Trends and implications of ICT-Based Ethnomathematics Studies: Bibliometric Analysis

Gregoria W. Komaladewi[1]*, Maria S. Nderu[2], Avelina Yasinta[3],
Maria Anjalina Kurniyati[4], Krista Irna Utami[5], Maximus Tamur[6]
{ wiwin081251@gmail.com, roinnderu@gmail.com}

[1-6]Program Studi Pendidikan Matematika, Universitas Katolik Indonesia, Ruteng, Indonesia

Abstract. Learning that uses local content in various fields and considers the help of technology has become the best choice lately. However, more information in the literature still needs to be available to explain the trends and application of local content used in learning. This bibliometric study specifically presents research trends in ethnomathematics that help ICT in learning. 128 of 278 data were deemed appropriate and identified from online databases using the perish or parish (PoP) application. The analysis results show that research related to ethnomathematics is progressing by involving the use of ICT media, identification of regional culture and traditional houses, and community activities linked to technology. However, only some have considered sophisticated media, such as augmented reality. The effectiveness of ethnomathematics is also associated with various mathematical abilities, but there is still little research on meta-cognition. This gap is a gap to be filled in further research.

Keywords: Ethnomathematics, Information and Communication Technology, Bibliometric Analysis.

1 Introduction

Integrating ethnomathematics as part of a didactic framework in mathematics learning has recently become a recommended option [1]–[3]. Applying ethnomathematics is an important part of getting closer to students and their inherited culture so that it can be passed on to the next generation [4]–[6]. Combining ethnomathematics as local wisdom in learning will increase student interest, motivation, and learning outcomes [7]–[9]. Because of these advantages, the integration of ethnomathematics has been widely carried out by various countries, including Indonesia.

Ethnomathematics integration is also associated with combining various media in learning. However, the role of media mediated by the development of information and communication technology (ICT) has supported the implementation of ethnomathematics in learning [10]–[13]. This fact has encouraged a flurry of studies highlighting the effectiveness, development, and testing of teaching materials or didactic frameworks supported by the integration of ethnomathematics and ICT (e.g., [14], [15]).

Previous research has left gaps to be filled for further investigation. Scientific weaknesses must be addressed to contribute to scholarship on this topic. These gaps include the need to conduct a comprehensive review study on the application of ethnomathematics in learning. To fill this gap, several meta-analyses and bibliometric studies, as well as systematic reviews of

literature, have been carried out related to the topic of ethnomathematics (e.g., [1], [3], [16]–[18]). However, until now, not many have continued this research and considered ICT variables in ethnomathematics studies. However, this needs to be done to complement previous studies and benefit literature and scientific developments.

This study focuses on filling the previous gap by considering ICT variables, which limit the review to ethnomathematics studies. The results of this research will provide practical and useful information for teachers, lecturers, students, researchers, and other related parties who will specifically consider using ICT in the future to implement ethnomathematics. Thus, this research aims to describe trends in studies of ICT-based ethnomathematics. This study also provides an overview of important topics or themes that have been researched but still escape attention. Based on these objectives, the focus of this research is to answer two core problem formulations: First, what are the trends from year to year in the implementation of studies on ICT-based ethnomathematics? and what important themes often emerge and which are still rarely researched? These two core questions provide answers that can be considered important implications for the future when applying ICT-supported ethnomathematics.

2   Method

This work uses a bibliometric analysis approach, namely statistical and mathematical procedures, that can simultaneously describe the themes and characteristics of various articles [19]. This research uses the PoP application to collect data from online databases. The database chosen was Goggle Scholar because of its wide coverage [20]. Figure 1 shows searching for articles from the Google Scholar database using PoP.

Fig. 1. PoP Application

Based on the search process, 278 articles were obtained that were related to the ethnomathematics theme. Articles that meet the analysis requirements contain ICT-based ethnomathematics themes between 2010 and 2023. Regarding the inclusion requirements, 128 studies meet the analysis requirements. These articles are then collected and analyzed using the VosViewer application. This application specifically helps map networks between themes so that they can be interpreted according to research objectives and problems.

