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### **The trends of studies mathematics learning in elementary schools the perspective of bibliometric analysis**

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#### **Abstract**

This study aims to explore trends in the direction of research that is developing in the field of elementary school mathematics learning. This study uses Scopus search analysis and VOSviewer software. Based on 55,051 documents (367 selected documents) selected from Scopus indexed journals, co-authorship, co-citation, co-occurrence, clusters, and content analysis were carried out. The results of the quantitative analysis show that publications are very important in learning mathematics in elementary schools, namely learning mathematics and basic mathematics. Literature on learning mathematics in elementary schools has explored several hot themes over the last five years, including: elementary mathematics, elementary education, spatial reasoning, functional thinking, teacher leadership, math anxiety, representation, algebraic thinking, e-learning, covid 19, learning process, geometry, robotic. The bibliometric study conducted provides a thorough and comprehensive picture of research on learning mathematics in elementary schools which

may be valuable for researchers who are interested in the development of research on learning mathematics in elementary schools in the future. So the researchers suggest exploring this trending research topic.

### **Keywords**

learning mathematics, elementary school, VOSviewer

### **Introduction**

Learning mathematics in elementary schools is one of the studies that is always interesting to put forward because of the differences in characteristics, especially between the nature of children and the nature of mathematics. The thinking stage of elementary school students is still not formal, maybe there are even elementary school students, especially in lower grades, it is not impossible that some of them think they are still at the pre-concrete stage while mathematics is a deductive science, axiomatic, formal, hierarchical, abstract, language solid anti symbols and such so mathematicians can develop a mathematical system. The stage of development of thinking in elementary school age children is not yet formal and relatively concrete, coupled with the diversity of intelligence, as well as the large population of elementary school students and the addition of the 9 year compulsory education, these factors must be considered so that the process of learning mathematics in elementary schools can work (Karso, 2021).

To help train concepts is through the application of appropriate learning models (Sukma Cipta et al., 2021). This can be seen from the various learning models used in learning mathematics in elementary schools as evidenced by studies that have been conducted by teachers or researchers. A solid foundation in mathematics is important for students' long-term academic success. Many factors influence students' learning of mathematics including the content of mathematics students learn at school, the quality of teaching, and the attitudes of teachers and students towards mathematics (Schaeffer, Marjorie W.; Rozek, Christopher S.; Maloney, Erin A.; Berkowitz, Talia; Levine, Susan C.; Beilock, 2021). The effectiveness of low interference training methods, which are different from the pedagogical methods used today, can pave the way for improving the way multiplication is taught. (Dotan, Dror; Zviran-Ginat, 2022). Math anxiety may reduce the encoding of new math content in memory in low grade students, potentially causing cumulative gaps in math ability for students with math anxiety since the start of their formal education (Tomasetto, Carlo; Morsanyi, Kinga; Guardabassi, Veronica; O'Connor, 2021). Good reading skills pave the way for students to develop their math skills. These findings underscore the importance of considering reading performance in overcoming math difficulties (Erbeli, Florina; Shi, Qinxin; Campbell, Aaron R.; Hart, Sara A.; Woltering, 2021).

Improving mathematics learning in elementary schools is critical to supporting better academic and life outcomes for students later (Walsh, 2022) so

that the Department of Education, teachers and schools need to work together to develop the math teaching skills of every elementary school teacher (Uddin, 2022) finally the teacher can teach based on the research that has been done, and vice versa based on the teacher teaching in the classroom can produce new research studies. Therefore, the purpose of this manuscript is to conduct a bibliometric study to thoroughly describe how mathematics is taught in elementary schools over the last five years using scientific mapping methods through the structure of intellectual, conceptual and social networks as well as the evolution and performance of the various studies studied. This study contributes to the presentation of quantitative data and qualitative analysis for the evolution and current trends of learning mathematics in elementary schools as a reference for further research.

