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Ethnomathematics in Mathematics Learning: Evidence on Achievement, Engagement, and Instructional Design from a Systematic Literature Review

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ABSTRACT

Background: Ethnomathematics integrates cultural knowledge into mathematics education, potentially enhancing mathematical understanding, student engagement, and culturally relevant learning. However, evidence concerning its educational effectiveness remains methodologically diverse.
Aim: This study aims to systematically examine the contributions of ethnomathematics to mathematics achievement, student engagement, and instructional design while distinguishing empirical outcomes from exploratory evidence.
Method: A systematic literature review was conducted following the PRISMA 2020 framework. Publications from 2020–2025 were retrieved from Scopus, ERIC, and Google Scholar. Of 1,245 identified records, 12 studies met the selection criteria and were analyzed using thematic narrative synthesis.
Result: The findings indicate that traditional games, dances, cultural artifacts, and community practices provide meaningful contexts for connecting informal experiences with formal mathematical concepts. Selected studies reported positive achievement outcomes, while others documented learning trajectories, student engagement, cultural appreciation, and instructional possibilities. However, methodological differences and inconsistent outcome measurements prevented quantitative synthesis and limited causal interpretations.
Conclusion: Ethnomathematics offers promising opportunities for culturally responsive mathematics instruction when cultural activities are systematically aligned with mathematical objectives. Future research should employ rigorous evaluation designs, comparable assessment instruments, and clearly defined learning outcomes to establish its educational effectiveness.

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INTRODUCTION

Mathematics instruction often requires learners to move between everyday experiences and formal representations, yet these connections are not equally accessible in every classroom. Indonesia's performance in PISA 2022, with a mathematics mean score of 366 compared with the OECD mean of 472, illustrates a continuing need to strengthen mathematical literacy (OECD, 2023). These scores cannot by themselves establish that culturally disconnected instruction caused lower attainment. They do, however, invite consideration of how students encounter mathematics within their linguistic and social environments. Research on culturally relevant mathematics teaching suggests that local knowledge can inform the design of problems and

representations, provided that mathematical reasoning remains explicit (Acharya et al., 2021; Mania & Alam, 2021).

Ethnomathematics draws attention to mathematical practices embedded in community activities, arts, games, and artifacts (D'Ambrosio, 1985; Rosa & Orey, 2016). When translated into classroom tasks, these practices may connect learners' informal knowledge with school mathematics rather than serve as decorative examples. For instance, work on Sasak architecture identifies geometrical ideas with potential curricular use, while research on traditional Banyuwangi houses examines connections among geometrical, numerical, and thematic tasks (Fauzi et al., 2022; Hariastuti et al., 2022). Such studies make an important distinction between identifying mathematics in culture and documenting what students subsequently learn. The distinction is central to judging claims about the impact of ethnomathematics.

Recent instructional studies have broadened the range of mathematical content addressed through cultural contexts. Mathematics teaching using Javanese calendars, traditional dances, puppetry, and digital media has been explored for statistics, integer operations, sets, and spatial reasoning (Risdiyanti & Prahmana, 2021; Johar et al., 2025; Nursyahidah et al., 2025; Hastuti et al., 2025). Other work has developed culturally grounded worksheets, learning media, and modeling tasks rather than evaluating a common achievement outcome (Romandoni et al., 2024; Wijaya et al., 2025; Rahayu et al., 2025). These contributions suggest several possible routes from cultural experience to mathematical representation. Their methodological diversity also makes direct comparisons of effectiveness difficult.

The affective dimension is relevant because meaningful learning may involve participation, confidence, motivation, and recognition of learners' cultural identities. Studies examining mathematics teachers' perceptions and students' responses identify both opportunities and challenges in implementing culturally contextualized instruction (Mania & Alam, 2021; Bela et al., 2025; Cesaria et al., 2025). Evidence concerning learning attitudes has also been synthesized in recent meta-analytic research, although the reported findings depend on the types of studies and outcomes included (Hartoyo et al., 2025; Pratama & Yelken, 2024). Attitudes and cultural appreciation should nevertheless not be treated as interchangeable with performance on mathematics assessments. A review concerned with learning outcomes therefore needs to separate affective experience from measured cognitive change.

