Suska Journal of Mathematics Education
(p-ISSN: 2477-4758|e-ISSN: 2540-9670)
Volume 11, Issue 2, 2025, page 141-150

Augmented Reality as a Bridge between Culture and Technology in Mathematics Education: A Meta-Analysis

Maximus Tamur[1]*, Eliterius Sennen[2], Princess De Guzman[3]

[1]*Program Studi Pendidikan Matematika, Universitas Katolik Indonesia Santu Paulus Ruteng, Indonesia*
[2]*Program Pendidikan Profesi Guru, Universitas Katolik Indonesia Santu Paulus Ruteng, Indonesia*
[3]*Southern Luzon State University - Main Campus, Philippines*
e-mail: maximustamur@gmail.com

ABSTRACT. The rapid development of Augmented Reality (AR) in education has created new possibilities for connecting cultural heritage with technological innovation, particularly through an ethnomathematics approach to mathematics learning. This study provides novelty by offering a comprehensive meta-analysis investigating how sample size and subject matter moderate the effectiveness of AR-based ethnomathematics in improving mathematics education outcomes. Fifteen relevant empirical studies published between 2015 and 2025 were systematically identified through leading academic databases, and effect sizes were synthesized using a random-effects model. A rigorous coding process and statistical analysis were used to ensure the reliability and validity of the findings. The results indicate that AR significantly improves students' mathematical abilities, with variations depending on the subject matter. Furthermore, subject matter was found to be an important moderating variable, influencing the extent to which AR supports the integration of cultural and technological dimensions in mathematics education. These findings recommend that future research consider pedagogical design, cultural context, and technological adaptability when implementing AR-based ethnomathematics to optimize learning outcomes.

Keywords: augmented reality; ethnomathematics; mathematics education; meta-analysis; sample size; subject matter

ABSTRAK. Perkembangan pesat *Augmented Reality* (AR) dalam pendidikan telah menciptakan kemungkinan baru untuk menghubungkan warisan budaya dengan inovasi teknologi, khususnya melalui pendekatan etnomatematika dalam pembelajaran matematika. Studi ini memberikan kebaruan dengan menawarkan meta-analisis komprehensif yang menyelidiki bagaimana ukuran sampel dan materi pelajaran memoderasi efektivitas etnomatematika berbasis AR dalam meningkatkan hasil pendidikan matematika. Lima belas studi empiris relevan yang diterbitkan antara tahun 2015 dan 2025 diidentifikasi secara sistematis melalui basis data akademik terkemuka, dan ukuran efek disintesis menggunakan model efek acak. Proses pengkodean yang ketat dan analisis statistik digunakan untuk memastikan keandalan dan validitas temuan. Hasil menunjukkan bahwa AR secara signifikan meningkatkan kemampuan matematika siswa, dengan variasi tergantung pada materi pelajaran. Lebih lanjut, materi pelajaran ditemukan sebagai variabel moderasi penting, yang memengaruhi sejauh mana AR mendukung integrasi dimensi budaya dan teknologi dalam pendidikan matematika. Temuan ini merekomendasikan bahwa penelitian masa depan harus mempertimbangkan desain pedagogis, konteks budaya, dan kemampuan adaptasi teknologi ketika menerapkan etnomatematika berbasis AR untuk mengoptimalkan hasil pembelajaran.

Kata kunci: *augmented reality*; etnomatematika; meta-analisis; pendidikan matematika, pokok bahasan; ukuran sampel

INTRODUCTION

The rapid advancement of digital technology has transformed the educational landscape worldwide, offering new tools to enhance teaching and learning. Among these innovations,

DOI:http://dx.doi.org/10.24014/sjme.v11i2.38044

Augmented Reality (AR) has emerged as a transformative medium that combines virtual and real-world experiences in a dynamic learning environment (Maharbid et al., 2025; Tamur, 2023; Tamur et al., 2025). In mathematics education, AR allows learners to visualize abstract concepts more concretely, making the material more engaging and accessible. This growing trend signals a significant shift toward technology-based learning, where cultural relevance and technological innovation must coexist harmoniously.

While technology provides new opportunities, mathematics education is also deeply embedded in cultural contexts. Ethnomathematics, as a field of study, highlights the ways in which mathematical ideas are practiced, expressed, and understood across diverse cultural traditions (Ayu et al., 2023; Suherman & Vidákovich, 2024). Integrating ethnomathematics into mathematics education allows learners to connect abstract concepts with their cultural identities, fostering inclusivity and relevance in the learning process (Annisa et al., 2023; Rahmadani et al., 2023). Thus, bridging technology and culture has become both a major challenge and opportunity in today's educational landscape. Augmented Reality has unique potential to bridge cultural heritage and technological advancements in mathematics education (Tamur, Pantaleon, et al., 2023, 2024; Tamur, Wibisono, et al., 2024). By embedding cultural artifacts, symbols, and practices into AR-based learning activities, educators can contextualize mathematical content in ways that align with students' lived experiences (Tamur, 2023; Wangid et al., 2020). This approach not only enriches conceptual understanding but also fosters greater motivation and engagement among learners (Zainovi et al., 2025). Thus, AR-based ethnomathematics has the potential to transform mathematics education into a culturally meaningful and technologically advanced experience.