3 Results and Discussion

This research was carried out with two main objectives: to obtain an overview of trends from studies on ICT-based ethnomathematics and to identify important topics that are often written about or studied and that still escape attention. Figure 2 includes a trend analysis of studies on ICT-based ethnomathematics between 2010 and 2023.
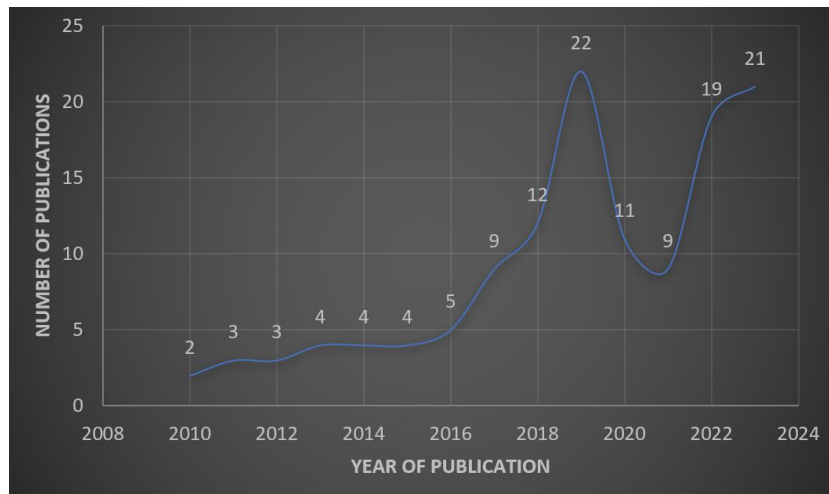
Fig. 2. Number of publications between 2010-2023 (N = 128)

Based on Figure 2, it is clear that the number of publications between 2010 and 2019 experienced a sharp increase. Meanwhile, the trend from the study decreased from 2019 to 2021. However, it increased again from 2022 to 2023.

Furthermore, important themes that have been extensively researched can be seen from mapping analysis results between topics exported from the Vosviewer application. Figure 3 below presents the results of the analysis.
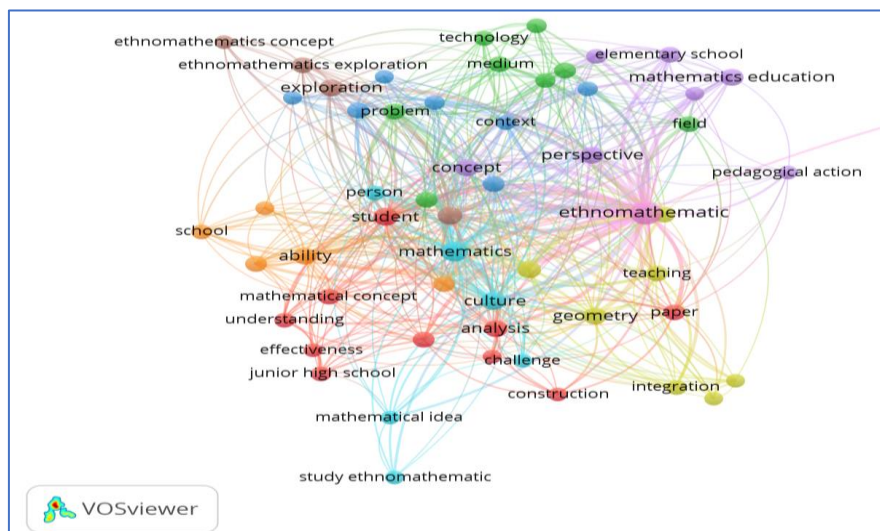
Fig. 3. Mapping Analysis

When Figure 3 is examined, it can be seen that the results of mapping between themes using the VosViewer application produce color variations representing 9 clusters. Cluster 1 includes geogebra as the main theme. Cluster 2 is represented by the theme of technology applications as the main topic and is associated with friends relevant to ethnomathematics. Cluster 3 contains the theme of the art, associated with seven items and connected to ethnomathematics. Clusters 4 to 9 also contain important themes related to technology, ethnomathematics, exploration, mathematical ideas, realistic mathematics, culture, literacy, systematic literature review, concepts, and context. Meanwhile, topics that should be researched are related to meta-cognition and augmented reality media.

The research results show that the number of publications between 2010-2019 is very significant. This is in line with the results of bibliometric analysis from previous studies, which showed an increasing trend until 2019 [1], [3], [21]–[23]. Furthermore, the downward trend from 2019 to 2021 was mediated by the impact of COVID-19, as seen from the results of previous research in 2019 [21]. This makes perfect sense because, during COVID-19, little research was carried out due to social restriction policies [24], [25].

