# Systematic Literature Review: The Letter of the Ethnomathematics Approach in Improving Critical Thinking Skills

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**Abstract**

This study aims to examine the implementation of the ethnomathematics approach in mathematics learning to improve the critical thinking skills of junior high and high school students. The method used is a Systematic Literature Review (SLR) of 19 relevant articles published between 2020 and 2025. Articles were selected through Google Scholar, Semantic, and Scopus with strict inclusion and exclusion criteria. The analysis shows that the integration of local cultural contexts with mathematics material significantly improves critical thinking skills through the interpretation of mathematical concepts in real life. The summary of findings highlights an increase in motivation, conceptual understanding, and analytical skills, symbol interpretation, and mathematical argumentation. Many studies report successful implementation through various innovative learning models such as inquiry-based learning, problem-based learning, and the use of digital media such as 3D e-modules, Android applications, and virtual reality that link local culture with mathematics material. These findings recommend an ethnomathematics approach as a contextual strategy to improve student engagement, understanding, and critical thinking skills.

**Keywords:** ethnomathematics, critical thinking, mathematics learning

## Introduction

The 4C's competencies, which include critical thinking and problem solving, communication, creativity, and collaboration, are key skills that are essential for facing the challenges of the 21st century (Cynthia & Sihotang, 2023). Critical thinking skills are an essential part of mathematics learning, as they involve logical, systematic, critical, and creative thinking processes to solve problems in everyday life and prepare for future challenges (Muslimahayati et al., 2020). These skills play a role in every stage of problem solving, including identifying problems, planning solutions, evaluating solutions, and implementing them (Friedel et al., 2008; Mislia et al., 2019).

International data shows that students' mathematical abilities in Indonesia are still low, as reflected in the 2022 PISA result with an average score of 379 and ranked 68th out of 81 countries (PISA, 2022), as well as the 2023 TIMSS results, which show that the percentage of correct answers in the knowing and applying categories is around 40% and reasoning is 20% (TIMSS, 2023). This condition indicates the need to improve students' critical thinking skills (Safitri et al., 2025). Students's difficulty in identifying problems when faced with non-routine questions is the main cause of low critical thinking skills

(Zendrato et al., 2024). Many students also showed inconsistency and errors in organizing the steps to solve problems, indicating low ability in recognizing and solving problems, which is an indicator of critical thinking (Sastrawati & Guspita, 2022).

Ethnomathematics combines mathematics with culture, providing dual benefits in learning. This approach not only makes it easier for students to understand the material, but also allows them to appreciate the cultural values that surround them. By linking mathematical concepts and cultural contexts, ethnomathematics is an effective solution in helping students understand and analyze problems critically. Indonesia, as a country with significant cultural diversity, makes the integration of culture in mathematics learning important. This aims to improve students' understanding and make learning more meaningful (Ajmain et al., 2020). As stated by (Surat, 2018), ethnomathematics examines the ways in which different cultures understand, express, and use mathematical concepts.

Ethnomathematics was first introduced by D'Ambrosio in 1985 with the aim of encouraging students to appreciate their culture and contribute to the formation of national character amid the increasingly strong tide of modernization (D'Ambrosio, 1985). The relationship between ethnomathematics and critical thinking skills is very close in education. Ethnomathematics not only increases students' interest and motivation, but also improves their understanding of mathematical concepts through cultural contexts (Ismunandar et al., 2020). Research by Una et al., (2024) shows that ethnomathematics influences students' critical thinking skills in various aspects, such as identifying, translating, interpreting symbols, understanding, and applying ideas. Therefore, the application of ethnomathematics in education is very important to prepare students for future challenges.

This study aims to review the literature related to the ethnomathematics approach in improving critical thinking skills through the systematic literature review method. The result of this study are expected to provide insight and recommendations for teachers to create more interesting and contextual mathematics learning.

## Method

This study uses Systematic Literature Review (SLR), so data collection must be in accordance with the procedures. SLR is a research method that involves examining, evaluating, and interpreting various studies relevant to the issue being researched (Ikstanti & Yulianti, 2023). The purpose of using the SLR method in this study is to examine various findings from previous studies related to the role of the ethnomathematics approach in improving critical thinking skills. Through this method, researchers can identify, evaluate, and review all relevant research findings according to specific criteria. This method is user to find solutions to current problems, identify issues to be examined from various perspectives, and resolve theories related to the research topic. The SLR implementation procedure in this study refers to the phases formulated by Zawacki et al., (2020) as follows.