Although numerous studies have reported the benefits of AR and ethnomathematics, findings across studies remain fragmented and sometimes inconsistent. Differences in research design, sample characteristics, and subject domains often lead to variations in reported outcomes. Furthermore, educators and other stakeholders need robust information to determine the best conditions for integrating AR-supported ethnomathematics. Meta-analysis provides a robust methodological approach to systematically synthesize these findings, offering more reliable conclusions about the effectiveness of AR-based ethnomathematics in mathematics education (Juandi & Tamur, 2020; Yohannes et al., 2021). By statistically aggregating data, meta-analysis also allows for the exploration of moderating variables that might explain variation in effect sizes. Sample size has long been recognized as a critical factor influencing the robustness and generalizability of research findings. In the context of AR-based ethnomathematics studies, variations in sample size can influence the magnitude of observed effects, potentially leading to overestimation or underestimation of the impact of AR. Therefore, examining sample size as a moderator is crucial to ensure that conclusions drawn from the literature are reliable and representative. Understanding this aspect contributes to deeper methodological insights into the effectiveness of AR interventions.

Another important factor influencing the outcomes of AR-based ethnomathematics is the specific subject matter being taught. Mathematics comprises diverse domains such as geometry, algebra, statistics, and problem-solving, each with distinct cognitive demands and learning challenges. AR may enhance certain areas, such as spatial reasoning in geometry, more effectively than others. By examining subject matter as a moderator, this study identifies which mathematical domains benefit most from AR-based ethnomathematics, providing more nuanced and practical implications for educators. With these considerations in mind, this study conducted a meta-analysis to evaluate the overall effectiveness of AR-based ethnomathematics in mathematics education, with particular attention to sample size and subject matter as moderators. The findings aim to provide comprehensive insights into how AR can bridge culture and technology while supporting mathematical achievement across contexts. By clarifying the conditions under which AR-based ethnomathematics is most effective, this study advances theoretical understanding and practical applications in mathematics education. Ultimately, this research contributes to shaping future pedagogical strategies that are culturally responsive, technologically innovative, and empirically grounded.

METHOD

Research Design

This study uses a meta-analysis research design to synthesize empirical findings regarding the effectiveness of Augmented Reality (AR)-based ethnomathematics in mathematics education. Meta-analysis was chosen because it allows for the systematic integration of quantitative results from multiple independent studies, resulting in more reliable and generalizable conclusions. This study adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological rigor and transparency.

Data Sources and Search Strategy

Relevant empirical studies were systematically collected from leading academic databases, including Scopus, Web of Science, ERIC, ScienceDirect, and Google Scholar. The search was limited to articles published between 2010 and 2025 to capture the latest developments in AR-based mathematics education. Keywords such as "augmented reality", "ethnomathematics", "mathematics education", and "student achievement" were combined with Boolean operators to narrow the search. A manual search of the reference lists of relevant articles was also conducted to ensure completeness.

Inclusion and Exclusion Criteria

Studies were considered for inclusion if they met the following criteria: (a) investigated AR-based interventions in mathematics education, (b) incorporated ethnomathematics or culturally contextualized mathematics learning approaches, (c) reported sufficient statistical information (e.g., mean, standard deviation, effect size) to calculate standardized mean differences, and (d) were published in peer-reviewed journals or conference proceedings. Excluded studies consisted of theoretical papers, reviews, case studies without control groups, and articles lacking sufficient quantitative data for effect size calculations.

Coding Procedure

Each eligible study was coded independently by two researchers to minimize bias and ensure consistency. Coding categories included publication year, sample size, educational level, country of study, subject matter type (e.g., geometry, algebra, problem-solving), study design, and statistical outcomes. Any discrepancies in coding were resolved through discussion and consensus, and inter-rater reliability was calculated to ensure consistency in data extraction.

Data analysis

Effect sizes were calculated using Hedges' g and standardized to ensure comparability across studies. When studies reported multiple outcomes, effect sizes were averaged to avoid violating the assumption of independence. A random-effects model was applied because it accounts for within-study sampling error and inter-study variability, making it suitable for heterogeneous educational research. Publication bias was assessed using funnel plots and Egger's regression test, while sensitivity analyses were conducted to evaluate the robustness of the results.