As shown in Figure 2 above, the trend in the application of ICT-based ethnomathematics will continue to increase in the following year. This is in line with educational policies and measures of learning quality, namely making the environment and technological media a learning resource [26]–[39]. The use of technology helps students to understand concepts, supports their mathematical literacy, and helps them understand mathematics meaningfully [13], [26], [40].

Finally, when Figure 3 is examined, important topics are seen that are associated with ICT support, culture, and ethnomathematics on students' mathematical abilities. Interestingly, the abilities measured from previous main studies are related to students' mathematical literacy. It is clear that the application of ethnomathematics can support students' alliteration because the context used can stimulate their understanding [12], [41]–[44]. However, this research is still limited because the number of articles reviewed is still small. This cannot be separated from the consequences of closed access that still apply to several databases. Further efforts need to be made to produce trends that can provide added value regarding ethnomathematics practice and ICT support in the future.

4 Conclusion

First, this research produces information about learning trends that use an ethnomathematics framework and ICT support. The trend is increasing and is used as an indicator of learning quality. Second, various important topics have been studied, providing unique ethnomathematics and ICT boundaries. Then, topics rarely researched are also explained, such as how the application of ethnomathematics framed by augmented reality media will be a priority for future research. Apart from that, only one meta-cognitive theme emerged in the mapping. Further studies on metacognition and problem-solving abilities need to be prioritized to measure the effectiveness of ethnomathematics with ICT support, including augmented reality.

References

[1]   M. Tamur, T. Wijaya, A. Nurjaman, M. Siagian, and K. Perbowo, "Ethnomathematical Studies in the Scopus Database Between 2010-2022: A Bibliometric Review," in *The Third International Conference on Education, Humanities, Health and Agriculture (3rd ICEHHA)*, 2023. doi: 10.4108/eai.21-10-2022.2329666.

[2] M. Tamur, E. Sennen, and K. V Pantaleon, "Etnomatematika Daerah Manggarai Flores-Ntt Dalam Tradisi Belis Dan Pengukuran," in *Seminar Nasional Matematika dan Pendidikan Matematika*, 2017, pp. 15–21.

[3] Y. N. Deda, H. Disnawati, M. Tamur, and M. Rosa, "Global Trend of Ethnomathematics Studies of The Last Decade: A Bibliometric Analysis," *Infin. J.*, vol. 13, no. 1, pp. 233–250, 2024, doi: 10.22460/infinity.v13i1.p233-250.

[4] N. Nurjanah, I. Mardia, and T. Turmudi, "Ethnomathematics study of Minangkabau tribe: formulation of mathematical representation in the Marosok traditional trading," *Ethnogr. Educ.*, vol. 16, no. 4, pp. 437–456, 2021, doi: 10.1080/17457823.2021.1952636.

[5] N. Faiziyah, "Ethnomathematics: Mathematics in Batik Solo," *Journal of Physics: Conference Series*, vol. 1720, no. 1. 2021. doi: 10.1088/1742-6596/1720/1/012013.

[6] S. Supriadi, "Didactic design of sundanese ethnomathematics learning for primary school students," *Int. J. Learn. Teach. Educ. Res.*, vol. 18, no. 11, pp. 154–175, 2019, doi: 10.26803/ijlter.18.11.9.

[7] R. Rahayu, "Collaborative assessment using QR-code on ethnomathematics learning for pre-service teacher," *Int. J. Eng. Technol.*, vol. 7, no. 2, pp. 413–417, 2018, doi: 10.14419/ijet.v7i3.2.14563.

[8] H. Setiawan, "The Development of Geometrical Learning Devices Based on Rumah Gadang Ethnomathematics for Grade VII Junior High School," *Journal of Physics: Conference Series*, vol. 1742, no. 1. 2021. doi: 10.1088/1742-6596/1742/1/012003.

[9] M. Lakapu *et al.*, "Workshop Pengembangan Perangkat Pembelajaran Berbasis Etnomatematika Untuk Mgmp Matematika SMP Kabupaten Manggarai," *J. Abdimas Ilm. Citra Bakti*, vol. 4, no. 3, pp. 388–399, 2023, doi: 10.38048/jailcb.v4i3.1693.

[10] F. Nursyahidah and I. U. Albab, "Learning Design on Surface Area and Volume of Cylinder Using Indonesian Ethno-mathematics of Traditional Cookie maker Assisted by GeoGebra," *Math. Teaching-Research J.*, vol. 13, no. 4, pp. 79–98, 2021.