*Develop Research Question*

This research question is formulated based on the needs of the topic being studies. The research question for this study is formulated as follows.

RQ1: How can the implementation of ethnomathematics in learning support the improvement of critical thinking skills?

*Construct Selection Criteria*

This stage is a data selection process that aims to ensure the suitability of data in the research. To ensure that the selection process was systematic, the inclusion and exclusion criteria listed in Table 1 were applied as a guide. These criteria are designed to filter data that is truly relevant and meets the standards applied, so that the results of the analysis are scientifically accountable.

**Table 1**. The Inclusion and Exclusion Criteria

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| Articles relevant to the ethnomathematics approach and critical thinking skills. | Articles that are not relevant to the ethnomathematics approach and critical thinking skills. |
| Articles published in reputable national and international scientific journals. | Articles with restricted acces or that cannot be accessed in their entirety. |
| Articles published between 2020 and 2025. | Articles published before 2020-2025. |
| The research was conducted at the junior high school or high school level. | Research beyond junior high school or high school level. |

*Develop Search Strategy*

Harzing's Publish or Perish is used as a tool to search for scientific articles relevant to the research topic. In this process, three main databases were used: Google Scholar, Semantic, and Scopus, to ensure that the sources obtained were comprehensive, highly credible, and accountable. To narrow the scope of the search and make the result more relevant, a number of keywords were used, such as ethnomathematis, critical thinking, and mathematics.

*Select Studies Using Selection Criteria*

At this stage, the selection process is carried out by applying inclusion and exclusion criteria. Initial screening was conducted by reviewing the titles and abstracts to assess the suitability of the articles for the focus of the study. Next, articles deemed relevant are examined in depth by reading the full text to ensure that the content of the article truly meets the established criteria (Zawacki et al., 2020).

*Asses the Quality of Studies*

The collected data was then assessed for quality using quality assessment (QA) standards, with the following predetermined criteria.

QA1: Is the research clearly explained?

QA2: Are the articles indexed by SINTA and Scopus?

QA3: Is there a relationship between the ethnomathematics approach and critical thinking skills?

Each QA will be answered with a yes or no.

*Synthesis Result of Research Question*

In the final stage, all collected data is synthesized to final answers to the researcher's questions (RQ).

## Results and Discussion

The article selection stage for this study is presented in the form of a flowchart that illustrates the review process in a clear and systematic manner.