Earlier reviews documented research growth, cultural diversity, and implementation patterns in ethnomathematics (Hendriyanto et al., 2023; Batiibwe, 2024; Sunzuma & Umbara, 2025). Reviews of traditional games and classroom implementation similarly identify a rich range of artifacts and pedagogical possibilities (Setiaputra et al., 2025; Winardi & Jupri, 2025; Wardani & Himmah, 2026). Meta-analyses focusing on selected quantitative studies have reported favorable associations between ethnomathematics-oriented instruction and performance or mathematical literacy (Sulistyowati, 2023; Pratama & Yelken, 2024; Hartoyo et al., 2025). Yet an estimate derived from a quantitative subset cannot be extended without qualification to ethnographies, conceptual explorations, or design experiments. The contribution of a mixed-design SLR lies in explaining what each evidential approach can and cannot establish.

A second gap concerns the way reviews characterize cultural relevance across settings. A study of the Papua crown describes mathematically meaningful patterns and their potential use for inclusive geometry teaching, but the identification of a suitable artifact does not automatically demonstrate improved student achievement (Lestari et al., 2025). Likewise, research on Shagai probability can contribute experimental learning activities without making the count of game trials equivalent to the number of learners (Miyejav & Otgonbaatar, 2025). Work on the Tordauk

tradition shows how locally situated arithmetic ideas can inform a structured learning sequence, while research from South Africa reveals the adaptation difficulties teachers encounter with a traditional game (Labuem et al., 2025; Meeran et al., 2024). These contrasting examples indicate a need for synthesis organized by evidence type, mathematical task, and cultural setting rather than by favorable conclusions alone.

This review therefore examines the reported cognitive and affective contributions of ethnomathematics-oriented mathematics education and considers the instructional factors associated with those reports. It draws on the 12 studies selected from the 2020–2025 search and uses a thematic narrative approach because designs, outcomes, and contexts are heterogeneous. The review asks how achievement evidence differs from observations of engagement and from the identification of mathematical potential in cultural practices. Its conceptual contribution is to distinguish these evidence categories while tracing recurring instructional mechanisms from contextual exploration to mathematical formalization. Practically, the analysis is intended to support curriculum design that respects cultural knowledge without overstating what existing studies demonstrate.

1.1 Ethnomathematics: Concepts and Development

Ethnomathematics examines how mathematical ideas are expressed and used in particular cultural environments (D'Ambrosio, 1985; Rosa & Orey, 2016). The educational question is not merely whether a cultural artifact contains number, geometry, measurement, or pattern, but how these ideas can support mathematically productive tasks. Ethnomodeling situates this translation between locally meaningful practices and school or disciplinary representations (Orey & Rosa, 2021). Research in Nepal similarly emphasizes the relevance of language, contextualized mathematics, and local knowledge to curriculum decisions (Acharya et al., 2021). Examples from Indonesian architecture illustrate that identifying a cultural structure is only the starting point for making mathematical content teachable (Fauzi et al., 2022; Hariastuti et al., 2022). Fouze and Amit (2023) likewise discuss ethnomathematics as an educational perspective linking mathematical knowledge and cultural practices.

In design research, a hypothetical learning trajectory offers a way to document the progression from informal activity to formal mathematical reasoning. The Wayang and Mahabharata study used familiar narrative characters to organize a trajectory for sets (Risdiyanti & Prahmana, 2021). The Pranata Mangsa study integrated technology, ethnomathematics, and realistic mathematics education to design a statistics trajectory for eighth-grade learners (Nursyahidah et al., 2025). Parallel developments have linked ethnomathematics to digital resources, student worksheets, and mathematical modeling (Johar et al., 2025; Tamari & Utami, 2023; Wijaya et al., 2025). These approaches offer plausible mechanisms for learning but should be assessed through evidence appropriate to each research design.

1.2 Mathematics Learning Outcomes from a Cultural Perspective

Mathematics learning outcomes in this review refer to reported cognitive evidence, including achievement, conceptual understanding, and mathematical reasoning, and affective evidence, including motivation, participation, and cultural appreciation. Anderson and Krathwohl's (2001) framework provides a general vocabulary for distinguishing kinds of cognitive objectives, although the source studies did not all use the same outcome measures. A quantitative difference on a tested outcome has a different inferential status from a qualitative account of students' engagement. Sari et al. (2023) reported students' responses to

ethnomathematics-oriented learning, whereas Ariani and Suswandari (2024) examined achievement under a classroom comparison. These differences justify reporting the kind of outcome, measurement approach, and limitations alongside each finding.