[11] M. Tamur *et al.*, "Pendampingan Guru Matematika Pada Kelompok Sinar Harapan Dalam Menggunakan Geogebra Terintegrasi Kearifan Lokal," *JMM (Jurnal Masy. Mandiri)*, vol. 6, no. 6, p. 4943, 2022, doi: 10.31764/jmm.v6i6.11291.

[12] 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.

[13] M. Tamur *et al.*, "Pengembangan E -Modul Matematika Interaktif Terintegrasi Kahoot ! untuk Mendukung Literasi Matematis Siswa SMP," vol. 9, no. 2, pp. 135–144, 2023.

[14] I. Yuliantari, "Penerapan Penggunaan Media Pembelajaran Software Geogebra Flash Berbasis Etnomatematika Sunda terhadap Kemampuan Berpikir Kreatif Matematik Siswa Sekolah Dasar," Universitas Pendidikan Indonesia., 2017.

[15] R. Ramadhani, E. Syahputra, and E. Simamora, "Ethnomathematics approach integrated flipped classroom model: Culturally contextualized meaningful learning and flexibility," *J. Elem.*, vol. 9, no. 2, pp. 371–387, 2023, doi: 10.29408/jel.v9i2.7871.

[16] 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.

[17] M. Tamur, V. S. Kurnila, E. Jehadus, and S. Ndiung, "Learning from the Past : Meta-Analysis of Contextual Teaching-Learning of the Past Decade," vol. 4, no. 1, pp. 1–10,

2021.

[18] M. Tamur, D. Juandi, and A. M. G. Adem, "Realistic Mathematics Education in Indonesia and Recommendations for Future Implementation : A Meta-Analysis Study," *J. Teor. dan Apl. Mat.*, vol. 4, no. 1, pp. 17–27, 2020, doi: 10.31764/jtam.v4i1.1786.

[19] 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.

[20] P. Hallinger and C. Chatpinyakoop, "A bibliometric review of research on higher education for sustainable development, 1998-2018," *Sustain.*, vol. 11, no. 8, 2019, doi: 10.3390/su11082401.

[21] M. Tamur, L. L. Jedia, R. Kurniyati, and M. A. Banggut, "Analisis Bibliometrik Penggunaan Geogebra dalam Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Dekade Terakhir," *Suska J. Math. Educ.*, vol. 8, no. 2, pp. 75–86, 2022, doi: 10.24014/sjme.v8i2.19868.

[22] M. Tamur, F. E. Men, K. E. Ermi, A. M. Muhut, R. Nunang, and O. A. Lay, "Penggunaan ICT dan Pengaruhnya terhadap Kemampuan Penalaran Matematis Siswa: Sebuah Analisis Bibliometrik," *Juring (Journal Res. Math. Learn.*, vol. 5, no. 4, p. 261, 2022, doi: 10.24014/juring.v5i4.19991.

[23] M. Tamur, A. Nurjaman, and M. Marzuki, "Analisis Bibliometrik Tren Riset Global Tentang Penerapan Software Matematika Menggunakan Basis Data Scopus," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 12, no. 3, p. 3025, 2023, doi: 10.24127/ajpm.v12i3.7347.

[24] 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.

[25] M. Tamur, S. Ndiung, R. Weinhandl, T. T. Wijaya, E. Jehadus, and E. Sennen, "Meta-Analysis of Computer-Based Mathematics Learning in the Last Decade Scopus Database: Trends and Implications," *Infin. J.*, vol. 12, no. 1, p. 101, 2023, doi: 10.22460/infinity.v12i1.p101-116.

[26] M. Tamur *et al.*, *Pembelajaran Bangun Ruang di SMP Berbasis Cabri 3D*. Ruteng: UNIKA Santu Paulus Ruteng, 2021.

[27] 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.

[28] M. Tamur, D. Juandi, and Subaryo, "A meta-analysis of the implementation of the gamification approach of the last decade," *AIP Conf. Proc.*, vol. 090002, no. 1, pp. 1–7, 2023, doi: 10.1063/5.0155519.

[29] D. Juandi, M. Tamur, and Suparman, "Formulating Best Practices for Digital Game-Based Learning: A Meta-analysis study," *AIP Conf. Proc.*, vol. 090003, no. 1, pp. 1–7, 2023, doi: 10.1063/5.0155520.

