

Research Article

Current trend of mathematic anxiety research and publication: a bibliometric analysis

Aditya Ananta Parameswara^{1*}, Imam Yuadi² and Nur Eva³

Postgraduate School of Universitas Airlangga, Surabaya, East Java, Indonesia

Article Info

Received: 7 April 2023
Accepted: 20 June 2023
Available online: 30 June 2023

Keywords:

Bibliometric analysis
Current trend
Mathematic anxiety

2717-8587 / © 2023 The JMETP.
Published by Genç Bilge (Young
Wise) Pub. Ltd. This is an open
access article under the CC BY-NC-
ND license



Abstract

People often feel anxious, frustrated and have negative attitudes towards mathematics because mathematics is often considered a difficult subject because the characteristics of mathematics are abstract, logical, systematic and full of confusing symbols and formulas. There is a need to address mathematic anxiety either through therapy, modification of learning methods, and so on to. Several research and publications related to mathematic anxiety has been done. However, until now, no definite solution has been found to overcome mathematic anxiety Therefore, this study was made to find out what is the current trend on research and publications related to mathematic anxiety in the last ten years. Data for this study is gathered from Scopus index. Analysis for this study was carried out using the bibliometric analysis method. Results of this study shows that Indonesia is the country with the highest number of publications related to mathematic anxiety. We also found that mathematic anxiety keyword has direct link to mathematics learning. Also, there are some topics that are less explored, for example the topic of therapy and the role of mathematics teachers which could be the focus of future research.

To cite this article

Parameswara, A.A., Yuadi, I., & Eva, N. (2023). Current trend of mathematic anxiety research and publication: a bibliometric analysis. *Journal for the Mathematics Education and Teaching Practices*, 4(1), 11-19.

Introduction

Mathematics is frequently seen as a difficult topic since its traits are abstract, logical, systematic, and full of perplexing symbols and formulas. (Santri et al., 2017). People frequently experience anxiety, frustration, and have bad attitudes toward mathematics. Feelings of anxiety usually rising when they have difficulty solving questions or during exams. (Doruk et al., 2015)

According to Luttenberger et al. (2018), math anxiety is defined as a fear and heightened psychological activity when interacting with math, such as when manipulating numbers, solving math problems, or confronted with evaluative situations (tests/exams) related to math. Also, definition from one of the latest researches defines mathematic anxiety as anxiety felt by individuals when they solve mathematical problems (Choi-Koh & Ryoo, 2019). It can be said that math anxiety is a feeling of anxiety, pressure, worry, dislike, or fear of everything related to mathematics.

Mathematic anxiety has primarily been studied in educational settings, with little connection to clinical research on anxiety disorders. The Diagnostic and Statistical Manual of Mental Disorders (DSM) and the International Classification of Diseases (ICD) are two diagnostic systems for mental disorders that categorize mathematic anxiety

¹ Corresponding Author: Posgraduate School of Universitas Airlangga, Department of Human Resource, Surabaya, East Java, Indonesia E-mail: adityaanantaparameswara@gmail.com ORCID: 0000-0002-5124-0886

² Posgraduate School of Universitas Airlangga and Faculty of Social Science and Politics Universitas Airlangga, Surabaya, East Java, Indonesia. ORCID: 0000-0002-7848-1671

³ Assoc. Prof., Psychology Department, Faculty of Psychology, Universitas Negeri Malang, Indonesia. E-mail: nur.eva.fpsi@um.ac.id ORCID: 0000-0003-3584-5049

under general anxiety section. But according to Paechter et al. (2017) mathematic anxiety is distinct from other subjects' anxieties or general test anxiety; for example, research on anxiety in related subjects such as math and statistics shows that, to a large extent, math anxiety and statistics anxiety are independent of each other and have different effects on learners.

People who suffer from math anxiety may find that the fear of doing math overwhelms their working memory. This is the region of the brain that stores small amounts of information needed to complete a task (Sokolowski & Ansari, 2017). Therefore, someone who experiences mathematic anxiety will have poor performance in math (Zhang et al., 2019).

