

Ethnomathematical Studies in the Scopus Database Between 2010-2022: A Bibliometric Review

Maximus Tamur¹, Tommy Tanu Wijaya², Adi Nurjaman³, Muhammad Daut Siagian⁴
Krisna S. Perbowo⁵

{maximustamur@unikastpaulus.ac.id¹, tanuwijayat@gmail.com², nurjamanadi@ikipsiliwangi.ac.id³,
mdsiagian@fkip.uisu.ac.id⁴, krisna_satrio@uhamka.ac.id⁵}

¹Universitas Katolik Indonesia Santu Paulus Ruteng, Indonesia

²School of Mathematical Sciences, Beijing Normal University, Beijing, China

³Intitut Keguruan dan Ilmu Pendidikan Siliwangi, bandung

⁴Universitas Islam Sumatera Utara, Medan, Indonesia

⁵University of Warwick, Warwick, United Kingdom

Abstract. Today, ethnomathematics studies have become a global trend for decades. However, there is no comprehensive understanding of the state of studies on ethnomathematical topics to date. For this reason, this study seeks to fill these limitations by conducting a bibliometric study of 198 studies on the Scopus database between 2010 and 2022. This research addresses two issues: (i) an overview of the growth trajectory of studies related to ethnomathematics; and (ii) mapping to identify the most important gaps and topics. The results of the analysis show that the trajectory of the study is related to the influence of Covid-19. Key-topics and research gaps are discussed. Some of the implications are presented as useful information for scientists and stakeholders.

Keywords: bibliometrics, mathematics education, mathematics in context, ethnomathematics, Scopus.

1 Introduction

Ethnomathematics has emerged as a trend in mathematics teaching over the last four decades [1]. Ethnomathematics-based learning does not condition students to memorize formulas but understands how some mathematical formulas can be derived or inspired from everyday contexts. This context is used as a stimulus to direct students in finding mathematical concepts through the mathematization process [2]–[7]. Ethnomathematics is an approach to explore local wisdom and local culture using the study of mathematical concepts [8]. Ethnomathematics can empirically improve students' cognitive abilities in primary and secondary schools [9].

Mathematics is a human activity whose mathematical activity must be encouraged in the learning process [2], [10], [11]. Therefore, the goal of ethnomathematics is to make mathematics education closer, precise, and meaningful for most students [10]. Ethnomathematics-based learning is built on a variety of cultures and real-life situations that serve as a starting point for decontextualization towards contextualization [12].

In ethnomathematics-based learning, real life is contextualized as the starting point of learning. The role of ethnomathematics includes mediating students to be able to explore concepts and providing a learning environment that can foster motivation and interest in learning [13]. In other words, ethnomathematics bridges human activity with mathematics through its relevance to everyday problems or real life. Previously, researchers and practitioners of learning mathematics studied ethnomathematics from different perspectives [5], [14]–[16]. Ethnomathematics integration in learning has developed according to the characteristics of each region.

Today, ethnomathematics has crossed the borders of Brazil to reach the whole world. A number of countries have adapted teaching programs to integrate ethnomathematics [17]. Ethnomathematics has been shown to improve students' understanding and achievement in mathematics [18]. The application of ethnomathematics and mathematical modeling allows us to see different realities and gives us insight into the mathematics achieved in a holistic manner [7].

In addition, ethnomathematics has been shown to increase students' active participation in the classroom [19], [20], promote flexibility in learning programs [17], [21] and improve student learning attitudes in mathematics classrooms [22]–[24]. Its application in various countries, for example, in the United States, is implemented through contextual-based mathematics education [12], while in Indonesia it is called Indonesian realistic mathematics education [6].

However, until now there has not been a comprehensive understanding of the state of the study on ethnomathematical topics. To fill this gap, a bibliometric study is needed to identify trends in the research field [25]. This method has been widely applied to evaluate research gaps [26], sustainable development [27], and mathematics education [28], [29]. However, the application of this bibliometric tool for ethnomathematical education research has not been carried out. In addition, several bibliometric studies in the field of mathematics education have not explored much about ethnomathematics integration. For this review, this study seeks to overcome this by synthesizing previous research patterns in the field of ethnomathematics during the previous decade. The following two research questions will be examined: a) What is the growth trajectory of studies related to ethnomathematics? b) How is the mapping, gap and density from the study of ethnomathematics?