[30] T. T. Wijaya, Y. Cao, R. Weinhandl, and M. Tamur, "A meta-analysis of the effects of E-books on students' mathematics achievement," *Heliyon*, vol. 8, no. 6, p. e09432, 2022, doi: 10.1016/j.heliyon.2022.e09432.

[31] Nurjanah, B. Latif, R. Yuliardi, and M. Tamur, "Computer-assisted learning using the Cabri 3D for improving spatial ability and self- regulated learning," *Heliyon*, vol. 6, no. 11, p. e05536, 2020, doi: 10.1016/j.heliyon.2020.e05536.

[32] N. Hermita *et al.*, "The Hungry Ant : Development of Video-Based Learning on

Polyhedron," *Int. J. Interact. Mob. Technol.*, vol. 15, no. 17, pp. 18–32, 2021, doi: 10.3991/ijim.v15i17.23099 Neni.

[33]   J. Pereira, J. Tang, S. Tan, T. T. Wijaya, M. Tamur, and H. Neni, "Analysis of students ' mathematical problem solving ability : Arithmetic operation cases at Filial Baduro elementary school Timor Leste," in *The 4th International Conference on Science and Science Education (IConSSE 2021)*, AIP Conference Proceedings, 2022, pp. 1–6. doi: 10.1063/5.0103492.

[34]   M. Tamur, Y. S. Kusumah, D. Juandi, T. T. Wijaya, A. Nurjaman, and A. O. Samura, "Hawthorne effect and mathematical software based learning: A meta- analysis study," *J. Phys. Conf. Ser.*, vol. 1806, no. 1, p. 012072, 2021, doi: 10.1088/1742-6596/1806/1/012072.

[35]   M. Tamur, D. Juandi, and Y. S. Kusumah, "The Effectiveness of the Application of Mathematical Software in Indonesia; A Meta-Analysis Study," *Int. J. Instr.*, vol. 13, no. 4, pp. 867–884, 2020, doi: 10.29333/iji.2020.13453a.

[36]   M. Tamur and D. Juandi, "Effectiveness of Constructivism Based Learning Models Against Students Mathematical Creative Thinking Abilities in Indonesia: A Meta-Analysis Study," *Pervasive Heal. Pervasive Comput. Technol. Healthc.*, no. 1, pp. 107–114, 2020, doi: 10.4108/eai.12-10-2019.2296507.

[37]   M. Tamur, A. Gahung, M. A. L. Belos, M. Limur, D. F. Sutrani, and Y. E. W. Lagam, "Bermain dan Belajar dengan Kahoot!: Meningkatkan Keterlibatan Siswa SMP Menggunakan GAME Digital," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 11, no. 4, pp. 2857–2865, 2022, doi: 10.24127/ajpm.v11i4.6065.

[38]   M. Tamur, S. Fedi, E. Sennen, Marzuki, A. Nurjaman, and S. Ndiung, "A meta-analysis of the last decade STEM implementation : what to learn and where to go," *J. Phys. Conf. Ser.*, vol. 1882, no. 1, p. 012082, 2021, doi: 10.1088/1742-6596/1882/1/012082.

[39]   M. F. B. Paloloang, D. Juandi, M. Tamur, B. Paloloang, and A. M. G. Adem, "Meta Analisis: Pengaruh Problem-Based Learning Terhadap Kemampuan Literasi Matematis Siswa Di Indonesia Tujuh Tahun Terakhir," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 9, no. 4, pp. 851–864, 2020, doi: 10.24127/ajpm.v9i4.3049.

[40]   M. Tamur, E. Sennen, and F. E. Men, *Konsep Dasar Matematika Berbasis CAS dan DGS*. STKIP St. Paulus Ruteng, 2018.

[41]   O. O. de Paiva, "Ethnomathematics: An experience in the rural family home in Breves/PA," *Margens*, vol. 15, no. 24, pp. 237–252, 2021, doi: 10.18542/rmi.v15i24.10057.

[42]   M. Balamurugan, "Etnomathematics; An Approach For Learning Mathematics From Multikultural Perspective," *Int. J. Mod. Res. Rev.*, vol. 3, no. 6, pp. 716–720, 2015.

[43]   M. A. Rudhito, "Development of open online ethnomathematics course," *Journal of Physics: Conference Series*, vol. 1470, no. 1. 2020. doi: 10.1088/1742-6596/1470/1/012057.

[44]   A. Brandt and E. Chernoff, "The Importance of Ethnomathematics in the Math Class," *Ohio J. Sch. Math.*, no. 71, pp. 31–36, 2015.