Moderator Analysis

To examine factors influencing the variability in AR effectiveness, moderator analyses were conducted. Sample sizes were categorized into small, medium, and large groups to evaluate their moderating role in the distribution of effect sizes. Subject matter was coded by mathematics

domain (e.g., geometry, algebra, statistics, problem-solving) to determine which content areas benefited most from AR-based ethnomathematics. Subgroup analyses and meta-regression techniques were used to test the significance of moderator effects.

RESULTS AND DISCUSSION

Results

In this study, fifteen empirical studies met the inclusion criteria. The studies included in the analysis are presented in Table 1 below.

Table 1. Studies Included in the Analysis

Author, year	Sample Size	Subjeck matter
(Apricillia et al., 2024)	Less than 31	Numeracy
(Himayati et al., 2024)	More than 30	Literacy
(Arifin & Efriani, 2025)	Less than 31	Geometry
(Dewi et al., 2024)	Less than 31	Geometry
(Jampel & Antara, 2025)	Less than 31	Geometry
(Nurhasanah et al., 2023)	Less than 31	Geometry
(Muwahiddah et al., 2021)	Less than 31	Geometry
(Nugroho et al., 2024)	Less than 31	Numeracy
(Pasaribu et al., 2024)	Less than 31	Geometry
(Pramulia et al., 2025)	Less than 31	Geometry
(Rahayu et al., 2025)	More than 30	Geometry
(Richardo et al., 2023)	More than 30	Numeracy
(Siregar et al., 2025)	More than 30	Geometry
(Susanto et al., 2025)	More than 30	Geometry
(Gusteti et al., 2025)	Less than 31	Numeracy

Table 1 shows that sample sizes and subject matter vary across studies. Based on an analysis of the 15 studies listed in the table, the majority (10 studies) used sample sizes of fewer than 31 respondents. This analysis indicates a strong tendency to use small-scale research designs, which are generally aligned with qualitative approaches, exploratory studies, or classroom-based research. Only five studies included samples larger than 30 respondents, indicating that the generalizability of their findings remains a common limitation. This pattern suggests the need for further research with a broader sample size to strengthen the external validity of the results.

In terms of subject matter, geometry dominated the research focus, with nine studies, far surpassing numeracy (4 studies) and literacy (1 study). The dominance of geometry, particularly in studies with small samples, indicates that this topic is considered complex and rich in cognitive processes, often studied in depth through qualitative approaches or case studies. Conversely, the lack of research on literacy, especially with large samples, indicates a significant research gap. This finding opens up opportunities for future research, particularly in literacy and numeracy, using quantitative or mixed-methods research designs involving larger numbers of participants.

Furthermore, the overall analysis using the CMA program yields a forest plot of the study, as shown in Figure 1 below.