2 Method

To achieve the research objectives as described previously, the study used bibliometric analysis methods. The bibliometric analysis method is the application of statistical and mathematical methods to books and other communication media [30]. The bibliometric analysis used is descriptive bibliometrics which describes the characteristics or characteristics of a literature. Bibliometric analysis is used for various reasons including revealing emerging trends in articles and journals [31]. Bibliometric analysis techniques are divided into two categories, namely performance analysis and mapping.

To date, bibliometric analysis has been used in different research topics including those related to mathematics. For example, [32] uses 9,941 research reports published in WOS-indexed journals to identify scientific communication in mathematics education. In addition [10] analyzed 282 Scopus indexed documents in the range 1972 to 2020 for RME research trends worldwide. In line with this research, this study analyzes 218 Scopus indexed documents between 2010 – 2022 which specifically examines ethnomathematics. The work was carried out to answer the four research questions previously described above. Relational bibliometric analysis allows readers to explore the structure of ethnomathematical topics, identify topics of

most interest to research, and also reveal research trends in these topics [33]. In bibliometric analysis, the identification of co-occurrence of keywords shows the constructs that are often used in the articles analyzed [10]. In this study, the Scopus database was chosen as a place to search for documents because Scopus applies consistent standards in selecting documents to be included in its index. Scopus displays more documents than other top databases such as the WOS especially specifically for research reviews in education and social sciences [26], [27]. Given these important reasons, Scopus was used in this study. In this study, we use the Publish or Perish application to collect data related to ethnomathematical studies from the Scopus database. Figure 1 shows the process of browsing the Scopus database using the POP application.

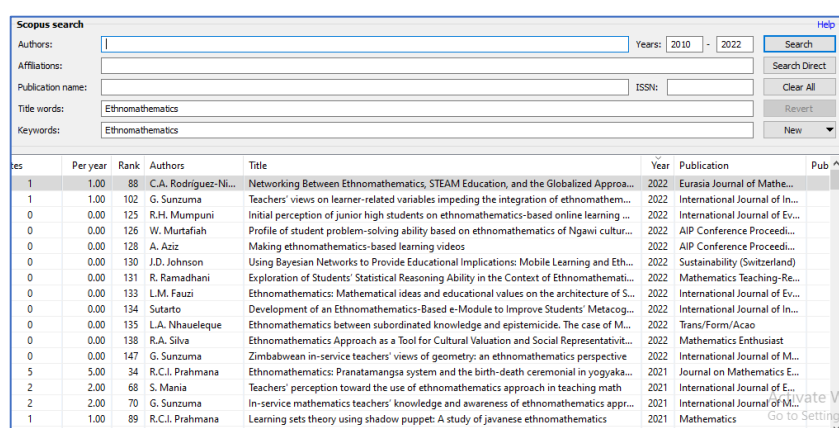


Fig. 1. Ethnomathematical Study Tracing from Scopus Database Using PoP

Fig.1. is the initial procedure in collecting the Scopus database through PoP before being screened. Furthermore, to filter the data collected through PoP, this study followed the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines (see Figure 2). In the identification step, the search is carried out using the keyword “ethnomathematics”, the publication name is “journal”, and the year of publication of the article is “2010 – 2022”. Based on the results of searching data through PoP, 198 articles were obtained which were the population of this study, which were then filtered. In the screening step, the specified inclusion criteria are (i) Document type: unlimited; (ii) Language: English; (iii) Subject area: unlimited; and (iv) Year of publication: between 2010-2022. In this process, 16 documents were omitted due to lack of abstracts. Thus, 182 documents were continued in the third step (feasibility). In the third step, we investigate each document by reading its title and abstract. The research group re-investigates the title, abstract, and sometimes full-text articles to determine whether or not the article should be rejected. In this step, 46 documents were omitted because their contents were not relevant to ethnomathematics. The final dataset consisted of 136 documents all of which were stored in RIS files for further bibliometric analysis. The application that helps the analysis is the VOSviewer software. This application is used for mapping in finding trends in international scientific publications with the Scopus database on ethnomathematics in mathematics learning according to keywords.