Integrating cultural contexts with realistic mathematics education has been explored as a process in which everyday situations become a starting point for formalization (Risdiyanti & Prahmana, 2021; Nursyahidah et al., 2025). Recent research has investigated fractions, geometry, statistics, and computational thinking through culturally contextualized tasks (Azmi et al., 2025; Wewe et al., 2025; Rahayu et al., 2025). Studies focused on perceived usefulness, exploration of artifacts, or teacher perspectives make different contributions from controlled comparisons of learning achievement (Bela et al., 2025; Loviana et al., 2026). Accordingly, the present synthesis distinguishes pedagogical possibility, observed classroom processes, and assessed learning change. This distinction permits a more precise interpretation of existing studies without creating a common effect estimate where one is not warranted.

2. Research Method

2.1 Design and Protocol

The study adopted a systematic literature review (SLR) with a thematic narrative synthesis, using PRISMA 2020 as a reporting framework (Page et al., 2021). The review protocol was designed before the search was conducted. A narrative approach was selected because the corpus brought together quasi-experimental research, design studies, probabilistic modeling, qualitative ethnography, and case studies whose outcomes were not directly commensurable. The review therefore compared study contexts, methods, reported findings, and evidential scope rather than statistically pooling effects. The analytical orientation was informed by thematic synthesis procedures (Thomas & Harden, 2008). This structure is consistent with general principles for transparent systematic reviews (Kitchenham, 2004).

2.2 Data Sources and Search Strategy

The literature search covered Scopus, ERIC, and Google Scholar, with the review restricted to English- and Indonesian-language publications dated 2020–2025. Scopus and ERIC provided complementary journal and education coverage, while Google Scholar broadened retrieval of potentially relevant publications. The review focused on the use of ethnomathematics or culture-based mathematics activities in educational contexts and on reports concerning cognitive or affective learning. The three sources were treated as routes to locate publications rather than as independent evidence of the methodological quality of each included study.

English search terms reported in the original methods included 'ethnomathematics', 'ethno-mathematics', 'culture-based mathematics education', 'mathematics learning outcomes', 'ethnomathematics AND learning achievement', and 'ethno-RME'. Indonesian terms included 'etnomatematika', 'pembelajaran matematika berbasis budaya', 'hasil belajar matematika', and 'pendekatan etnomatematika'. The search combined related terms through the Boolean operators AND and OR. The review retained the stated retrieval period of 2020–2025 and the three named databases, without attributing unreported dates, platform-specific search strings, or additional screening procedures to the original study.

2.3 Inclusion and Exclusion Criteria

Table 1 reproduces the original eligibility criteria. In interpreting the final corpus, the synthesis distinguishes studies that directly assessed learning outcomes from studies that chiefly

described cultural mathematical resources or instructional possibilities; the latter provide contextual evidence but not equivalent proof of achievement gains.

Table 1. Inclusion and Exclusion Criteria for Articles

Inclusion Criteria	Exclusion Criteria
(a) Articles published in reputable journals with a peer-review process, preferably indexed in Scopus or ERIC	(a) Articles that are editorials, letters to the editor, or reviews without empirical data
(b) Articles that examine the integration of ethnomathematics or culture-based approaches in mathematics learning	(b) Articles that only explore mathematical concepts in cultural artifacts without measuring the impact on learning
(c) Articles that measure or report mathematics learning outcomes (cognitive and/or affective) as a dependent variable	(c) Articles whose full text is not available
(d) Articles published between 2020 and 2025	
(e) Articles available in full text in Indonesian or English	

2.4 Article Selection Process (PRISMA)

The PRISMA identification stage reported 1,245 identified records: 623 from Scopus, 287 from ERIC, and 335 from Google Scholar. After 218 duplicate records were removed, 1,027 titles and abstracts were screened and 972 records excluded, leaving 55 full texts for eligibility assessment. Of these, 43 were excluded, comprising 18 without explicit learning-outcome measures, 12 outside the stated publication range, eight without available full texts, and five classified as non-empirical or conceptual. The selection process thus retained 12 studies for synthesis. These totals describe the selection flow reported in the manuscript; the results below distinguish outcome assessment from exploratory educational relevance because the retained reports differ markedly in design.