Several research and publications related to mathematic anxiety has been done. However, until now, no definite solution has been found to overcome mathematic anxiety (Ramirez et al., 2018). Therefore, this study was made to find out how far the development of research and publications related to mathematic anxiety in the last ten years.

Problem of Research

Based on the information that has been presented previously, the problem of this research is obtained as follows:

- What is the current trend of research and publications related to mathematic anxiety if reviewed using bibliometric analysis?

Methods

Research Model

This research was carried out through online data collection on June 12, 2023. The data was taken from Scopus document search results. The data taken is document data both from conference papers, scientific articles, and books. The documents used in this research are limited to a maximum of ten years back to maintain the relevance of this research.



Figure 1. Research method flow chart

Data Analysis

Analysis for this study was carried out using the bibliometric analysis method. Bibliometric analysis is a popular and rigorous method for exploring and analyzing large amounts of scientific data (Donthu et al., 2021). It allows us to unpack the evolutionary nuances of a specific field while shedding light on its emerging areas. Bibliometric analysis is frequently used with network visualization software, either by using command-based software like the Bibliometric package in R. (Aria & Cuccurullo, 2017) or by using graphical user interface-based software like VOSviewer (van Eck & Waltman, 2014).

Data from Scopus search findings then exported into a file with the RIS (Research Information Systems) format. Then RIS file is imported into the VOSviewer software. VOSviewer version 1.6.19 was used for this study. VOSviewer is used to generate generate keyword maps based on existing keyword networks or relationships. The keyword frequency is set as desired when creating the bibliometric map, and irrelevant or less relevant keywords are removed.

Results

The initial data found contained 58 relevant documents. After filtering with search criteria based on title, abstract, keyword "mathematic anxiety" and the maximum published year is the last ten years, 13 documents are found that meet the criteria.

Table 1. Document related to "mathematic anxiety" and their author

No	Cite	Topic
1	Zhou et al. (2022)	The connections between problematic smartphone use, math anxiety, learning interest, and achievement
2	Collado-Soler et al. (2022)	Primary school students' motivation and anxiety toward mathematical learning
3	Almo et al. (2022)	Collaborative mathematics game experience using seven spell and peer tutoring
4	Dondio et al. (2021)	Literature review about possible games that reduce mathematic anxiety
5	Dewi & Royanto (2020)	Elementary student's metacognitive strategy for completing arithmetic word problems
6	Ifdil et al. (2019)	Chromotherapy as an alternate treatment for primary school kids' maths anxiety
7	Choi-Koh & Ryo (2019)	Measurement of mathematic anxiety
8	Bjälkebring (2019)	Study about forms of teaching and learning that can help students with mathematic anxiety at university
9	Ardi et al. (2019)	Using rasch measurement investigated elementary students' learning difficulties in mathematics based on students' mathematic anxiety, mathematics self-efficacy, and value beliefs.
10	Daharnis et al. (2019)	Study about mathematic anxiety among prospective elementary school teachers and their treatment
11	Esa & Mohamed (2017)	A study of students' learning styles and mathematics anxiety
12	Yildirim & Gurbuz (2017)	An examination of elementary school teachers' maths concern in relation to many variables
13	Doruk et al. (2015)	The investigation of vocational school students' mathematic anxiety in terms of learning style and multiple intelligence

These documents are then grouped according to the type of document and three groups of document types are obtained. Here are the three categories of documents.

Table 2. Grouping according to document type

No	Document Type	Total Document(s)
1	Conference Paper	6
2	Article	5
3	Book Chapter	2

Table 2 shows that there are six documents in the form of conference papers related to mathematic anxiety. A total of five documents are in the form of articles and two documents are in the form of book chapters.

Author

This research is complemented by data on the authors of documents related to mathematic anxiety. We present this data so that readers can find out the development of documents on the topic of mathematic anxiety through author data. Based on the documents collected, we found the top 10 author names that most researched mathematic anxiety.