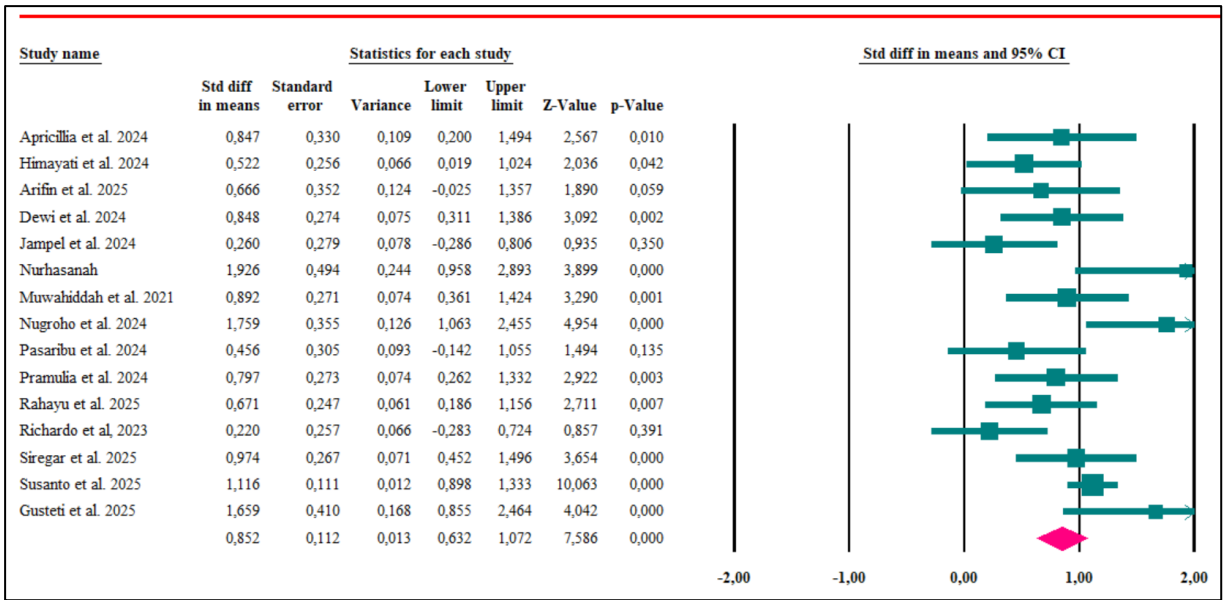

Figure 1. Research Forest Plot

Based on Figure 2, the horizontal line (confidence interval, 95% CI) for each study is not the same, indicating the uncertainty range of the estimate. The size of the rectangular area indicating the effect size of each study varies. It is also seen that three studies crossed the 0 line, indicating that the study effect was less significant. Meanwhile, the other twelve crossed the 0 line, indicating the superiority of the AR-based ethnomathematics model. Descriptively, this position has shown variation in results between the main studies. The diamond model describes the combined effect size of all studies, which is close to one.

The results of the analysis of all studies are presented in Table 2 below.

Table 2. Results Summary of Data Analysis Results

Model		Hedges's g	Standard error	Test of null		Heterogeneity	
				Z-value	P-value	Q	P
Fixed-effects	15	0.87	0.06	13.29	0.00	35.47	0.00
Random-effects	15	0.85	0.01	7.24	0.00		

Based on Table 2, the estimated model fits the assumed random effects model ($Q=35.47$; $P<0.05$). The random effects model shows a significant positive effect of AR-based ethnomathematics on students' mathematical abilities, with an overall effect size of $g = 0.85$ (95% CL = 0.63–1.07, $p<0.00$). These values indicate a moderate to large impact of AR in bridging the cultural and technological dimensions of mathematics learning. Furthermore, an examination of the funnel plot was conducted to ensure that the combined effect size was resistant to publication bias. Figure 2 presents the funnel plot of the study.

The funnel diagram analysis, as presented in Figure 2, showed no significant asymmetry, and Egger's regression test yielded a p-value of $0.335 > 0.05$, indicating minimal publication bias.

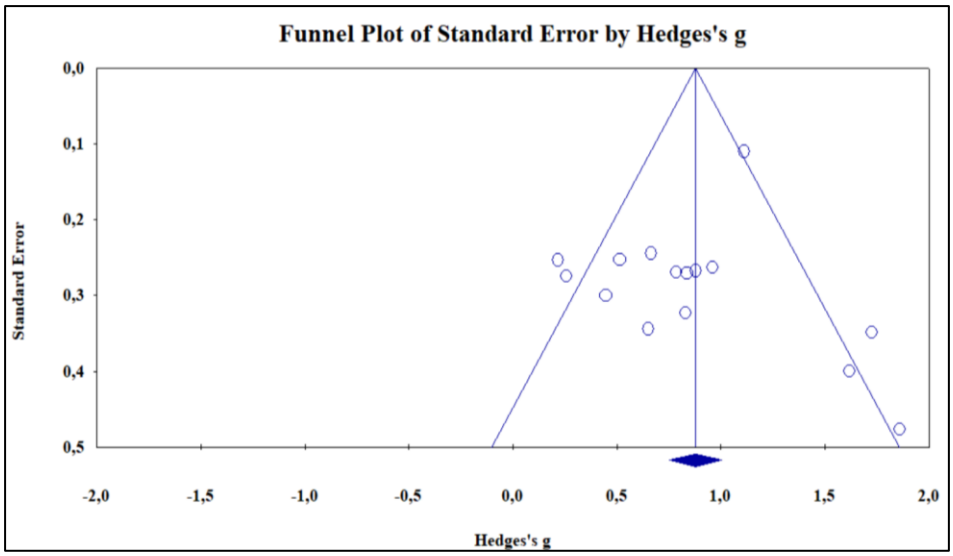

Figure 2. Research Funnel Plot

This study considered sample size and subject matter as moderators. Because the heterogeneity test was accepted, further examination of moderator variables that may be associated with the overall pooled effect size of the study should be continued. Table 3 shows the results of the moderator analysis.

Table 3. Results of the Research Moderator Analysis

Moderator Variables	Category	N	Hedge's g	Heterogeneity (Qb)	df(Q)	P
Sample Size	Less than 31	10	0.86	0.022	1	0.88
	More than 30	5	0.88			
Subject Matter	Numeracy	4	0.59	17.34	2	0.01
	Literacy	1	0.65			
	Geometry	10	0.93			

Examining Table 3, the sample size is unrelated to study effect sizes. Variation in results between primary studies was unaffected by sample size (Qb=0.022; P>0.05). Subject matter variables, on the other hand, were related to the combined effect size of all studies (Qb=17.34; P<0.05). In other words, one reason for the differences in effect sizes between primary studies is due to differences in subject matter. The AR-based ethnomathematics intervention was most effective in geometry (g=0.93), followed by literacy (g=0.65), and numeracy (g=0.59).