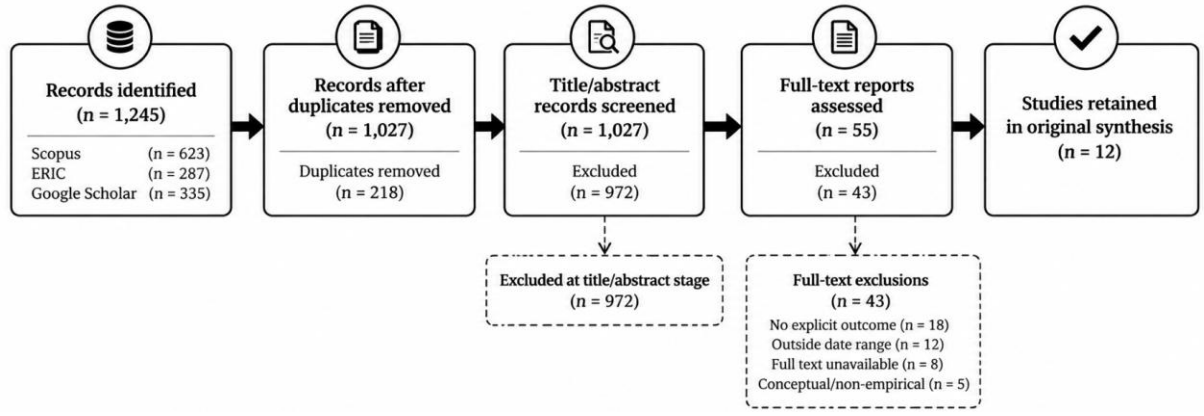


Figure 1. PRISMA-based selection flow reported in the review (2020–2025)

2.5 Data Extraction and Analysis

The extraction framework recorded eight study characteristics: bibliographic information, research purpose, cultural context, design, participant information, instruments or outcome evidence, reported findings or effect sizes, and limitations. Two researchers were reported to have screened and extracted independently, with an initial agreement of 87% and disagreements resolved by discussion. The 12 included publications were organized under study codes S1–S12, with study characteristics reported in Table 2. Where source documents primarily described

cultural ideas or a learning design, their findings are presented as exploratory or process evidence rather than as direct evidence of higher mathematics test scores.

The qualitative synthesis followed three connected activities: coding reported findings, grouping recurrent descriptions into descriptive themes, and interpreting relationships among themes across studies (Thomas & Harden, 2008). The comparison focused on achievement evidence, mathematical representation and reasoning, engagement and cultural identification, and practical conditions affecting implementation. Research designs were treated as a principal boundary on inference. Controlled outcome comparisons could address differences in measured performance, whereas design experiments supported interpretations of learning processes and ethnographies documented practices, resources, or implementation challenges. No pooled effect size was calculated from the 12 studies because the reports did not provide a consistent quantitative estimand or comparable measurement framework.

3. Research Results

3.1 Characteristics of the Reviewed Articles

The 12 source records presented in Table 2 cover five identifiable country settings. Eight concern locations in Indonesia (S2, S3, S6, S7, S8, S10, S11, and S12), while one each concerns Malaysia (S1), Mongolia (S4), the United Arab Emirates (S5), and South Africa (S9). The listed designs are heterogeneous: three studies describe design research (S3, S6, and S7); six use qualitative, ethnographic, or case-based approaches (S2, S8, S9, S10, S11, and S12); S1 reports a quasi-experimental comparison; S4 uses a mixed-method probability activity; and S5 uses Bayesian network analysis. These descriptions are groupings of the study information reported in Table 2, not evidence that every paper measured the same dependent variable. Figure 2 illustrates these classifications.