Table 3. Authors of mathematic anxiety document publication

No	Author	Total Document(s)
1	Afdal, A.	3
2	Ardi, Z.	3

No	Author	Total Document(s)
3	Ifdil, I.	3
4	Alizamar, A.	2
5	Daharnis, D.	2
6	Dondio, P.	2
7	Erwinda, L.	2
8	Fadli, R.P.	2
9	Rangka, I.B.	2
10	Refnadi, R.	2

Table 3 shows that Afdal, A., Ardi, Z. and Ifdil, I. are the authors who have the most research related to mathematic anxiety with each author producing 3 documents. Then Alizamar, A., Daharnis, D., Dondio, P., Erwinda, L., Fadli, R.P., Rangka, I.B. and Refnadi, R. each produced 2 document works.

Subject Area

Mathematic anxiety is examined in various subject areas, but there are five subject areas that are most related. The five subject areas are shown in the following table.

Table 4. Subject area with the publication topic of mathematic anxiety

No.	Subject Area	Total Document(s)	Percentage (%)
1	Social Sciences	7	36,84
2	Physics and Astronomy	4	21,05
3	Computer Science	3	15,79
4	Psychology	3	15,79
5	Arts and Humanities	2	10,53

Based on table 4, it can be seen that social science is the largest subject area that is most related to the topic of mathematic anxiety. This is followed by physics and astronomy in second place, computer science in third place, psychology in fourth place and finally arts and humanities in the fifth place.

Country/territory

Based on the data obtained, it can be seen which countries are actively publishing documents related to mathematic anxiety. There are nine countries that have publications related to mathematic anxiety which are summarized in the following table.

Table 5. Countries that actively carry out publications about mathematic anxiety

No.	Country/territory	Total Document(s)
1	Indonesia	4
2	Ireland	2
3	Turkey	2
4	China	1
5	Malaysia	1
6	South Korea	1
7	Spain	1
8	Sweden	1
9	United States	1

Based on table 5, it can be seen that the topic of mathematic anxiety is most researched in Indonesia with four documents produced. Ireland and Turkey produced two documents each. China, Malaysia, South Korea, Spain, Sweden, and United States each contributed 1 document.

Data Mapping

Data retrieved from Scopus related to mathematic anxiety resulted in 13 documents between 2014 and 2023. The data was then exported into RIS format and imported into VOSviewer for analysis and visualization. Six main keywords were found and there were nine relationships with a total relationship strength of 11 from the visualized data. Two clusters were found from the six main keywords generated. The first cluster contains four main keywords, namely learning systems, mathematics anxiety, mathematics achievement, and mathematics learning. The second cluster contains two main keywords, namely elementary schools and primary schools.

Network Visualization

The network visualization shows the relationship between keywords that are interrelated, and the total strength of a keyword used in research related to mathematic anxiety. Based on the existing data, the following visualization results are obtained.