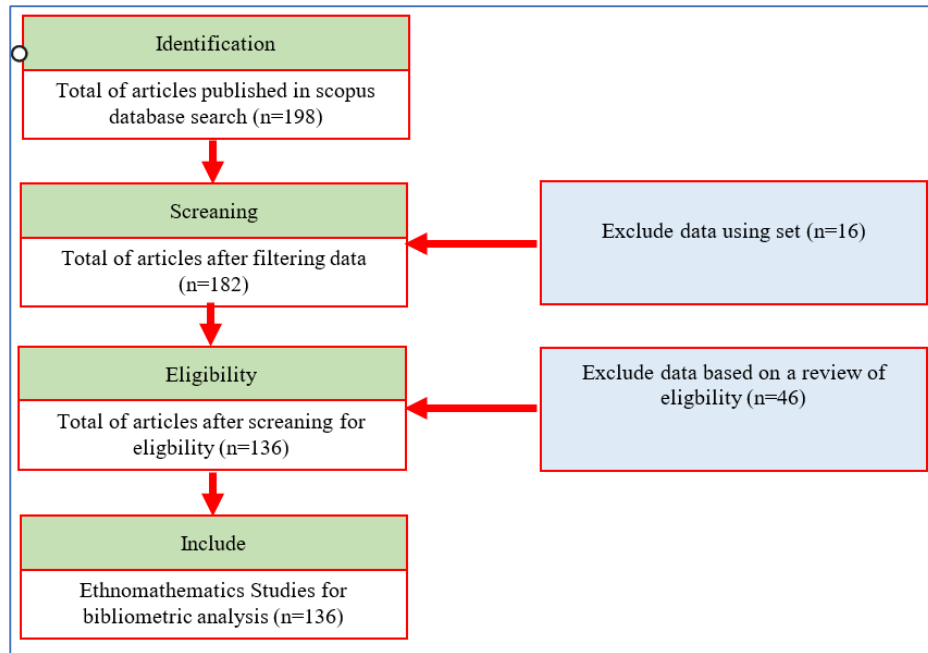


Fig. 2. Data Filtering Protocol

3 Results and Discussion

This study aims to analyze the four problems proposed. Based on the analysis of the results using the VOSviewer program

3.1 What is the growth trajectory of studies related to ethnomathematics?

First, we present the results regarding the original research question. Specifically, our four-step PRISMA search and identification process resulted in 184 documents related to ethnomathematical studies. Regarding the timeline, Figure 2 presents the number of ethnomathematical related documents published between 2010 and 2022.

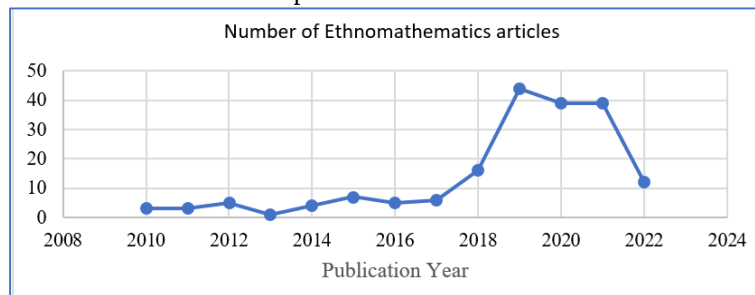


Fig. 3. Number of ethnomathematical studies between 2010 and 2022 (N = 184)

Based on Fig. 3, it can be seen that the publication of studies related to etomathematics with a period of twelve years has fluctuated. It can be seen that the number of articles in the period 2010 to 2017 is not very volatile. In this range, the increase and decrease in the number of articles is not too significant. A significant increase occurred from 2018 to its peak in 2021. In