### **Research methods**

This study used bibliometric analysis using the five standards from Zupic & Cater, namely study design, data collection, data analysis, visualization, and interpretation. (Zupic & Čater, 2015). The bibliometric analysis method is used to describe the mapping of knowledge or concepts or topics as a whole and shows research trends and the process of evolution of a field of knowledge. The bibliometric approach used in this study uses modern technology in information engineering, database management and statistics by combining VOSviewer software. The research steps can be seen in Figure 1.

The first step is the study design. This step analyses descriptively regarding relevant information regarding various studies of learning mathematics in elementary schools so that researchers get information on the evolutionary metrics of this study. The second step is data collection. This step is carried out by compiling bibliometric data to build data and determine research sources from the Scopus database. The selection of Scopus was based on the consideration that the Scopus database is widely known and widely used for the analysis of reputable scientific articles. Scopus is a database of abstracts and citations for peer-reviewed literature and is also part of SciVerse provided by Elsevier as described in the previous section and is also based on the same database as Science Direct. (Franceschini et al., 2016). Several combinations of keywords such as "mathematics learning" and "elementary school" were used to search for documents where these keywords made it easier to find documents that fit the problems of this research. The search results obtained 55,051 documents, then after specifying the 1998-2022 range, the type of article document, and the subject area of mathematics, the existing database totalled 367 documents.

Third step: Data analysis. This step was carried out by analyzing the data using the feature application on the Scopus web, and VOSviewer software version 1.6.15.0. Fourth step: Visualization. This step is carried out with the visualization provided by the VOSviewer software, namely network visualization, overlay visualization and density visualization. This step is used to facilitate understanding

and interpretation of research conducted on elementary school students in learning mathematics. Fifth step: Interpretation. This step is carried out by interpreting all the data obtained in this bibliometric study. The purpose of this step is to obtain a summary and conclusion of the various findings in this study.

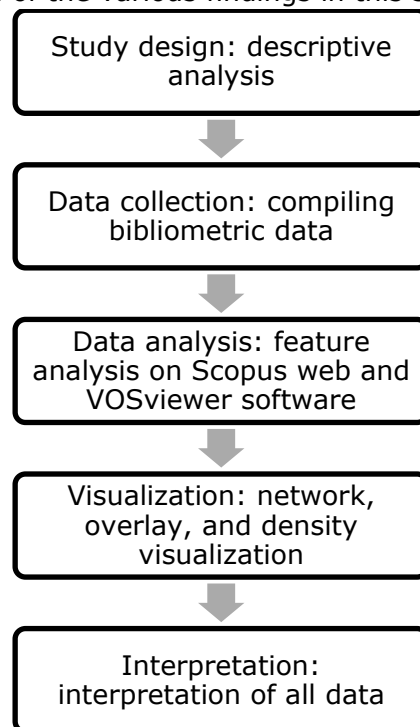


Figure 1. Zupic & Cater Standard Workflow

### Result of the research and discussions

Based on the database that has been specified in this study, namely 367 Scopus data documents, it can be seen that the trend of learning mathematics in elementary schools from 2019 to 2022 based on documents published annually in the Scopus dataset can be seen in Figure 2 which shows that learning research trends Mathematics in elementary schools continues to increase from 2019 and will increase rapidly in 2022 compared to previous years where in 2022 the number of publications reached 105 documents.