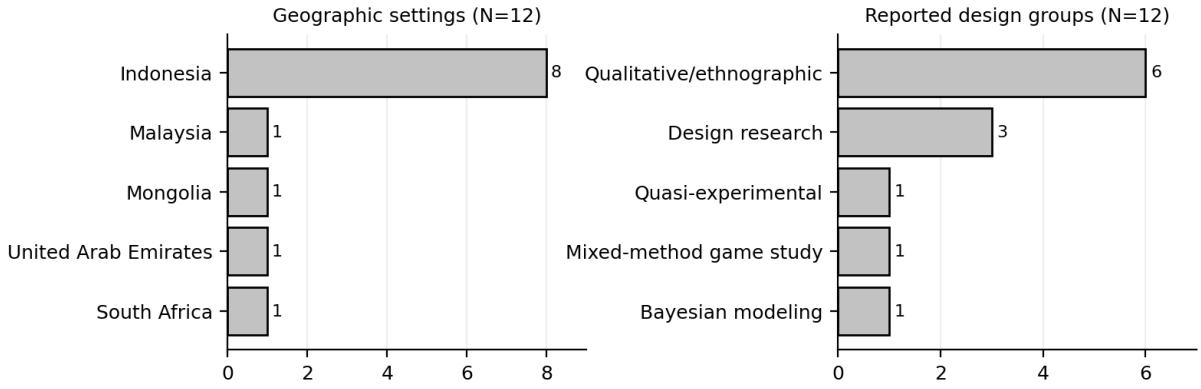


Figure 2. Distribution of geographic settings and reported methodological designs (N = 12)

Cultural contexts in the corpus include performances and stories (S1, S6, and S7), artifacts or built forms (S2, S10, and S12), traditional games (S4, S8, and S9), seasonal or community traditions (S3 and S11), and a modeling study examining cultural relevance in mathematics education (S5). Figure 3 summarizes this descriptive grouping. The studies' learning evidence varied considerably. S1 reported a comparison of academic achievement, and S4 reported a pre/post statistical result, although the 10,050 Shagai trials were physical game throws rather than a student sample. The Ende marbles study identified embedded mathematical ideas rather than measuring achievement (Mei et al., 2020). Several other studies developed trajectories or described possible educational applications without measuring the change in students'

performance with comparable designs. Table 2 therefore labels the evidential scope of individual studies rather than treating all positive descriptions as measured gains.

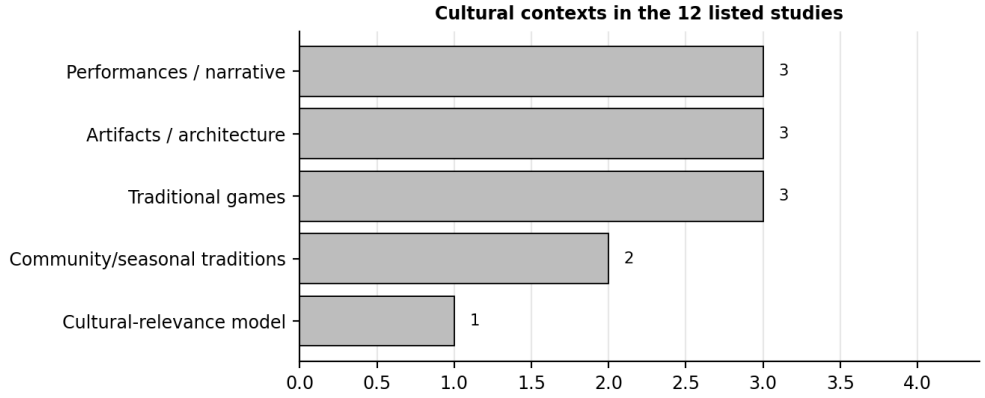


Figure 3. Descriptive grouping of cultural contexts within the 12 reviewed articles