2019 the highest number of articles was obtained, namely 44 articles. The illustration of the trend of ethnomathematical studies spanning the years 2010-2019 as shown in Figure 3 resembles a graph in research [10] which explains that the accumulation of publications per year forms an exponential growth curve in the period 1972 to 2019. Other studies also support this finding (e.g., [30]). Meanwhile, from 2020 to 2022, there was a decline again. This is very likely because of the time span of the Covid-19 outbreak that hit the world [34], [35]. Most governments have decided to temporarily close educational institutions in an effort to reduce the spread of the virus. COVID-19 [35]. The education sector has been affected by the COVID-19 crisis at all levels from preschool to university and has also led to the cancellation of various academic congresses [36]. This has resulted in a lack of mobilization of researchers including in the field of ethnomathematics.

The search results using PoP showed the total number of citations of articles related to ethnomathematics was 674 out of 184 articles from 2010-2022. The articles with the highest number of citations are presented in Table 1

cit	Author	Research Title	Year	Journal Name	Rank
39	A. Pais	Criticisms and contradictions of ethnomathematics	2011	Educational Studies in Mathematics	1
36	D. Muhtadi	Sundanese ethnomathematics: Mathematical activities in estimating, measuring, and making patterns	2017	Journal on Mathematics Education	2
29	W. Widada I.	Realistic mathematics learning based on the ethnomathematics in Bengkulu to improve students' cognitive level	2018	Journal of Physics: Conference Series	3
28	Risdiyanti	Ethnomathematics: Exploration in Javanese culture	2018	Journal of Physics: Conference Series	4
25	A.S. Abdullah	Ethnomathematics in perspective of sundanese culture	2017	Journal on Mathematics Education	5
24	D. Herawaty	Students' metacognition on mathematical problem solving through ethnomathematics in Rejang Lebong, Indonesia	2018	Journal of Physics: Conference Series	6
22	G. Knijnik	Differentially positioned language games: Ethnomathematics from a philosophical perspective	2012	Educational Studies in Mathematics	7
21	M. Rosa	A trivium curriculum for mathematics based on literacy, matheracy, and technoracy: an ethnomathematics perspective	2015	ZDM - International Journal on Mathematics Education	8
18	R. Pinxten	Politics in an Indian canyon? Some thoughts on the implications of ethnomathematics	2011	Educational Studies in Mathematics	9
17	S. Hartinah	Probing-prompting based on ethnomathematics learning model: The effect on mathematical communication skills	2019	Journal for the Education of Gifted Young Scientists	10

3.1 How is the mapping, gap and density from the study of ethnomathematics?

The second objective of this research is to answer questions related to mapping, gaps and density of studies on ethnomathematics. From the analysis results obtained mapping, analysis

of novelty and also the density of studies on ethnomathematics as illustrated in Figure 4, Figure 5, and Figure 6.

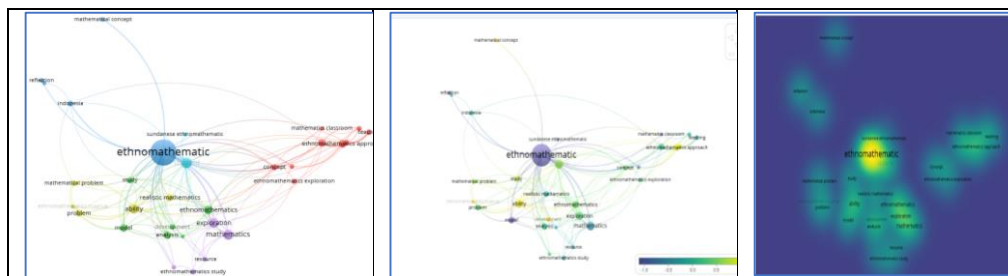


Fig. 4 Mapping results, gaps and density of studies on ethnomathematics.