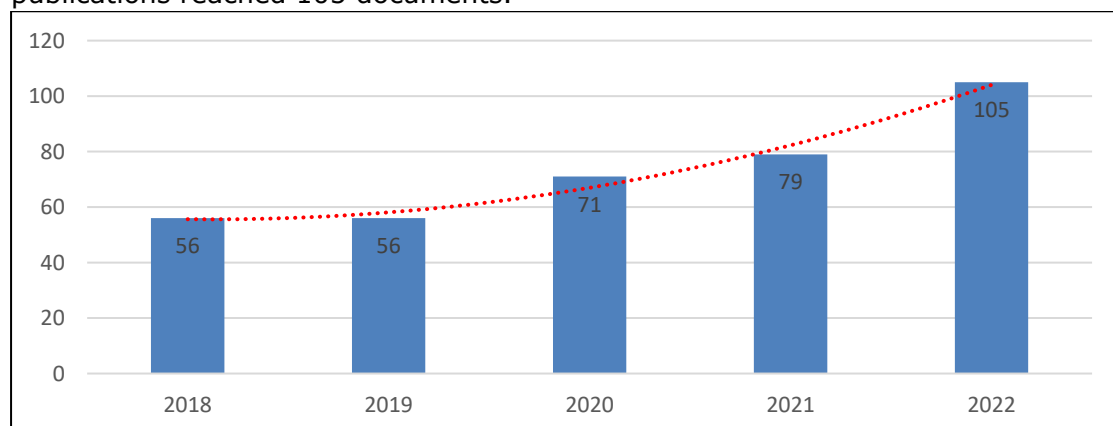


Figure 2. Scopus Database of Mathematics Learning in Elementary Schools 2018-2022

Furthermore, citation analysis, this analysis is used to analyze the relationship between publications by identifying the most influential publications (Donthu et al., 2021). Based on the type of documents obtained, it can be seen based on direct analysis from the Scopus web that the country that has contributed the most to publishing research on learning mathematics in elementary schools based on the Scopus dataset is the United States with 652 citations, the following Table 1 shows the 10 countries that have contributed the most to research learning mathematics in elementary schools.

Table 1. Top 10 Countries Publication of Learning Mathematics in Elementary Schools

Countries	Publication	
	Number of Publications	Number of Citations
United States	126	652
Indonesian	24	139
Turkish	22	73
Canada	19	75
Chinese	20	128
Taiwan	19	180
German	17	89
South Korea	15	34
Spanish	15	41
Israel	14	28

Based on the analysis of the search results for the top 10 authors, it can be seen in Table 2. This data shows that among the authors mentioned in Table 2, research on learning mathematics in elementary schools allows for authors who have fewer publications but have more citations or should. In addition, the large number of publications indicates the regularity of contributions on this topic in the period 2018 to 2022.

Table 2. Top 10 Authors of Publications Learning Mathematics in Elementary Schools

Author	Publikasi	
	Number of Publications	Number of Citations
Thanheiser, E.	5	31
Cai, J.	4	25
Canadas, M.C.	4	4
Yang, D.C.	4	18
Ayala-Altamirano, C.	3	13
Georges, C.	3	10
Heinze, A.	3	45
Hourigan, M.	3	8
Kim, M.K.	3	15
Leavy, A.M.	3	8

To find out the conceptual structure of mathematics learning research in elementary schools, co-word analysis was carried out which was mapped and grouped into co-occurrence as shown in Figure 3.