The results showed a combined effect size of 0.85 across all studies, which is considered a large effect size (Cohen et al., 2018). This finding is more significant than previous meta-analyses, where AR's effect was moderate in improving mathematical abilities (Cui, 2020; Tamur, Wijaya, et al., 2024; Tamur et al., 2025). However, the novelty of this meta-analysis lies in its specific focus on ethnomathematics as a cultural framework integrated with AR, which has rarely been systematically studied. While previous reviews have emphasized the general effectiveness of AR (for example, Lin & Yu, 2023; Tamur et al., 2025; Tamur, Komaladewi, et al., 2024; Yilmaz & Batdi, 2021), this study uniquely demonstrates how AR can serve as a bridge between culture and technology in mathematics learning. By highlighting moderator effects, this study also offers more nuanced insights than previous reviews, thus advancing theoretical and practical understanding of AR-based ethnomathematics.

Moderator analysis revealed that sample size did not significantly affect the magnitude of the effect size. Although results from previous studies have shown that smaller studies tend to report stronger effects (e.g., Juandi et al., 2022; Tamur, 2021; Tamur et al., 2020, 2021; Tamur, Ndiung,

et al., 2023)), this study showed different results, where sample size did not moderate the effect size. This clearly demonstrates students' independence and freedom to access technology without being limited by space and time (Gusteti et al., 2025; Kyeremeh et al., 2023; Wulandari et al., 2024; Zhengtao & Hidayat, 2025).

In contrast, the subject matter in this study played a crucial role in determining the effectiveness of AR. Geometry showed the largest effect size, consistent with AR's ability to support spatial visualization and interactive object manipulation. This is logical because geometry is associated with visual-spatial exploration, which AR can easily demonstrate in real time (Ahdhianto et al., 2025; Anesti & Irwanto, 2025; Sunzuma & Maharaj, 2019; Tamur, Juandi, et al., 2023; Tamur, Wibisono, et al., 2024; Zhengtao & Hidayat, 2025). The relatively smaller effect observed in statistics suggests AR's limitations in domains where conceptual reasoning and data interpretation are less reliant on visual-spatial support. These results suggest that educators should strategically target the mathematics domain where the integration of AR and ethnomathematics can yield the greatest learning benefits.

CONCLUSION

This meta-analysis provides strong evidence that Augmented Reality (AR) integrated with ethnomathematics significantly improves students' mathematical abilities. By synthesizing findings from 15 empirical studies, the analysis demonstrates that AR serves as an effective bridge between cultural context and technological innovation in mathematics education. The study further highlights the role of subject matter as an important moderator of AR effectiveness. AR-based ethnomathematics proved particularly effective in geometry, followed by literacy and numeracy, highlighting that mathematical domains differ in their responsiveness to AR interventions.

Overall, this research contributes novelty by clarifying under what conditions AR-based ethnomathematics produces the strongest learning impact. These findings not only advance theoretical perspectives on the integration of culture and technology in mathematics education but also offer practical guidance for educators and researchers in designing culturally responsive and technologically innovative learning experiences.

REFERENCES

Ahdhianto, E., Barus, Y. K., & Thohir, M. A. (2025). Augmented Reality as a Game Changer in Experiential Learning : Exploring its Role Cultural Education for Elementary Schools. *JPR: Journal of Pedagogical Research, 9*(1), 296–313. https://doi.org/10.33902/JPR.202533573

Anesti, V., & Irwanto, I. (2025). Research on Augmented Reality in Education: A Bibliometric Analysis. *Journal of Learning for Development*, *12*(1), 125–141. https://doi.org/10.56059/jl4d.v12i1.1314

Annisa, C., Triani, D. A., & Tanti, Y. K. (2023). Is it True that PBL based on Islamic Ethnomathematics Makes it Easier for PTKIN Students to Understand Mathematical Concepts? *Journal Focus Action of Research Mathematic (Factor M), 6(1),* 82-98. https://doi.org/10.30762/factor_m.v6i1.1228

Apricillia, N. N. D. E., Suarjana, I. M., & Jayanta, I. N. L. (2024). Improving Numeracy and Metacognitive Skills of Grade V Students Through Balinese Ethnomathematics-Based Mobile Learning. *International Journal of Elementary Education*, *8*(4), 709–718. https://doi.org/10.23887/ijee.v8i4.91544

Arifin, S., & Efriani, A. (2025). Integrating Augmented Reality in RME-Based Digital Learning: Impact on Students' Problem-Solving Ability. *Hipotenusa: Journal of Mathematical Society*, *7*(1), 32–53. https://doi.org/10.18326/hipotenusa.v7i1.3768

Ayu, A., Nursyahidah, F., & Prayito, M. (2023). Development of Learning Media Using

Ethnomathematics-Based Augmented Reality on Cube and Block Material. *Jurnal Phenomenon*, *13*(2), 207–225. https://doi.org/10.21580/phen.2023.13.2.17130

Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education* (8th ed.). Routledge.