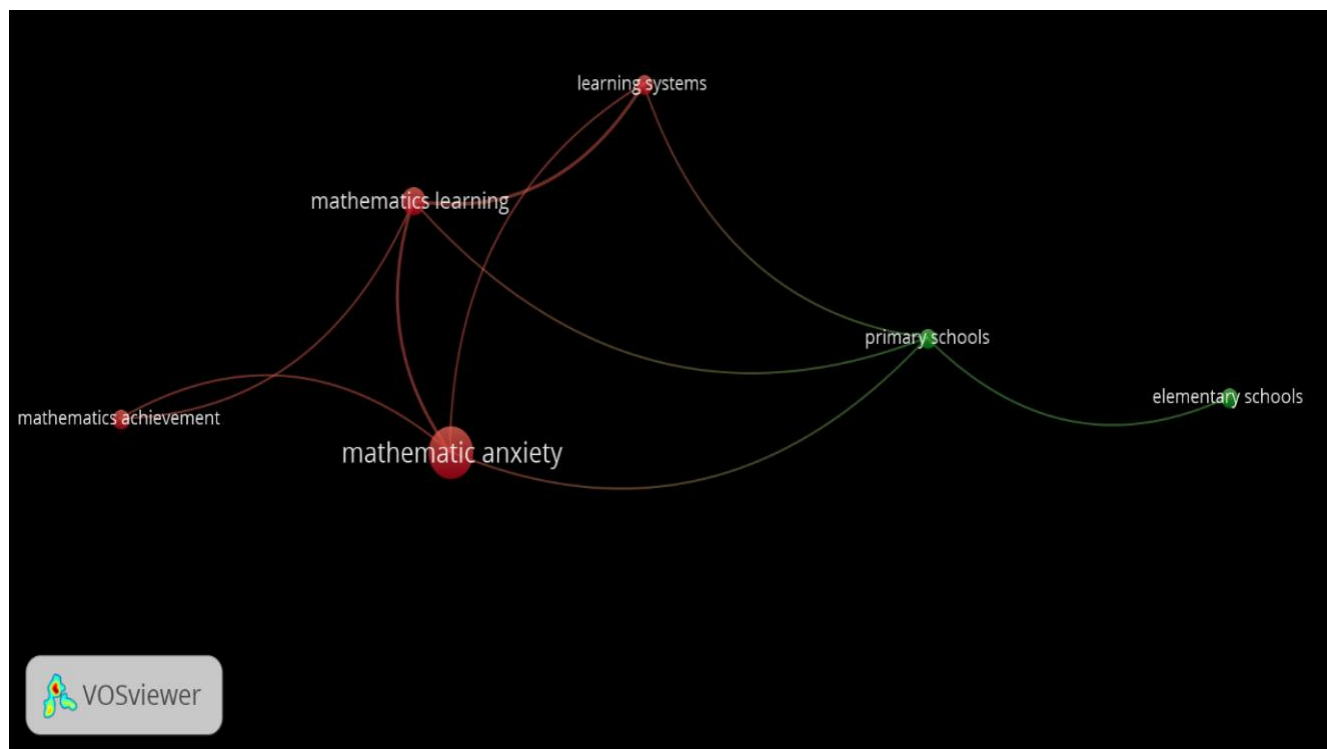


Figure 2. Network visualization

The visualization results in Figure 2 show that there are six main keywords found. The keywords in the network visualization are displayed into two clusters. The first cluster is shown in red which contains four keywords namely mathematic anxiety, mathematics learning, mathematics achievement, and learning systems. Then the second cluster is shown in green which includes two main keywords namely primary schools and elementary schools. Each keyword has a relationship with other keywords which can be seen in the following table.

Table 6. Keywords total link and link strength

No	Cluster	Keyword	Link	Link strength
1	1	Mathematic anxiety	4	5
2		Mathematics learning	4	6
3		Learning systems	3	4
4		Mathematics achievement	2	2
5	2	Primary schools	4	4
6		Elementary schools	1	1

Overlay Visualization

Overlay visualization is used to illustrate the distribution of document years from the data that has been retrieved with the keywords displayed differentiated into dark and light. Overlay visualization can also explain the average document

year of a keyword. The distribution of documents by year is divided into five main scales, so that the following visualization is obtained.

