Heuvel-Panhuizen, Maria. "Didactical Phenomenology (Freudenthal)." *Encyclopedia of Mathematics Education*, edited by Lerman, Stephen, Springer, 2020a, pp. 218-20.

Van den Heuvel-Panhuizen, Maria. "Improvement of (didactical) Assessment by Improvement of Problems: An Attempt with respect to Percentage." *Educational Studies in Mathematics*, vol. 27, no. 4, 1994, pp. 341-72.

Van den Heuvel-Panhuizen, Marja, and Paul Drijvers. "Realistic Mathematics Education." *Encyclopedia of Mathematics Education*, edited by Stephen Lerman, Springer, 2014.

Van den Heuvel-Panhuizen, Marja. *International Reflections on the Netherlands Didactics of Mathematics: Visions on and Experiences with Realistic Mathematics Education*. Springer, 2020b.

Yilmaz, Rezan. "Prospective Mathematics Teachers' Cognitive Competencies on Realistic Mathematics Education." *Journal on Mathematics Education*, vol. 11, no. 1, 2020, pp. 17-44.

Zulkardi, and Ilma Putri. "Design Your Own Contextual Mathematics." *Proceedings of KNM*, 2006.

Zulkardi, Z. *Developing a Learning Environment on Realistic Mathematics Education for Indonesian Student Teachers*. University of Twente, 2002.

Zupic, Ivan, and Tomaz Čater. "Bibliometric Methods in Management and Organization." *Organizational Research Methods*, vol. 18, no. 3, 2015, pp. 429-72.

Author Details

Alp Bayrak, *Ministry of National Education, Turkey,* ***Email ID:*** *alpbayrak.30@gmail.com*

Seher Aslanci, *Alanya Alaaddin Keykubat University, Turkey,* ***Email ID:*** *seher.aslanci@alanya.edu.tr*