Table 2. Characteristics of the Articles Reviewed in the SLR

No	Code & Short Title	Cultural Context	Research Method	Main Findings Related to Learning Outcomes
1	S1 – Zapin and Kuda Kepang dances (Malaysia)	Traditional dance	Quasi-experiment; reported N = 60	Reported group differences in achievement and cultural appreciation; quantitative and interview evidence.
2	S2 – Javanese batik (Indonesia)	Batik patterns	Cultural and educational analysis	Identified geometry and values in batik patterns; educational potential, not a controlled gain estimate.
3	S3 – Pranata Mangsa (Indonesia)	Traditional calendar	Design research; N = 32	Designed statistics trajectory and documented conceptual development during activities.
4	S4 – Shagai game (Mongolia)	Traditional game	Mixed-method probability study; 10,050 throws	Game-trial probabilities and a reported pre/post t(8) = 4.43, p = .002; throws are not student N.
5	S5 – Bayesian networks (UAE)	Cultural relevance	Probabilistic/Bayesian modeling	Modeled associations involving cultural context and grades; observational inference, not a causal trial.
6	S6 – Sagele dance (Indonesia)	Traditional dance	Design research	Developed an integer-operations trajectory from movement to number-line representations.
7	S7 – Wayang and Mahabharata (Indonesia)	Shadow-puppet stories	Design research (HLT)	Designed a trajectory for the concept of sets using familiar story characters.
8	S8 – Marbles game (Indonesia)	Traditional game	Ethnography; three players	Identified arithmetic, distance, and shape concepts; no measured student achievement gain.
9	S9 – Morabaraba (South Africa)	Traditional game	Qualitative case study	Reported teachers' adaptations and classroom implementation challenges.
10	S10 – Rumoh Aceh (Indonesia)	Traditional architecture	Ethnographic/CT analysis	Examined geometrical patterns and computational-thinking applications in a cultural artifact.
11	S11 – Tordauk tradition (Indonesia)	Community tradition	Qualitative ethnomathematics; N = 20	Mapped arithmetic ideas to a five-stage instructional strategy; outcomes not pooled.
12	S12 – Papua crown (Indonesia)	Cultural crown patterns	Ethnographic analysis	Identified two-dimensional geometric patterns and proposed inclusive instructional uses.

4. Discussion

The synthesis suggests that ethnomathematics can be associated with stronger mathematics learning when cultural experiences are embedded in tasks that require explicit mathematical reasoning. The Malaysian dance study (S1) provides a reported comparison of achievement, whereas the Mongolian Shagai study (S4) offers pre/post evidence related to statistical reasoning (Abdullah et al., 2025; Miyejav & Otgonbaatar, 2025). These studies address different topics and apply different units of analysis, so neither establishes a universal effect for all cultural approaches. The 10,050 Shagai trials describe repeated game outcomes and should not be interpreted as the number of students tested. Quantitative syntheses elsewhere report favorable effects for selected interventions, but their conclusions apply to the designs and outcomes actually included (Pratama & Yelken, 2024; Hartoyo et al., 2025; Sulistyowati, 2023). Taken together, the findings support cautious interest in achievement benefits rather than an unqualified claim of causation across the review corpus.

A recurrent instructional mechanism involves moving from culturally intelligible activity to symbolic mathematical representation. In the Pranata Mangsa statistics trajectory, culturally meaningful temporal categories provided a starting point for work on formal statistical concepts (Nursyahidah et al., 2025). Sagele dance movements similarly supported the design of tasks connecting directions of movement with operations on integers, while Wayang stories organized the classification of elements into sets (Hastuti et al., 2025; Risdiyanti & Prahmana, 2021). These contributions accord with ethnomodeling, in which locally grounded mathematical activity is interpreted using disciplinary representations (Orey & Rosa, 2021). Recent developments in spatial learning and modeling worksheets indicate that the strength of this transition depends on carefully sequenced tasks, not cultural familiarity alone (Johar et al., 2025; Wijaya et al., 2025). For teachers, the relevant design decision is how a cultural example becomes a sequence of mathematical questions, representations, and feedback.

The exploration of mathematical patterns in artifacts provides an important but different kind of evidence. The Yogyakarta batik study (S2) identified geometrical and cultural meanings, and the Papua crown study (S12) described shapes and patterns that could be used for culturally inclusive geometry instruction (Prahmana & D'Ambrosio, 2020; Lestari et al., 2025). These contributions extend the repertoire of tasks available to mathematics educators. However, an artifact's capacity to represent a concept is not equivalent to measured learning improvement among students. This distinction also appears in work on Sasak architecture, traditional houses, and multiple Indonesian cultural objects (Fauzi et al., 2022; Hariastuti et al., 2022; Loviana et al., 2026; Yustitia et al., 2025). Including such studies enriches conceptual coverage, provided that their pedagogical potential is not counted as an observed effect on achievement.

