

## Bibliometric Analysis with the Vosviewer-Based Keyword "Mathematical Abilities"

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### ABSTRACT

*Using VOSviewer can help students identify current journals or articles and spot gaps in current journals. This study also aims to identify mathematical articles that get the highest number of journals, make journal rankings, determine the country where they are published and make maps to find positions in international scientific journals and. using the Google Scholar database. This study used bibliometric analysis method. The population that was the subject of this study was 1000 articles found through data analysis using the Publish or Perish (PoP) tool between 2017 and 2022. The data is recorded in Microsoft Excel as input for data processing and storage in the RIS system. use the VOSviewer app to create visuals for popular publications. There was a significant increase in articles from 2017 to reach the highest number in 2019. In graph analysis using VOSviewer software, there are two topics related to bibliometric analysis, namely "Mathematics" and "Ability" that have not been studied. a lot of things and research. . new. These topics offer opportunities for further research.*

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### 1. INTRODUCTION

It is important to remember that mathematics plays a very relevant role in improving the quality of education, because it is closely related to the development of science and technology. Through mathematics lessons, students have the opportunity to continue to practice their abilities, so that they can develop themselves better. Excellent education should encourage students to learn actively and form values that are relevant to their lives [1]. The process experienced by students will shape their way of thinking into a critical and creative person, and able to overcome real-world problems. Therefore, conceptual understanding, problem-solving skills, communication skills, literacy, and creativity have an important role in the development of mathematics learning, in order to support 21st century skills for each individual [2]. Mathematics not only meets current needs, but also makes an important contribution in meeting future needs.

*Mathematical Abilities* are the result of human effort, which can be interpreted cognitively or pragmatically, depending on the intention in defining them [3]. The definition of cognitive is used to describe the development of mathematical abilities from a theoretical point of view, so that it can be explained as the ability to acquire, process, and store mathematical information Or in other words, as the ability to learn and understand new mathematical ideas and skills. Although achievement in mathematics has a relationship with mathematical ability, the main difference lies in its focus. Many people consider that having high math skills in school parallels achieving good results in math. Mathematical ability shows potential in solving math problems, while achievement includes success in facing math exams at school [4].

Typically, pragmatic definitions are used when considering these constructs from an evaluation point of view, such as when the goal is to recognize the potential of learners or assess learning outcomes. In this point of view, its definition is the ability to successfully solve mathematical tasks and effectively solve various mathematical problems. Such a definition can generally be decomposed into several components, which are not necessarily tied exclusively to one definition or another. So, what we're talking about is about a group of mathematical abilities rather than just one single ability.

However, there are other dimensions of mathematical ability to consider, namely potential or future-oriented skills; the ability to learn and master new mathematical ideas and skills, as well as the ability to tackle new and non-routine problems. Because of this dimension, mathematical ability cannot be measured directly. This can only be inferred through observable performance, making understanding and assessment of ability levels difficult and necessary to remain tentative and conjectural. When broader and consistent response patterns are observed across a variety of tasks and situations, a clearer picture of students' math abilities can emerge. However, no final diagnosis can be ascertained as there is always the chance that a significant experience may cause unexpected changes in a student's performance level, be it increased or decreased.

Ability is different from achievement. Achievement refers to the act of completing, achieving, or completing a task; A thing that is successfully completed is primarily through skill, practice, or perseverance. Thus, while mathematical ability is mathematical competence or intrinsic potential, which can only be inferred, mathematical achievement can be observed as a result of real performance in a mathematical task or test.

In the research process, research called bibliometric research is important as one of the important things. Mapping is a process that allows people to identify parts of knowledge and their patterns, strengths, overlaps, and relationships. Knowledge mapping is useful in technology management and covers many aspects, such as identifying research objectives, making decisions related to technology projects, creating knowledge bases, and developing research programs. A scientific map is a visual system for representing a particular scientific area.