Cui, Y. (2020). Meta-analysis of the Impact of Virtual Reality and Augmented Reality on Students' Learning Performance. In *An In Depth Look at Virtual Reality* (pp. 179–210). IntechOpen.

Dewi, S. S., Asfar, A. muhammad irfan taufan, Asfar, A. M. I. A., Nurannisa, A., Damayanti, W., & Wahyuni, N. (2024). Enhancing Students' Logical Thinking through Ethnomathematics-based Augmented Reality of Bola Soba Character Facades. *Journal of Innovation in Educational and Cultural Research*, *5*(3), 520–528. https://doi.org/10.46843/jiecr.v5i3.1033

Gusteti, M., Rahmalina, W., Wulandari, S., Azmi, K., Mulyati, A., Hayati, R., Gustina, R., & Nor Cahyati, V. (2025). GeoGebra Augmented Reality: An Innovation in Improving Students' Mathematical Problem-Solving Skills. *International Journal of Education in Mathematics, Science and Technology*, *13*(3), 584–596. https://doi.org/10.46328/ijemst.4872

Himayati, B. R. A., Elmiati, Mispalah, & Nursaly, B. R. (2024). Evaluasi Media Pembelajaran Augmented Reality Bangun Datar/Ruang Dengan Pendekatan Etnomatematika Rumah Adat Lengkong dalam Meningkatkan Kemampuan Spasial Siswa Sekolah Dasar. *JOEAI (Journal of Education and Instruction)*, *7*(2), 400–411. https://doi.org/10.31539/joeai.v7i2.12081

Jampel, I. N., & Antara, I. G. W. S. (2025). Ethnomathematics-Collaborative Augmented Reality: An Innovative Framework to Enhance Problem-Solving Skills in Elementary Geometry. *Jurnal Ilmiah Sekolah Dasar*, *8*(3), 522–528. https://doi.org/10.23887/jisd.v8i3.85666

Juandi, D., Kusumah, Y. S., & Tamur, M. (2022). A Meta-Analysis of the Last Two Decades of Realistic Mathematics Education Approaches. *International Journal of Instruction*, *15*(1), 381–400. https://doi.org/10.29333/iji.2022.15122a

Juandi, D., & Tamur, M. (2020). *Pengantar Analisis Meta* (1st ed.). UPI PRESS.

Kyeremeh, P., Awuah, F. K., & Dorwu, E. (2023). Integration of Ethnomathematics in Teaching Geometry: a Systematic Review and Bibliometric Report. *Journal of Urban Mathematics Education, 16(2)*, 68-89. https://doi.org/10.21423/jume-v16i2a519

Lin, Y., & Yu, Z. (2023). A Meta-analysis of the Effects of Augmented Reality Technologies in Interactive Learning Environments (2012–2022). *Computer Applications in Engineering Education*, *31*(4), 1111–1131. https://doi.org/10.1002/cae.22628

Maharbid, D. A., Herman, T., Agustin, M., & Riyana, C. (2025). Design of a Digital Ethnomathematics Module Based on Augmented Reality: A Study on Geometric Concepts Through the Exploration of the Mande Karesemen for Elementary Schools. *KnE Social Sciences*, 10(12), 59–68. https://doi.org/10.18502/kss.v10i12.18862

Muwahiddah, U., Asikin, M., & Mariani, S. (2021). The Ability Solve Geometry Problems in Spatial Intelligence through Project Based Learning-Ethnomathematics Assisted by Augmented Reality Apk. *Unnes Journal of Mathematics Education Research*, *10*(1), 97–1002. https://journal.unnes.ac.id/sju/ujmer/article/view/35021

Nugroho, M. A., Yulandari, I., & Cahyono, A. N. (2024). Project-based Learning through Augmented Reality-assisted Math Trails at Blenduk Church to Promote Mathematical Literacy. *Jurnal Elemen*, *10*(2), 363–377. https://doi.org/10.29408/jel.v10i2.25333