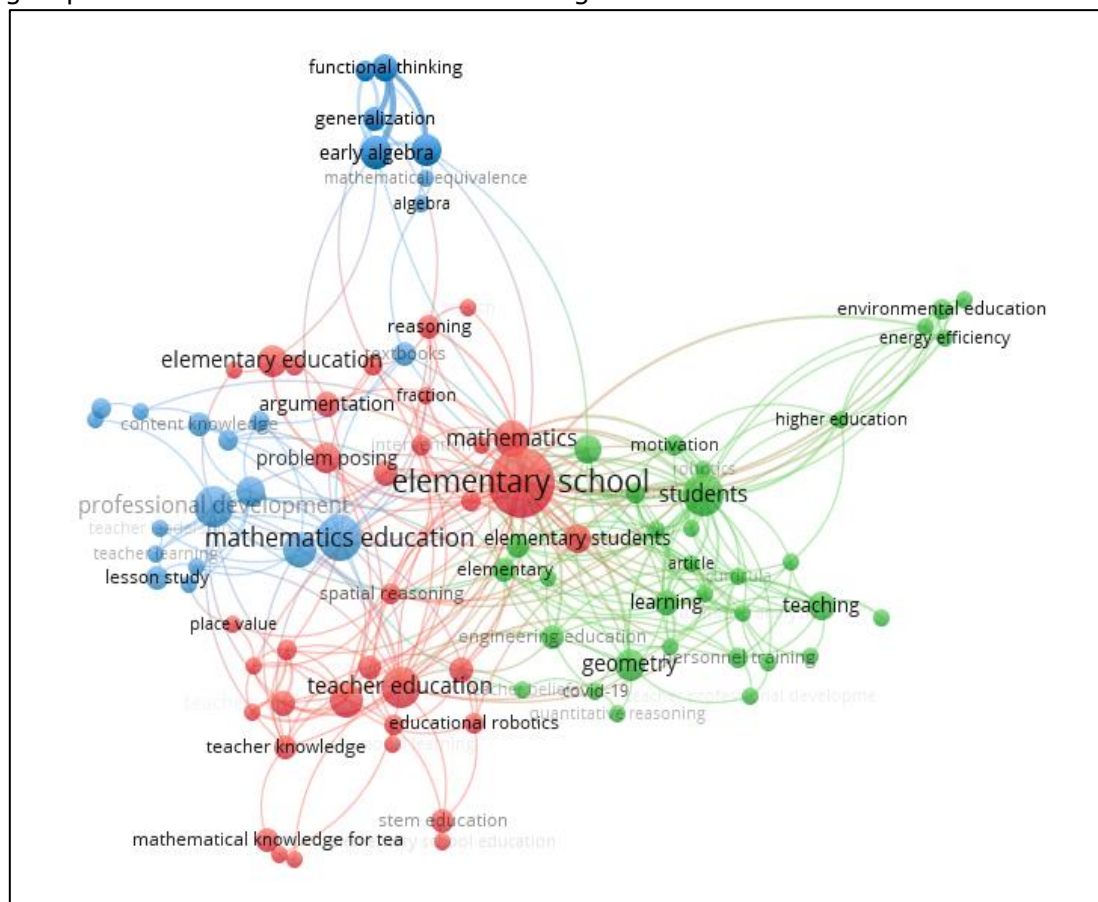


Figure 3. Visualization of the Conceptual Structure of Mathematics Learning Research in Elementary Schools

Figure 3 shows that each node represents one keyword. So, the larger the node size indicates the greater the frequency of these keywords. Then, we can also see that each node in Figure 3 is connected by links. The wider the link, the greater the link between the two keywords, the image only contains a maximum of 300 nodes with the highest degree to represent keywords (Wang & Chai, 2018).

Figure 3 illustrates that the biggest note in this study is elementary school, this indicates that elementary school is the most popular keyword. In addition, another major node, namely learning mathematics, is another popular keyword after elementary school. Figure 3 also shows that the widest link is with algebraic thinking, teacher knowledge and pedagogical content knowledge which shows its relation to elementary schools. While the widest link from the word learning mathematics is students so that research on both of them can be studied in more depth for further research.

There are 3 clusters identified in the results of the analysis using VOSviewer, including cluster 1 in red which is the most popular consisting of 35 keywords. The keywords that appear most often are problem solving and problem posing. Green cluster 2 consists of 33 keywords. The top keywords in the sequence are geometry,

study, and learning. Cluster 3 has 23 items, with the terms professional development and textbooks being the top keywords. The keywords in these various clusters show the research relationship between one term and another related to research on learning mathematics in elementary schools. For example, cluster 1 which connects various studies that have been conducted regarding the use of problem solving in learning mathematics on geometry material.