Based on the picture, it can be seen that the topic of ethnomathematics is quite varied. The topic that is widely raised is related to ethnomathematical exploration. This makes a lot of sense because the main work of ethnomathematics is concerned with exploring the culture practiced by each tribe. This is done to identify how mathematics is used in designing, constructing, calculating, and other cultural activities. In addition, the results of the analysis also show that topics that are rarely researched related to ethnomathematical studies are related to mathematical problems, and mathematical analysis. This is very clear because not all mathematical material can be contextualized. However, this gap can be a basic idea in conducting further research.

4 Conclusion

This research was conducted to obtain a comprehensive picture related to the study of ethnomathematics. This goal is achieved by conducting a bibliometric analysis. The study findings analyzed from 136 primary studies between 2010-2022 show the trend of ethnomathematical studies. The growth trajectory of ethnomathematics studies is influenced by social restrictions, especially in the school environment as a result of Covid-19. The results of the analysis also show that the topics that are rarely studied are related to ethnomathematical studies related to mathematical problems, and mathematical analysis. This is very clear because not all mathematical material can be contextualized. This gap will be the basic idea for further ethnomathematical studies.

Acknowledgments. Thank you to the Saint Paul Ruteng Foundation through research institutions and community service who have fully contributed to this research

References

- [1] U. D'Ambrosio, "State of the art in Ethnomathematics. In Current and Future Perspectives of Ethnomathematics as a Program," in *Springer International Publishing*, 2016, pp. 11–37.
- [2] D. Juandi, Y. S. Kusumah, and M. Tamur, "A Meta-Analysis of the Last Two Decades of Realistic Mathematics Education Approaches," *Int. J. Instr.*, vol. 15, no. 1, pp. 381–400, 2022, doi: 10.29333/iji.2022.15122a.
- [3] M. Tamur, V. S. Kurnila, E. Jehadus, A. Nurjaman, K. Mandur, and S. Ndiung, "The Effect of the Realistic Mathematics Education Approach : Meta-Analysis of the Measured Mathematical Ability Angle," *Adv. Soc. Sci. Educ. Humanit. Res.*, vol. 550,