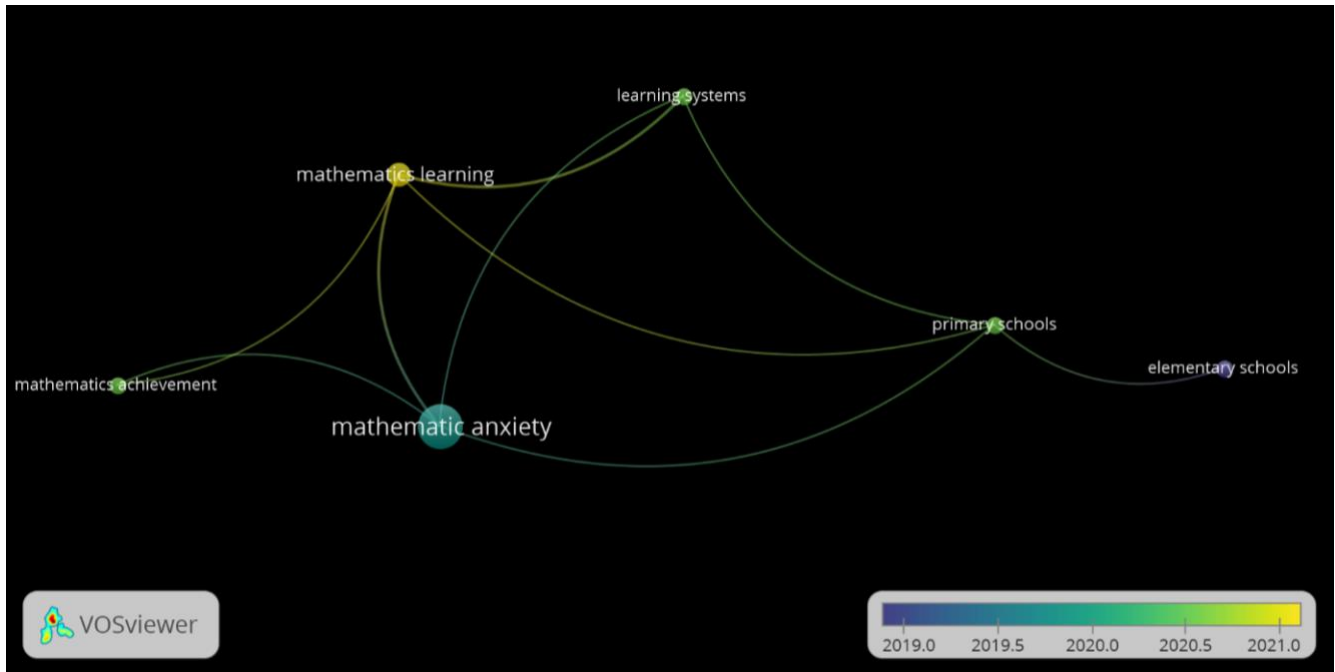


Figure 3. Overlay visualization

Figure 3 shows the result of overlay visualization that illustrates keywords with different color spheres, ranging from dark to light. Keywords with dark colors are elementary schools as the oldest document from the visualized data, which is 2019. Then the light blue keyword is mathematic anxiety which was visualized in the middle of 2019. Keywords primary schools, mathematics achievement, and learning systems are visualized in green indicating 2020. Finally, mathematics learning is visualized in yellow which indicates 2021. The document data can also be illustrated through the average annual document publication described in the following table.

Table 7. Average keywords publication year

No	Keyword	Year	Average Publication Year
1	Primary schools	2019	2019.00
2	Mathematics anxiety	2019	2019.83
3	Learning systems	2020	2020.50
4	Mathematics achievement	2020	2020.50
5	Primary schools	2020	2020.50
6	Machine learning	2021	2021.00

Density Visualization

Density visualization describes the distribution of documents through the two most visible colors, namely dark blue and yellow. Based on the research data, the density visualization is obtained as follows.