This vision is done by creating landscape maps that show relationships and processes in science. VOSViewer's main task is to develop, explain, and analyze relationships and interactions with current issues and news. To access its database, VOS Viewer can use a variety of sources, including Google Scholar, Scopus, Crossref, Semantic Scholar, and PubMed. Mapping analysis using VOSViewer software identified two themes related to mathematical ability, namely "Mathematical" and "Abilities," which are still *gap* research and become innovative themes in research. The findings provide exciting opportunities for further research. Bibliometrics is the application of statistical and mathematical methods to analyze books and other media (Rohanda and Jonah Winoto, 2014) . In 1969, Pritchard, Nalimov, and Mulchencko introduced two fields of science: bibliometrics and scientific [6].

## 2. METHODS

In this study, the literature review method was used to analyze the development of relevant research and literature. Mathematical metadata maps are made from well-known journals and recognized for international and national journal accreditation at the Sinta 2 to Sinta 6 (S2-S6) levels. The data was obtained from the Google Scholar site with a total of 1,000 articles covering the period 2017 to 2022 [7] . Bibliometric analysis involves several stages. The first step is to collect reports on IT capabilities using tools such as Publish or Perish (PoP) [8]. After that, the data is collected and processed using Microsoft Excel to create the necessary tables and graphs. In addition, to view report data in network format, the VOSViewer application is used. This is a description of the method in bibliometric analysis. First, in PoP software, the keyword "math" uses search years from 2017 to 2022 and a maximum of 1000 search results. To search for related research articles, the database selected and used is Google Search. to study because of ease of research and access. The search results can be seen in Figure 1 [9].

The screenshot displays a Google Scholar search for 'mathematical abilities'. The search results table is as follows:

Cites	Per year	Rank	Authors	Title	Year	Publication	Publisher	Type
282	47.00	1	E Surya, FA Putri	Improving mathematical proble...	2017	Journal on Mathematics E...	ERIC	
329	65.80	2	S Luttenberger, S ...	Spotlight on math anxiety	2018	Psychology research and ...	Taylor & Francis	
1065	177.50	3	MT Wang, JL Degol	Gender gap in science, technolog...	2017	Educational psychology r...	Springer	
718	119.67	4	M Schneider, K Be...	Associations of non-symbolic an...	2017	Developmental ...	Wiley Online Library	
3	1.50	5	EP Kania, N Autha...	ANALYSIS OF STUDENTS' MATHE...	2021	Jurnal Ilmiah Pendidikan ...	ejournal.unmuha.ac.id	
267	66.75	6	D Saxton, E Grefen...	Analysing mathematical reasonin...	2019	arXiv preprint arXiv:1904.0...	arxiv.org	
54	54.00	7	WS Kearney, TA G...	Student readiness to learn and te...	2022	Dialogues in Middle Level...	apitaylorfrancis.com	
715	178.75	8	A Dowker	Individual differences in arithmeti...	2019		books.google.com	BOOK
420	84.00	9	G Ramirez, ST Sha...	Math anxiety: Past research, pro...	2018	Educational psychologist	Taylor & Francis	
357	59.50	10	T Laurens, BA Fatl...	How does realistic mathematics e...	2017	Journal of Mathematics...	ejmste.com	
266	53.20	11	EA Gunderson, D ...	Reciprocal relations among moti...	2018	Journal of Cognition ...	Taylor & Francis	
273	68.25	12	R Ramadhani, U R...	The effect of flipped-problem bas...	2019	Journal for the ...	dergipark.org.tr	HTML
237	39.50	13	F Laumann, YM ...	Math-related career aspirations a...	2017	Developmental psychology	psycnet.apa.org	
272	54.40	14	K Skagerlund, T Li...	Financial literacy and the role of ...	2018	Journal of behavioral ...	Elsevier	HTML
278	46.33	15	S Kahn, D Ginther	Women and STEM	2017		nber.org	
312	104.00	16	KA Stroud, DJ Booth	Engineering mathematics	2020		books.google.com	BOOK
281	70.25	17	R Steinmayr, AF W...	The importance of students' moti...	2019	Frontiers in ...	frontiersin.org	HTML

Figure 1. Google Scholar Database Search

After getting the results of Figure 1, the data is stored in several important systems, such as Bibtext and RIS. The Bibtext format is used for data processing in the form of tables and graphs, while the RIS format is used for data processing in the form of networks and maps using the VOS Viewer tool [10].