- no. Icmmed 2020, pp. 40–46, 2021, doi: 10.2991/assehr.k.210508.040.
- [4] M. Tamur, D. Juandi, and A. M. G. Adem, “Realistic Mathematics Education in Indonesia and Recommendations for Future Implementation : A Meta-Analysis Study,” *JTAM (Jurnal Teor. dan Apl. Mat.*, vol. 13, no. 4, pp. 867–884, 2020.
 - [5] T. Nugraha, M. Maulana, and P. Mutiasih, “Sundanese Ethnomathematics Context in Primary School Learning,” *Mimb. Sekol. Dasar*, vol. 7, no. 1, pp. 93–105, 2020, doi: 10.17509/mimbar-sd.v7i1.22452.
 - [6] Z. Zulkardi, R. I. I. Putri, and A. Wijaya, “Two Decades of Realistic Mathematics Education in Indonesia,” in *International reflections on the Netherlands didactics of Mathematics, ICME-13 Monographs*, M. Van den Heuvel-Panhuizen, Ed. Cham: Springer, 2020, pp. 325–340.
 - [7] M. Rosa and D. C. Orey, “Ethnomodelling as the art of translating mathematical practices,” *Learn. Math.*, vol. 39, no. 2, pp. 19–24, 2019.
 - [8] U. Umbara, W. Wahyudin, and S. Prabawanto, “How to predict good days in farming: ethnomathematics study with an ethnomodelling approach,” *JRAMathEdu (Journal Res. Adv. Math. Educ.*, vol. 6, no. 1, pp. 71–85, 2021, doi: 10.23917/jramathedu.v6i1.12065.
 - [9] Z. Busrah and H. Pathuddin, “Ethnomathematics: Modelling the volume of solid of revolution at Buginese and Makassarese traditional foods,” *JRAMathEdu (Journal Res. Adv. Math. Educ.*, vol. 6, no. 4, pp. 331–351, 2021, doi: 10.23917/jramathedu.v6i4.15050.
 - [10] T. T. Phan *et al.*, “A Bibliometric Review on Realistic Mathematics Education in Scopus Database Between 1972-2019,” *Eur. J. Educ. Res.*, vol. 11, no. 2, pp. 1133–1149, 2021.
 - [11] M. Tamur, S. Ndiung, A. Nurjaman, and J. Pereira, “Do differences in measured mathematical abilities moderate the effectiveness of the realistic mathematics education approach? Meta-analysis studies,” *J. Math Educ. Nusantara*, vol. 7, no. 1, pp. 12–25, 2021, doi: 10.29407/jmen.v7i1.15736.
 - [12] M. Van den Heuvel-Panhuizen and P. Drijvers, “Realistic Mathematics Education,” in *Encyclopedia of Mathematics Education*, S. Lerman, Ed. Springer Netherlands, 2014, pp. 521–525.
 - [13] I. M. Surat, “Peranan Model Pembelajaran Berbasis Etnomatematika sebagai Inovasi Pembelajaran dalam Meningkatkan Literasi Matematika,” *Emasains J. Edukasi Mat. dan Sains*, vol. 7, no. 2, pp. 143–154, 2018, doi: 10.5281/zenodo.2548083.
 - [14] A. S. Nur, S. B. Waluya, R. Rochmad, and W. Wardono, “Contextual learning with Ethnomathematics in enhancing the problem solving based on thinking levels,” *JRAMathEdu (Journal Res. Adv. Math. Educ.*, vol. 5, no. 3, pp. 331–344, 2020, doi: 10.23917/jramathedu.v5i3.11679.
 - [15] F. Nursyahidah, B. A. Saputro, and M. R. Rubowo, “A Secondary Student’s Problem Solving Ability in Learning Based on Realistic Mathematics with Ethnomathematics,” *JRAMathEdu (Journal Res. Adv. Math. Educ.*, vol. 3, no. 1, p. 13, 2018, doi: 10.23917/jramathedu.v3i1.5607.
 - [16] G. Sunzuma and A. Maharaj, “In-service Zimbabwean teachers’ obstacles in integrating ethnomathematics approaches into the teaching and learning of geometry,” *J. Curric. Stud.*, vol. 53, no. 5, pp. 601–620, 2021, doi: 10.1080/00220272.2020.1825820.
 - [17] T. T. Nguyen *et al.*, “Realistic mathematics education in Vietnam: Recent policies and practices,” *Int. J. Educ. Pract.*, vol. 8, no. 1, pp. 57–71, 2020, doi: 10.18488/journal.61.2020.81.57.71.