Nurhasanah, N., Hayati, L., Salsabila, H. N., & Amrullah, A. (2023). Media Pembelajaran Berbasis Augmented Reality dengan Menggunakan Pendekatan Etnomatematika Materi Bangun Ruang Sisi Datar. *Journal of Classroom Action Research*, *5*(4), 260–266. https://doi.org/10.29303/jcar.v5i4.5642

Pasaribu, R. S., Husna, A., & Hanggara, Y. (2024). The Impact of Augmented Reality Media Integrated with Ethnomathematics on Students' Numeracy Literacy Skills. *JCP (Jurnal Cahaya Pendidikan)*, *10*(2), 133–144. https://doi.org/10.33373/chypend.v10i2.6312

Pramulia, P., Yustitia, V., Kusmaharti, D., Fanny, A. M., & Oktavia, I. A. (2025). Ethnomathematics of Al Akbar Mosque Surabaya: Augmented Reality Comics to Improve Elementary School Students' Literacy and Numeracy. *Multidisciplinary Science Journal*, *7*(6), 1–13. https://doi.org/10.31893/multiscience.2025277

Rahayu, R., Fahma, M. A., Bintoro, H. S., & Murti, A. C. (2025). Enhancing Mathematical Thinking Skills through Realistic Mathematics Education Assisted by an Ethnomathematics Mobile Module. *Jurnal Pendidikan MIPA*, *26*(1), 556–569. https://doi.org/10.23960/jpmipa.v26i1.pp556-569

Rahmadani, M. L., Zulfah, Z., & Zulhendri, Z. (2023). Pengaruh Pendekatan Ethno-RME terhadap Kemampuan Pemahaman Konsep Matematis Siswa. *Jurnal Pendidikan MIPA, 13(4)*, 1162-1170. https://doi.org/10.37630/jpm.v13i4.1350

Richardo, R., Wijaya, A., Rochmadi, T., Abdullah, A. A., Nurkhamid, N., Astuti, A. W., & Hidayah, K. H. (2023). Ethnomathematics Augmented Reality: Android-Based Learning Multimedia to Improve Creative Thinking Skills on Geometry. *International Journal of Information and Education Technology*, *13*(4), 731–737. https://doi.org/10.18178/ijiet.2023.13.4.1860

Siregar, M., Aryaningrum, K., & Sunedi, S. (2025). Pengaruh Media Pembelajaran Etnomatematika Berbasis Website Terhadap Kemampuan Numerasi Siswa Kelas IV SDN 248 Palembang. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, *6*(7), 651–645. https://doi.org/10.23969/jp.v10i02.26353

Suherman, S., & Vidákovich, T. (2024). Mathematical Creative Thinking-Ethnomathematics based Test: Role of Attitude toward Mathematics, Creative Style, Ethnic Identity, and Parents' Educational Level. *Revista de Education a Distancia (RED)*, *24*(77), 1-22. https://doi.org/10.6018/red.581221

Sunzuma, G., & Maharaj, A. (2019). Teacher-related Challenges Affecting the Integration of Ethnomathematics Approaches into the Teaching of Geometry. *Eurasia Journal of Mathematics, Science, and Technology Education, 15(9), EM1744.* https://doi.org/10.29333/EJMSTE/108457

Susanto, Dafik, Kristiana, A. I., Fatahillah, A., & Alfarisi, R. (2025). Enhancing Mathematical Creative Thinking in Ethno-Geometry Learning Using Augmented Reality Technology. *Mathematics Teaching-Research Journal*, *17*(3), 70–87.

Tamur, M. (2021). *Pengaruh Computer-Assisted Mathematics Education (CAME) Terhadap Kemampuan Matematis Siswa Sekolah Menengah Atas di Indonesia: Studi Meta-Analisis*. Universitas Pendidikan Indonesia.

Tamur, M. (2023). Teknologi Immersive Augmented Reality Memfasilitasi Pembelajaran : Analisis Meta Perbandingan antar Subject Matters. *Juring (Journal for Research in Mathematics Learning)*, *6*(4), 361–372. https://doi.org/10.24014/juring.v6i4.25813

Tamur, M., Juandi, D., & Kusumah, Y. S. (2020). The Effectiveness of the Application of Mathematical Software in Indonesia; A Meta-Analysis Study. *International Journal of Instruction*, *13*(4), 867–884. https://doi.org/10.29333/iji.2020.13453a

Tamur, M., Juandi, D., & Subaryo. (2023). A Meta-Analysis of the Implementation of the Gamification Approach of the Last Decade. *AIP Conference Proceedings*, *090002*(1), 1–7. https://doi.org/10.1063/5.0155519

Tamur, M., Komaladewi, G. W., Nona, M. A., Trinitas, E. L., & Syukur, Y. M. K. (2024). Global Trends in Augmented Reality Technology: A Meta-Analysis Study. *Proceeding of International Seminar on Student Reseacrh in Education, Science, and Technology*Mataram: Universitas Muhammadiyah Mataram. Retrieved from https://journal.ummat.ac.id/index.php/issrectec/article/view/22749

Tamur, M., Kurnila, V. S., Jehadus, E., Ndiung, S., Pareira, J., & Syaharuddin, S. (2021). Learning from the Past : Meta-Analysis of Contextual Teaching-Learning of the Past Decade.