The VOS Viewer app lets you explore the basics of scientific literature and the "potential of Mathematics". The results of data processing include three types of visualizations, namely "Network Visualization", "Overlay Visualization", and "Density Visualization". "Network Visualization" is used to see relationships with specific search terms and specific keywords [11][12]. "Overview" is used to determine the age of the subject of the related study. Currently, density visualization is used to analyze research topics that are dense or still poorly understood.

### 3. RESULT AND DISCUSSION

#### Development of Scientific Publications

Based on the development of scientific publications on "Mathematical Ability" from 2017 to 2022, there are a total of 998 publications recorded in the following table from Google Scholar.

Table 1. Development of Journal Publication From 2017-2022

year	Article
2017	288
2018	234
2019	181
2020	143
2021	83
2022	69
sum	998

From table 1 above, it can be seen that there were 288 books in 2017, 234 books in 2018, 181 books in 2019, 143 books in 2020, 83 books in 2021 and 69 books in 2022. Decreasing from year to year, this shows that this topic is still interesting to develop research on [13].

**Table 2. Development of Publication Journal From 2017-2022**

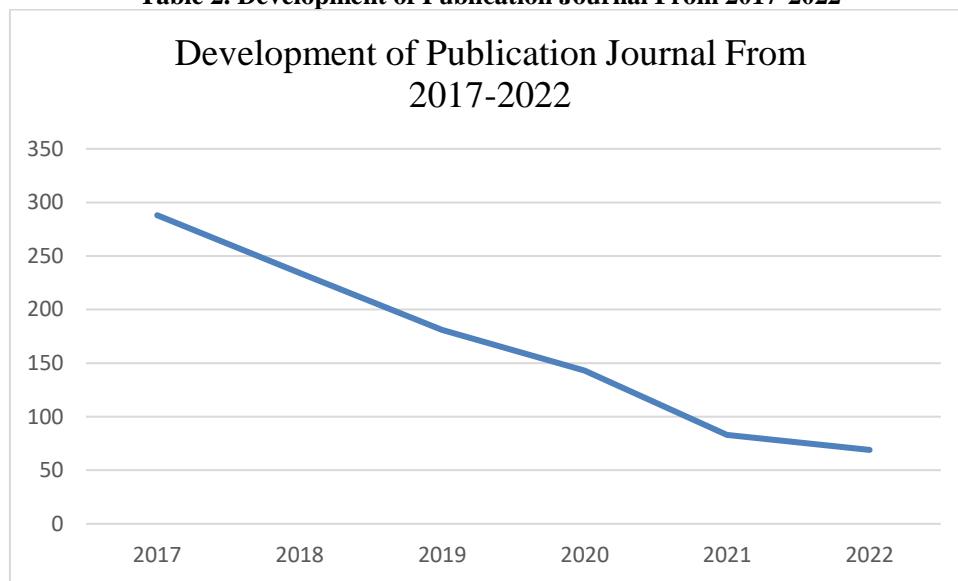
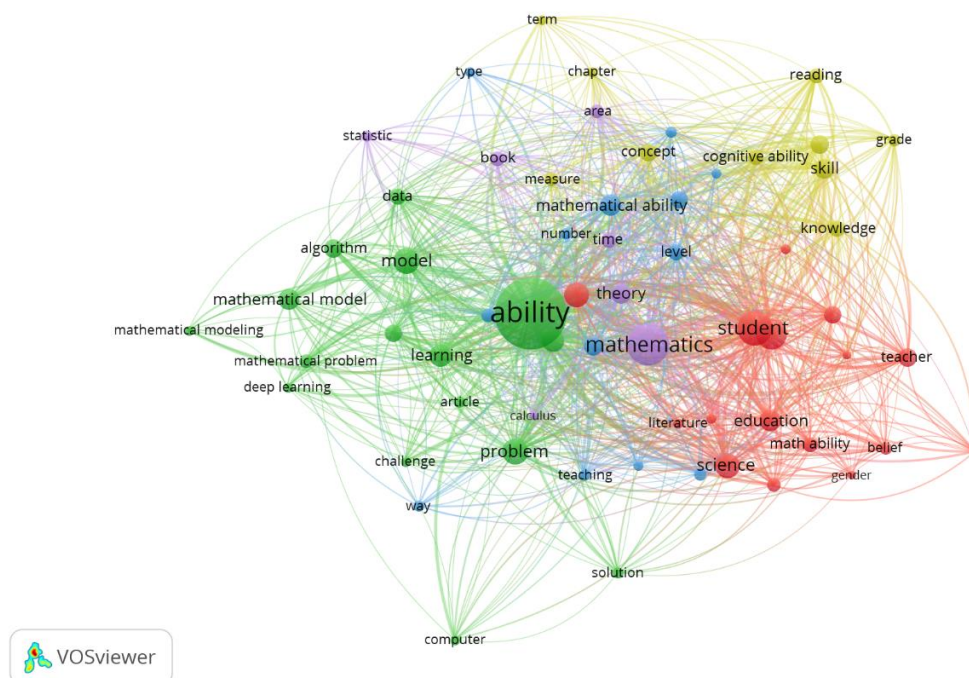