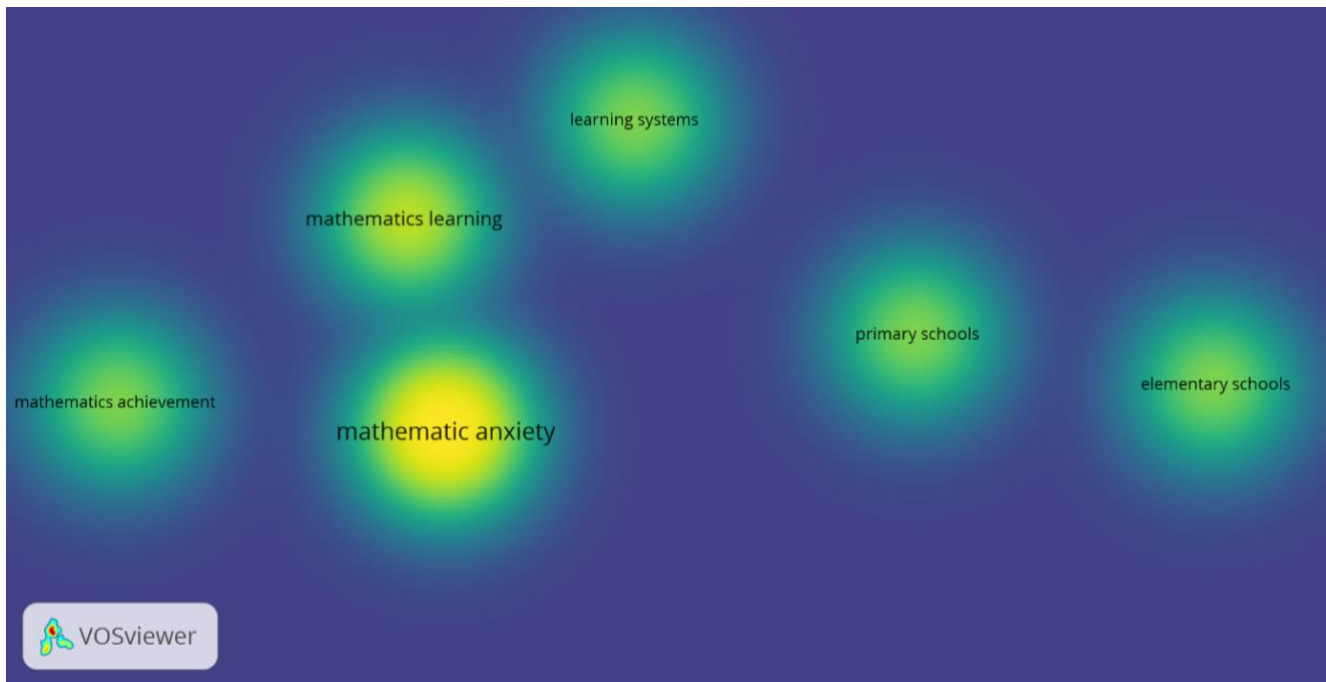


Figure 4. Density visualization

The visualization results in figure 4 show that the most used keyword is mathematic anxiety and then followed by mathematics learning. Keywords mathematics achievement, learning systems, primary schools, and elementary schools are visualized with similar colors.

Discussion and Conclusion

According to table 5, Indonesia is the country with the most publications related to mathematic anxiety. In line with this, we found an interesting fact. Several studies were conducted in order to assess the mathematical ability of students in various countries around the world, one of which was the Trends in International Mathematics and Science Study (TIMSS). The studies found that average mathematics achievement score of Indonesian students is categorized as Low International Benchmark. This achievement indicates that on average Indonesian students are only able to recognize a number of basic facts but have not been able to communicate, relate various topics, let alone apply complex and (Hadi & Novaliyosi, 2019). Also, according to (Udil et al., 2017) high mathematics anxiety can cause the lack of students' metacognition process while solving the mathematics problem. Based on this information, it seems that Indonesia is actively trying to solve the problems related to mathematic anxiety.

According to 2 and 3 we see that mathematics anxiety has a direct link with mathematics learning and both of them has larger circle diameter than other keywords. The darker the yellow color, the larger the diameter of the circle, the more frequent research on these topics increases, but if the color fades, blending into the background, the number of studies about these topics will decrease (Nandiyanto & Al Husaeni, 2021). Therefore, research that modifies mathematics learning technique might be a trend for future research.

Density visualization as shown in figure 4 gives us bright heatmap about mathematic anxiety and mathematics learning, but no keywords shown about the therapy/method for overcoming mathematic anxiety. Also, we didn't find any heatmap about teachers or educators even some of documents that were used in this study also related with topic such as teacher or educator. According to Udil et al (2017) it's important for the teachers to consider students mathematics anxiety to design and plan better mathematics learning. This phenomenon may be due to the lack of research on those topics. These findings are expected to be used as input and to provide insight into new areas of mathematical anxiety research.