Engagement and cultural recognition formed another recurring theme, but the evidence for affective outcomes was less uniform than some narrative interpretations imply. Interviews, student responses, and qualitative observations can document participation or perceived relevance without yielding a standardized motivation effect. The Morabaraba case study (S9) is particularly informative because teachers encountered practical difficulties when adapting game rules to mathematics content (Meeran et al., 2024). Studies of ethnomathematics-based materials and classroom perceptions likewise show that acceptance, usefulness, and instructional feasibility are distinct from test performance (Mania & Alam, 2021; Bela et al., 2025; Cesaria et al., 2025). An integrative reading therefore treats motivation and cultural appreciation as worthwhile outcomes in their own right, while avoiding numerical comparisons that the sources

do not support. Future evaluations could link these experiences to learning measures through transparent instruments and suitable comparison designs.

Variation across topics and educational settings complicates the interpretation of aggregate claims. Geometric artifacts may support spatial representation, whereas the Shagai game directly illustrates frequency and empirical probability (Miyejav & Otgonbaatar, 2025; Lestari et al., 2025). Work on Ngadhu Bhaga geometry, ethnomathematics-based worksheets, and culture-based computational thinking addresses different levels of mathematical reasoning (Wewe et al., 2025; Rahayu et al., 2025; Romandoni et al., 2024). Their outcomes should not be considered interchangeable simply because all use an ethnomathematics label. The reviewed studies similarly span experimental comparisons, design-based processes, and observational cultural analyses. A useful synthesis must therefore explain how mathematical content, learner population, and assessment design shape the kind of inference available.

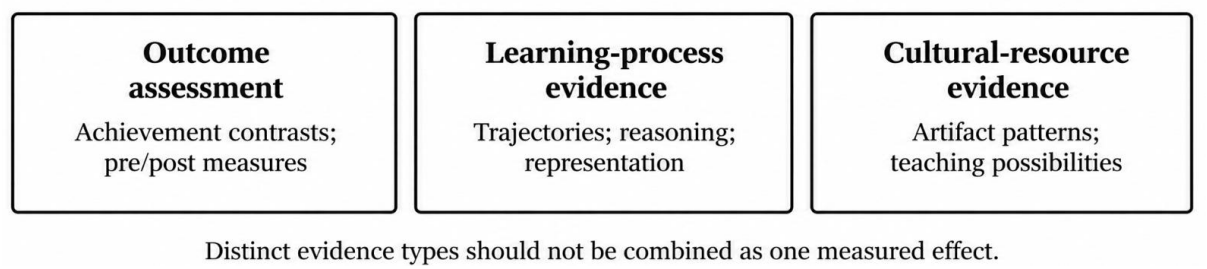


Figure 4. Evidence categories in the review corpus (conceptual synthesis)

Comparing the three more detailed examples in Table 3 clarifies why methodological distinctions matter. S1 focuses on an achievement comparison for transformations, S3 documents the development of a statistics learning trajectory, and S4 links game-based probability work to a reported pre/post result. These studies may each contribute to teaching practice, but a successful learning activity and a positive test contrast answer different questions. A similar limitation applies to the Bayesian network study in the UAE (S5): modeled relationships involving cultural contexts and grades should not be interpreted as proof that the absence of culture caused poorer performance (Johnson et al., 2022). Recent reviews of ethnomathematics research also describe this mixture of research approaches and the continuing need for stronger outcome designs (Hendriyanto et al., 2023; Setiaputra et al., 2025; Winardi & Jupri, 2025). Accordingly, evidence should be integrated by purpose and quality before any broader effectiveness judgment is made.