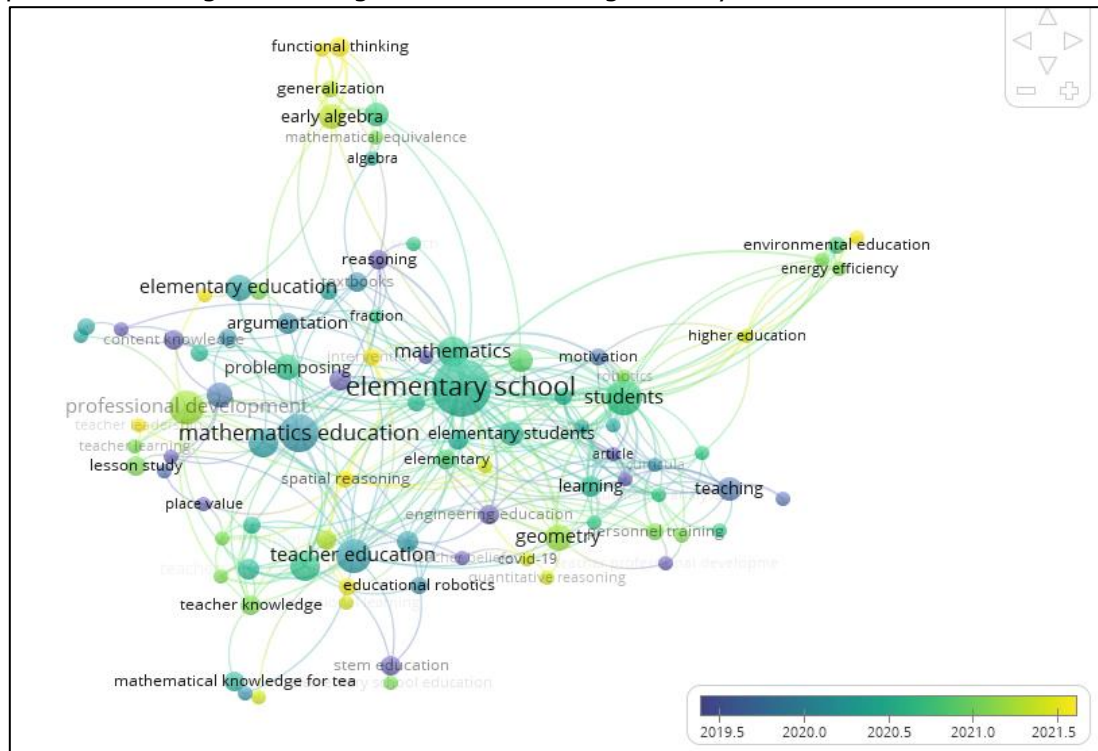


Figure 4. Overlay Visualization of Mathematics Learning in Elementary Schools 2018-2022

Based on the results of the overlay visualization on VOSviewer, various keywords can be seen which indicate the latest research with indications of light green to yellow in the period 2018 to 2022. Based on the results of the overlay visualization in Figure 4 it can be shown that several terms are clearly new and are trending. Recent research related to this study includes elementary mathematics, elementary education, spatial reasoning, functional thinking, teacher leadership, math anxiety, representation, algebraic thinking, e-learning, covid 19, learning process, geometry, robotics. So it can be concluded that learning mathematics in elementary schools is still very relevant to do because it is included in new research trends even though it has been carried out since the first until 2022 such as Scopus data and the results of analysis of studies that have been obtained. Learning mathematics in elementary schools is still very relevant to research because learning mathematics in elementary schools is the initial stage in learning mathematics. If the basics of mathematics are not taught properly at this stage, it is likely that students will have difficulty understanding mathematics material at a higher level. This is in line with the statement that a solid foundation in mathematics is important for students' long-term academic success (Schaeffer,

Marjorie W.; Rozek, Christopher S.; Maloney, Erin A.; Berkowitz, Talia; Levine, Susan C.; Beilock, 2021) and school mathematics influence the hierarchical arrangement of Education (Noyes, 2012).

### **Conclusion**

This study conducted a bibliometric analysis of 367 selected documents from the Scopus web related to learning mathematics in elementary schools using the Zupic and Cater work standards and the VOSviewer application. The results of this study reveal that several topics have become the latest research trends and are related to this study including studies on elementary mathematics, elementary education, spatial reasoning, functional thinking, teacher leadership, math anxiety, representation, algebraic thinking, e-learning, covid 19, learning process, geometry, robotic. The bibliometric study conducted can provide a thorough and complete picture of research on learning mathematics in elementary schools which is valuable for researchers for the development of future research in this field.

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