- [18] G. Sunzuma, N. Zezekwa, I. Gwizangwe, and G. Zinyeka, "A Comparison of the Effectiveness of Ethnomathematics and Traditional Lecture Approaches in Teaching Consumer Arithmetic: Learners' Achievement and Teachers' Views," *Pedagog. Res.*, vol. 6, no. 4, p. em0103, 2021, doi: 10.29333/pr/11215.
- [19] G. Sunzuma and A. Maharaj, "Exploring Zimbabwean Mathematics Teachers' Integration of Ethnomathematics Approaches into the Teaching and Learning of Geometry," *Aust. J. Teach. Educ.*, vol. 45, no. 7, pp. 77–93, 2020, doi: 10.14221/ajte.2020v45n7.5.
- [20] S. A. Tesfamichael, A. H. Nakkeen, T. Tumebo, and P. Grey, "Curriculum Implications of Using Ethnomathematics to Promote Student Learning in Ethiopia," *J. Math. Cult.*, vol. 15, no. 3, pp. 86–123, 2021.
- [21] S. Revina and F. K. S. Leung, "Educational Borrowing and Mathematics Curriculum : Realistic Mathematics Education in the Dutch and Indonesian Primary Curriculum," *Int. J. Emerg. Math. Educ.*, vol. 2, no. 1, pp. 1–16, 2018, doi: 10.12928/ijeme.v2i1.8025 Educational.
- [22] A. Q. Fouze and M. Amit, "Ethnomathematics and Geometrical Shapes in Bedouin Women ' s Traditional Dress," *Creat. Educ.*, vol. 10, pp. 1539–1560, 2019, doi: 10.4236/ce.2019.107112.
- [23] M. Rosa and M. E. Gavarrete, "An Ethnomathematics Overview: An Introduction," 2017.
- [24] Haryanto, N. Toto, Subanji, and Abadyo, "Ethnomathematics in Arfak (West Papua Indonesia): Hidden Mathematics on knot of Rumah Kaki Seribu," *Educ. Res. Rev.*, vol. 11, no. 7, pp. 420–425, 2016, doi: 10.5897/err2015.2620.
- [25] B. Pham-Duc, T. Tran, H. T. T. Le, N. T. Nguyen, H. T. Cao, and T. T. Nguyen, "Research on Industry 4.0 and on key related technologies in Vietnam: A bibliometric analysis using Scopus," *Learn. Publ.*, vol. 34, no. 3, pp. 414–428, 2021, doi: 10.1002/leap.1381.
- [26] P. Hallinger and C. Chatpinyakoo, "A bibliometric review of research on higher education for sustainable development, 1998-2018," *Sustain.*, vol. 11, no. 8, 2019, doi: 10.3390/su11082401.
- [27] P. Hallinger and V. T. Nguyen, "Mapping the landscape and structure of research on education for sustainable development: A bibliometric review," *Sustain.*, vol. 12, no. 5, pp. 1–16, 2020, doi: 10.3390/su12051947.
- [28] R. Julius *et al.*, "Bibliometric Analysis of Research in Mathematics Education using Scopus Database," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 17, no. 12, 2021, doi: 10.29333/EJMSTE/11329.
- [29] E. Lozada, C. Guerrero-Ortiz, A. Coronel, and R. Medina, "Classroom methodologies for teaching and learning ordinary differential equations: A systemic literature review and bibliometric analysis," *Mathematics*, vol. 9, no. 7, 2021, doi: 10.3390/math9070745.
- [30] R. Supinah and J. Soebagyo, "Analisis Bibliometrik Terhadap Tren Penggunaan ICT Pada Pembelajaran Matematika," *JNPM (Jurnal Nas. Pendidik. Mat.)*, vol. 6, no. 2, p. 276, 2022, doi: 10.33603/jnpm.v6i2.6153.
- [31] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *J. Bus. Res.*, vol. 133, no. April, pp. 285–296, 2021, doi: 10.1016/j.jbusres.2021.04.070.
- [32] A. Özkaya, "Bibliometric analysis of the studies in the field of mathematics education," *Educ. Res. Rev.*, vol. 13, no. 22, pp. 723–734, 2018, doi: 10.5897/err2018.3603.

- [33] I. Zupic and T. Čater, "Bibliometric Methods in Management and Organization," *Organ. Res. Methods*, vol. 18, no. 3, pp. 429–472, 2015, doi: 10.1177/1094428114562629.
- [34] A. Schleicher, "The impact of Covid-19 on Education Insights From Education At a Glance 2020," 2020.
- [35] M. Tamur, E. Jehadus, H. R. P. Negara, M. D. Siagian, M. Marzuki, and R. Sulastri, "Pembelajaran Selama Krisis COVID - 19 : Meta - Analisis dari Sudut Hasil Belajar yang Diukur," *J. Ris. Teknol. dan Inov. Pendidik.*, vol. 4, no. 1, pp. 101–108, 2021, doi: 10.36765/jartika.v4i1.413.
- [36] M. Ali, M. Allihyani, A. Abdulaziz, S. Alansari, S. Faqeh, and A. Kurdi, "What just happened ? Impact of on-campus activities suspension on pharmacy education during COVID-19 lockdown – A students ' perspective," *Saudi Pharm. J.*, vol. 29, no. 1, pp. 59–66, 2021, doi: 10.1016/j.jsps.2020.12.008.