Table 3. Comparison of study purpose, measurement, and strength of inference

Code	Cultural Context	Mathematics Topic	Design & Sample	Impact Measure	Strength of Evidence
S1	Zapin and Kuda Kepang	Transformations	Quasi-experiment; N = 60	Achievement comparison reported	More direct outcome evidence; interpretation depends on original comparability
S3	Pranata Mangsa	Statistics	Design research; N = 32	Learning trajectory and task processes	Process evidence; no controlled effect estimate
S4	Shagai game	Probability and statistics	Mixed method; 10,050 game throws	Reported $t(8) = 4.43$; $p = .002$	Pre/post outcome result; 10,050 is not participant N

The review also raises a question of cultural representation within mathematics education. The Tordauk study (S11) documents arithmetic patterns from the Aru Islands and proposes a staged sequence for connecting community knowledge with classroom concepts (Labuem et al.,

2025). The Papua crown study (S12) similarly shows how mathematical tasks could draw on underrepresented cultural artifacts without reducing those artifacts to visual decoration (Lestari et al., 2025). These findings are consistent with culturally sustaining pedagogy, which regards cultural practices as legitimate resources for education rather than as occasional motivational accessories (Paris, 2012). The practical challenge is to work with communities and teachers in ways that preserve meanings while making the mathematical objectives explicit. This argument concerns relevance and representation; it does not establish that any single cultural intervention will produce the same gain in every school.

Several practical implications follow from reading the evidence according to its design. Teachers and curriculum developers can begin with a well-specified mathematics objective, select a genuinely connected cultural practice, and build a trajectory that makes the transition to formal concepts observable (Risdiyanti & Prahmana, 2021; Johar et al., 2025). Digital resources and ethnomathematics-based worksheets may extend these possibilities, but feasibility and educational benefit require separate evaluation (Tamari & Utami, 2023; Rahayu et al., 2025; Sunzuma & Umbara, 2025). The stronger intervention literature motivates further controlled evaluations of achievement, while exploratory work can guide the selection and interpretation of cultural materials (Ariani & Suswandari, 2024; Wardani & Himmah, 2026). Reporting sample sizes, the unit of analysis, instruments, comparison groups, and cultural adaptation procedures would strengthen the comparability of future studies. Until these elements are sufficiently consistent, an interpretive narrative synthesis is more defensible than a pooled claim about the effect of ethnomathematics.

5. Conclusion

This systematic literature review examined 12 papers originally selected from Scopus, ERIC, and Google Scholar for the years 2020–2025. Across these sources, ethnomathematics was represented in classroom comparisons, learning-trajectory design, probabilistic modeling, and cultural or ethnographic analyses. The papers collectively describe how games, performances, built forms, and community traditions can be connected with formal mathematics. However, the corpus does not consist of 12 directly comparable evaluations of achievement. Claims concerning effectiveness must therefore be limited to the subset of studies that measured learning outcomes, while other studies contribute evidence about resources, reasoning processes, and implementation.

Three interpretive themes emerged: measured or reported cognitive outcomes in selected studies, engagement and cultural recognition documented with varied methods, and instructional sequences that connect informal cultural experience with formal mathematical representations. The review's main contribution is to distinguish these types of evidence rather than collapsing them into a single positive effect. Contextual tasks appear most informative when they have a discernible mathematical purpose and a trajectory for formalization. The source settings also illustrate the educational relevance of traditions beyond commonly studied cultural regions. These interpretations are compatible with recent literature, but their generalizability depends on the methods and populations of the contributing studies.

The principal limitation is the small and methodologically diverse source corpus. The reported selection counts and screening agreement summarize the review process, while the differences in study designs complicate outcome comparisons. In particular, artifact exploration, qualitative descriptions of classroom implementation, and game trials should not be treated as equivalent to experimental participant data. The lack of comparable outcomes prevents

defensible quantitative pooling. The English- and Indonesian-language restriction and dependence on the stated sources may also have excluded relevant research from other settings.

Future work should evaluate culturally grounded instructional sequences using clearly reported participant samples, instruments, comparison procedures where appropriate, and outcomes for both mathematical reasoning and affective engagement. Longitudinal designs could establish whether any benefits persist beyond the immediate teaching activity. Qualitative research remains important for understanding how teachers and communities adapt mathematical tasks and protect the meaning of cultural practices. Systematic reviews could also separate cultural-artifact discovery, design research, and impact evaluations at the eligibility and extraction stages. Such distinctions would strengthen the empirical and educational conclusions drawn from ethnomathematics research.

Author Contributions

Safiru Hunas: Conceptualization, original draft preparation, formal analysis, and visualization. Rama Wijaya Abdul Rozak: Methodology, supervision, review, and editing. Nandang Rusmana: Validation, investigation, resources, review, and editing.

Conflict of Interest Statement

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