Recommendations

This research has explored information related to publications on mathematic anxiety. From the results of this study, it can be seen that there are some topics that are less explored, for example the topic of therapy, the role of mathematics teachers and mathematics learning. Future research may be able to contribute to developing these topics

Limitations of Study

One of the limitations of this study is that the source of data collection only takes from publications listed on Scopus. There are some alternative sites that may be able to provide more data, such as Web of Science, PubMed, and ScienceDirect.

Acknowledgments

All authors contributed equally to the study. The authors declare that there is no conflict of interest. Ethical rules were followed in all processes of the study.

Biodata of the Authors



Aditya Ananta Parameswara completed his bachelor degree in State University of Malang, department of Psychology. Currently he studied in Posgraduate School of Universitas Airlangga, Department of Human Resource, Surabaya, East Java, Indonesia. His research interest are educational psychology, machine learning, and experimental psychology. E-mail: adityaanantaparameswara@gmail.com ORCID: 0000-0002-5124-

0886



Imam Yuadi, Ph.D is senior lecturer in Posgraduate School of Universitas Airlangga and Faculty of Social Science and Politics Universitas Airlangga. His research interests are digital forensics and image processing. Affiliation: Universitas Airlangga, Surabaya, East Java, Indonesia ORCID: 0000-0002-7848-1671

References

- Almo, A., Rocha, M., Brennan, A., & Dondio, P. (2022). Seven Spells and Peer Tutoring: A Collaborative Mathematics Game Experience. *Proceedings of the European Conference on Games-Based Learning, 2022-October*, 38–47. <https://doi.org/10.34190/ecgbl.16.1.533>
- Ardi, Z., Rangka, I. B., Ifdil, I., Suranata, K., Azhar, Z., Daharnis, D., Afdal, A., & Alizamar, A. (2019). Exploring the elementary students learning difficulties risks on mathematics based on students mathematic anxiety, mathematics self-efficacy and value beliefs using rasch measurement. *Journal of Physics: Conference Series*, 1157(3). <https://doi.org/10.1088/1742-6596/1157/3/032095>
- Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/J.JOI.2017.08.007>
- Bjälkebring, P. (2019). Math Anxiety at the University: What Forms of Teaching and Learning Statistics in Higher Education Can Help Students With Math Anxiety? *Frontiers in Education*, 4. <https://doi.org/10.3389/educ.2019.00030>
- Choi-Koh, S. S., & Ryoo, B. G. (2019). Differences of math anxiety groups based on two measurements, MASS and EEG. *Educational Psychology*, 39(5), 659–677. <https://doi.org/10.1080/01443410.2018.1543857>
- Collado-Soler, R., Manzano-León, A., & Rodríguez-Ferrer, J. M. (2022). Motivation and Anxiety Towards Mathematical Learning in Primary Education. *Education and the Collective Construction of Knowledge*, 21–33.
- Daharnis, D., Nirwana, H., Ifdil, I., Afdal, A., Ardi, Z., Taufik, T., Erlamsyah, E., Alizamar, A., Fadli, R. P., Erwinda, L., Zola, N., Refnadi, R., & Fikriyanda, F. (2019). Mathematics anxiety among prospective elementary school teachers and their treatment. *Journal of Physics: Conference Series*, 1157(4). <https://doi.org/10.1088/1742-6596/1157/4/042089>
- Dewi, N. F., & Royanto, L. R. M. (2020). Elementary students' mathematic anxiety and metacognitive strategy for the completion of mathematics word problems. *Psychological Aspects of Student Performance: Learning from Studies in an Indonesian Context*, 21–34.
- Dondio, P., Santos, F. H., Gusev, V., & Rocha, M. (2021). Do games reduce maths anxiety? A review of the current literature. *Proceedings of the European Conference on Games-Based Learning, 2021-September*, 287–295. <https://doi.org/10.34190/GBL.21.112>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285–296. <https://doi.org/10.1016/J.JBUSRES.2021.04.070>
- Doruk, I., Doruk, M., Doruk, G., Kaplan, A., & Kaplan, N. (2015). The examination of mathematic anxiety of vocational school students in terms of learning style and multiple intelligence. *Turkish Online Journal of Educational Technology*, 2015, 632–638.