Figure 2 illustrates that the graph of the development of scientific publications from 2017 to 2022 always shows a downward trend. In 2022, there was the lowest number of publications, namely 69, while the highest number of publications was recorded in 2017 with 288 publications [14].

**Publication Development Map**

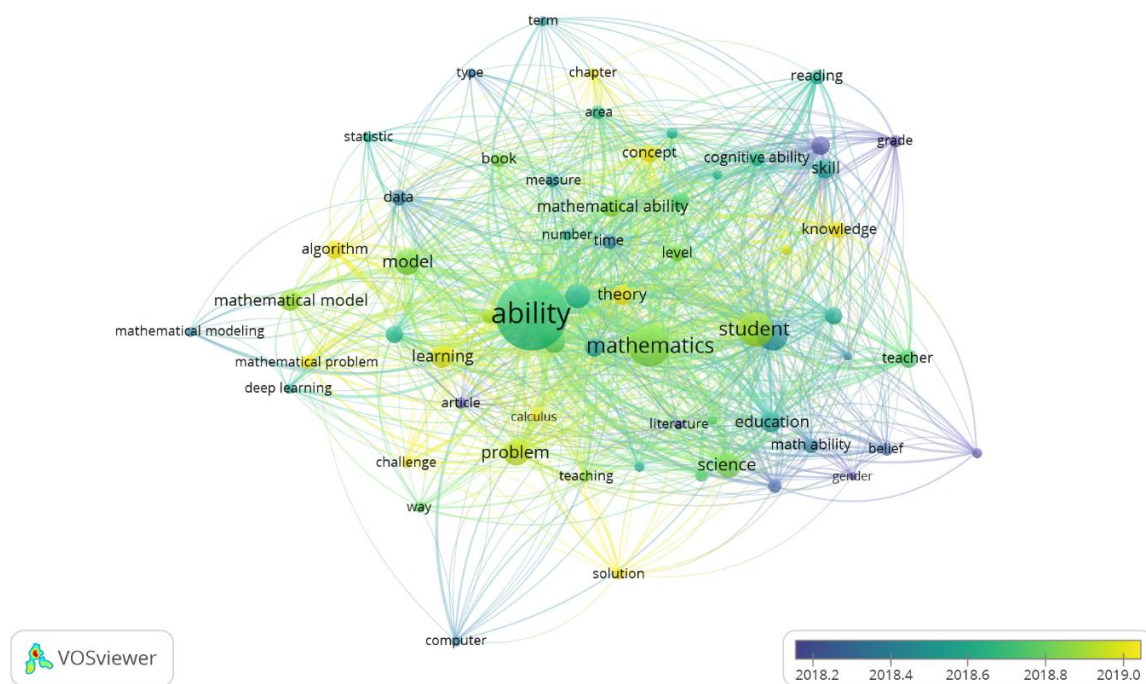
The binary calculation method is used in mapping the development of scientific publications, taking into account the minimum number of word views as many as 20 out of a total of 5470 words. Of all these words, there are only 97 words that meet the upper threshold. Of these words, 97 words were selected to be considered [15].