International Journal of Education & Curriculum Application, *4*(1), 1–10. https://doi.org/10.31764/ijeca.v4i1.3981

Tamur, M., Ndiung, S., Weinhandl, R., Wijaya, T. T., Jehadus, E., & Sennen, E. (2023). Meta-Analysis of Computer-Based Mathematics Learning in the Last Decade Scopus Database: Trends and Implications. *Infinity Journal*, *12*(1), 101. https://doi.org/10.22460/infinity.v12i1.p101-116

Tamur, M., Ngao, A. I., & Castulo, N. J. (2025). The Future of Augmented Reality Immersive Technology- Based Mathematics Learning : A Meta-Analysis Study. *JTAM (Jurnal Teori dan Aplikasi Matematika)*, *9*(3), 1013–1027. https://doi.org/10.31764/jtam.v9i3.31033

Tamur, M., Pantaleon, K. V., & Nendi, F. (2023). Pendampingan Guru Matematika Kelompok Saraya dalam Mengembangkan Perangkat Pembelajaran. *JMM (Jurnal Masyarakat Mandiri)*, *7*(5), 4233–4240. https://doi.org/10.31764/jmm.v7i5.16874

Tamur, M., Pantaleon, K. V., Wibisono, Y., Mamu, A. E., Ganas, P. R., Nurung, E. S., Rinta, I. K., & Berchmans, Y. J. (2024). PKM Pendampingan Guru Matematika SMP di Kota Ruteng Manggarai NTT untuk Perancangan dan Pengembangan Bahan Ajar Berbasis Augmented Reality. *Jurnal Masyarakat Mandiri*, *8*(6), 6700–6710. https://doi.org/10.31764/jmm.v8i6.27583

Tamur, M., Wibisono, Y., Makur, A., & Pantaleon, K. (2024). Challenges and Opportunities for Using Immersive Technology: A Meta-Analysis of the Effectiveness of Cross-Country Studies. *ICEHHA 2023*. https://doi.org/10.4108/eai.15-12-2023.2345622

Tamur, M., Wijaya, T. T., Makur, A. P., Wibisono, Y., & Pantaleon, K. V. (2024). *The Global Trend of Augmented Reality-Based Learning and Its Impact on Students ' Academic Ability : A Meta-Analysis*. *6*(2), 216–233. https://doi.org/10.18326/hipotenusa.v6i2.2454

Wangid, M. N., Rudyanto, H. E., & Gunartati. (2020). The Use of AR-Assisted Storybook to Reduce Mathematical Anxiety on Elementary School Students. *International Journal of Interactive Mobile Technologies*, *14*(6), 195–204. https://doi.org/10.3991/IJIM.V14I06.12285

Wulandari, D. U., Mariana, N., Wiryanto, W., & Amien, M. S. (2024). Integration of Ethnomathematics Teaching Materials in Mathematics Learning in Elementary School. *IJORER: International Journal of Recent Educational Research, 5(1)*, 204-218. https://doi.org/10.46245/ijorer.v5i1.542

Yilmaz, Z. A., & Batdi, V. (2021). Meta-Analysis of the Use of Augmented Reality Applications in Science Teaching. *Journal of Science Learning*, *4*(3), 267–274. https://doi.org/10.17509/jsl.v4i3.30570

Yohannes, Juandi, D., & Tamur, M. (2021). The Effect of Problem-Based Learning (PBL) Model On Mathematical Communication Skills of Junior High School Students – A Meta-Analysis Study. *Jurnal Pengukuran Psikologi dan Pendidikan Indonesia*, *10*(2), 142–157. https://doi.org/10.15408/jp3i.v10i2.17893

Zainovi, P. S., Mariana, N., Istiq'faroh, N., Wiryanto, W., & Muhimmah, H. A. (2025). Integrating Ethnomathematics in Geometry Learning to Enhance Primary Students' Numeracy Skills: A Systematic Literature Review. *Journal of Innovation and Research in Primary Education*, 4(3), 1044-1053. https://doi.org/10.56916/jirpe.v4i3.1467

Zhengtao, Z., & Hidayat, R. (2025). The Effects of Augmented Reality (AR) Toward Achievement on The Graphs and Geometry Topic Among Third-Grade Students. *Mathematics Teaching Research Journal*, *17*(1), 82–98.