- Esa, S., & Mohamed, N. A. (2017). A study of students' learning styles and mathematics anxiety amongst form four students in Kerian Perak. *AIP Conference Proceedings*, 1847. <https://doi.org/10.1063/1.4983879>
- Hadi, S., & Novaliyosi, N. (2019). TIMSS Indonesia (Trends In International Mathematics And Science Study). *Prosiding Seminar Nasional & Call For Papers*, 0(0). <https://jurnal.unsil.ac.id/index.php/sncp/article/view/1096>
- Ifdil, I., Fadli, R. P., Zola, N., Erwinda, L., Sari, A., Churnia, E., Rangka, I. B., Solihatun, S., Suranata, K., Bariyyah, K., Ardi, Z., Afdal, A., Refnadi, R., Zufriani, Z., Nikmarijal, N., Dahlan, D., Fitria, L., & Barseli, M. (2019). Chromotherapy: An alternative treatment for mathematics anxiety among elementary school students. *Journal of Physics: Conference Series*, 1175(1). <https://doi.org/10.1088/1742-6596/1175/1/012183>
- Luttenberger, S., Wimmer, S., & Paechter, M. (2018). Spotlight on math anxiety. *Psychology Research and Behavior Management*, 11, 311. <https://doi.org/10.2147/PRBM.S141421>
- Nandiyanto, A. B. D., & Al Husaeni, D. F. (2021). A bibliometric analysis of materials research in Indonesian journal using VOSviewer. *Journal of Engineering Research*, 9. <https://doi.org/10.36909/JER.ASSEEE.16037>
- Paechter, M., Macher, D., Martskvishvili, K., Wimmer, S., & Papousek, I. (2017). Mathematics Anxiety and Statistics Anxiety. Shared but Also Unshared Components and Antagonistic Contributions to Performance in Statistics. *Frontiers in Psychology*, 8(JUL). <https://doi.org/10.3389/FPSYG.2017.01196>
- Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math Anxiety: Past Research, Promising Interventions, and a New Interpretation Framework. *Educational Psychologist*, 53(3), 145–164. <https://doi.org/10.1080/00461520.2018.1447384>
- Santri, F., Matematika, S. J., Tarbiyah, F., Tadris, D., & Bengkulu, I. (2017). What's wrong with mathematic anxiety? *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang*, 1(1), 59–65. <https://e-journal.ivet.ac.id/index.php/matematika/article/view/458>
- Sokolowski, H. M., & Ansari, D. (2017). Who Is Afraid of Math? What Is Math Anxiety? And What Can You Do about It? *Frontiers for Young Minds*, 5. <https://doi.org/10.3389/FRYM.2017.00057>
- Udil, P. A., Kusmayadi, T. A., Riyadi, &, Matematika, M. P., & Maret, S. (2017). Metacognition Process of Students with High Mathematics Anxiety in Mathematics Problem-Solving. *International Journal of Science and Applied Science: Conference Series*, 2(1), 261–272. <https://doi.org/10.20961/IJSASCS.V2I1.16724>
- van Eck, N. J., & Waltman, L. (2014). Visualizing Bibliometric Networks. *Measuring Scholarly Impact*, 285–320. https://doi.org/10.1007/978-3-319-10377-8_13
- Yildirim, K., & Gürbüz, R. (2017). Sınıf öğretmenlerinin matematik kaygılarının farklı değişkenler açısından incelenmesi. *Milli Eğitim*, 1(251), 69–86.
- Zhang, J., Zhao, N., & Kong, Q. P. (2019). The relationship between math anxiety and math performance: a meta-analytic investigation. *Frontiers in Psychology*, 10(AUG), 458192. <https://doi.org/10.3389/FPSYG.2019.01613/BIBTEX>
- Zhou, D., Liu, J., Wang, T., Liu, J., & Li, G. (2022). Relationships among problematic smartphone use, mathematics anxiety, learning interest, and achievement: A multiple mediation model. *Computers in Human Behavior*, 129. <https://doi.org/10.1016/j.chb.2021.107171>