**Figure 2. Network Visualization**

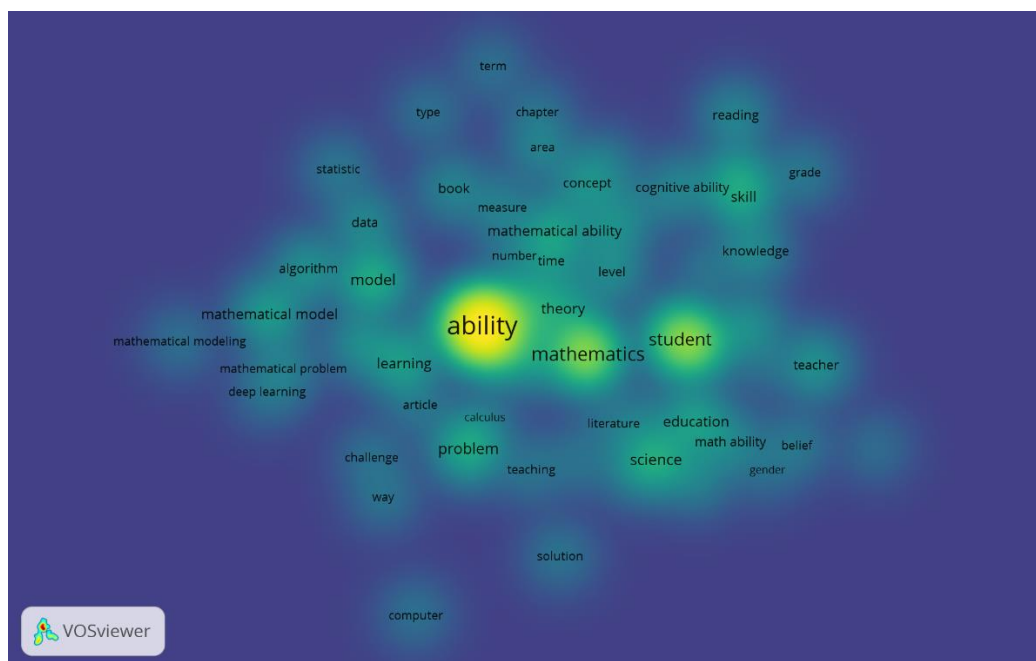
From table 1 above, it can be seen that there were 288 pounds in 2017, 234 pounds in 2018, 181 pounds in 2019, 143 pounds in 2020, 83 pounds in 2021, and 69 pounds in 2022. Year after year, it shows. and this topic is always interesting to develop your research . From table 1 above, it can be seen that there were 288 books in

2017, 234 books in 2018, 181 books in 2019, 143 books in 2020, 83 books in 2021, and 69 books in 2022. year, this-show. and this topic is always interesting for your research to develop[16].



**Figure 3. Overlay Visualization**

The results of Frames *OverlayVisualization* using VOSviewer software in Figure 3 show the process of writing articles in journals registered with Google Scholar that year [17]. The series of texts related to "mathematics" are arranged in purple, blue, tosca, dark green, light green, and yellow. The theme with light green color is the latest themes related to "Mathematical Ability". These themes can be considered as important references for future research that wants to explore newer aspects of "Mathematical Ability".



**Figure 4. Density Visualization**



The results of density analysis using VOSviewer software in Figure 4 show the density or density of search terms. In this view, the search keyword density indicator is yellow. The simpler the color of the subject, the more research is done in the field. On the other hand, the color is reduced, which means that the subject is still in demand. Dark colored circles such as "Math Modeling", "Math Model", "Mathematical Ability", "Mathematical Growth", and "Intelligent Ability" are topics that can be used as a reference for further reading. research so they can learn more. In the results of the study, there is one theme that is dimly colored in density visualization, namely "Mathematical Ability"[18].

#### 4. CONCLUSION

Based on findings, results, and discussion, it was found that the number of scientific publications on the Google Scholar site from 2017–2022 reached the highest number in 2017, which was 288 publications, while in 2022 it was the lowest publication with only 69 publications. Analysis using VOS Viewer software shows the results of network visualization with 94 variables and divided into 5 clusters with the main topic of "mathematical ability".

The results of overlay visualization and density visualization show that the study focused on topics such as "mathematical modeling," "mathematical model," "mathematical ability," "mathematical education," and "cognitive abilities." This indicates that these topics have been widely researched by other researchers.

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