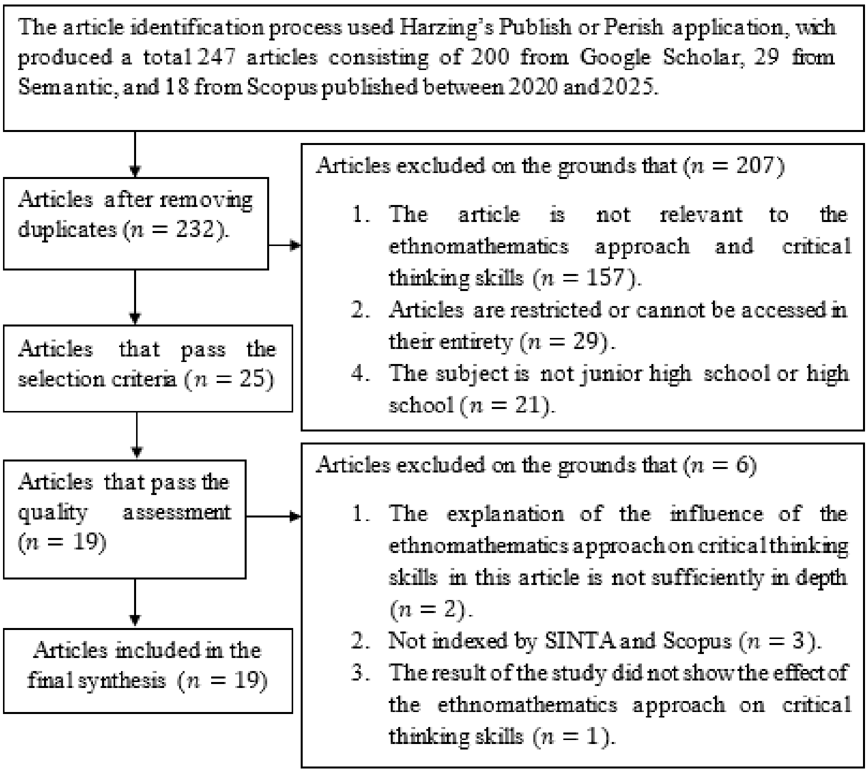


**Figure 1.** Article Review Process Flowchart

The initial search using Harzing's Publish or Perish yielded 247 articles. After removing 15 duplicate articles, there were 232 articles remained for further selection. Selection using inclusion and exclusion criteria narrowed the number of articles down to 25. The articles were then assessed for quality using quality assessment (QA) standards. The evaluation results show that 18 articles indexed by SINTA and 1 article indexed in Scopus meet all the predetermined quality criteria. After selection, the 19 articles were comprehensively reviewed to explore answers to the research question that had been designed previously.

**Table 2.** Article Included in the Final Synthesis

| No | Author, Year | Journals and Indexes | Method and Model | Subject | Key Findings |
|---|---|---|---|---|---|
| 1 | (Sarwoedi et al., 2021) | Annals of Mathematical Modeling (Indexed S4) | Quasi-experiment; Ethnomathematics-based PBL | High school students | Ethnomathematics-based PBL learning has been reported to contribute to high school students' mathematical critical thinking skills, particulary in the areas of analysis and problem solving. |

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| 2 | (Novitasari et al., 2022) | Vygotsky: Jurnal Pendidikan Matematika dan Matematika (Indexed S3) | Quasi experiment; Ethnomathematics-based worksheets with a STEM approach | Junior high school students | Ethnomathematics-based worksheets with a STEM approach have been reported to significantly improve students' critical thinking skills compared to conventional learning methods. |
| 3 | (Saputra et al., 2022) | Jurnal Riset Rumpun Matematika dan Ilmu Pengetahuan Alam (Indexed S5) | R&D; Inquiry-based ethnomathematics e-module | Junior high school students | The inquiry-based ethnomathematics e-module developed has been declared valid and practical and has the potential to support the development of students' critical thinking skills, although its effectiveness is still based on limited-scale trials. |
| 4 | (Dewi et al., 2022) | LINEAR: Journal of Mathematics Education (Indexed S4) | R&D; Ethnomathematics-based LKPD | Junior high school students | Ethnomathematics-based geometry LKPDs meet the criteria of validity and practicality, and facilitate the achievement of critical thinking indicators for students, especially in the clarification indicator. |
| 5 | (Rohman et al., 2023) | Journal Numeracy (Indexed S4) | Quantitative; PjBL assisted by Android ethnomathematics | Junior high school students | The application of an Android-assisted ethnomathematics-based PjBL model was reported to result in an increase in students' critical thinking scores compared to conventional Android-assisted ethnomathematics learning |
| 6 | (Victory et al., 2023) | Jurnal Ilmiah Edukasi Soulmath (Indexed S4) | R&D; Math trail using MathCityMap based on ethnomathematics | Junior high school students | The math trail that uses the ethnomathematics-based MathCityMap of Embung Tambakboyo shows potential in supporting students' critical thinking skills through |

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| | | | Embung Tambakboyo | | contextual problem-solving activities. |
| 7 | (Lubis et al., 2023) | JURING: Journal for Research in Mathematics Learning (Indexed S3) | Quasi experiment; Ethno-RME | Junior high school students | Ethno-RME learning has been reported to support the improvement of students' mathematical critical thinking skills and positive attitudes towards mathematics through the integration of the local Riau Mayal cultural context. |
| 8 | (Nopianda et al., 2023) | Nabla Dewantara: Jurnal Pendidikan Matematika (Indexed S6) | R&D; Ethnomathematics-based LKPD | Junior high school students | The ethnomathematics-based LKPD developed was found to be valid, highly practical, and very effective in facilitating students' mathematical critical thinking skills. |
| 9 | (Aprillian et al., 2023) | Prismatika: Jurnal Pendidikan dan Riset Matematika (Indexed S4) | Descriptive approach and qualitative research; Ethnomathematics learning in the game of gobak sodor | Junior high school students | Students' critical thinking skills in ethnomathematics learning are influenced by their initial skill levels, with different levels of critical thinking indicators achieved among students. |
| 10 | (Wahyuni & Kusaeri, 2024) | Kognitif: Jurnal Riset HOTS Pendidikan Matematika (Indexed S4) | Qualitative; Ethnomathematics learning of Tembe Nggoli Bima woven fabric | Junior high school students | Ethnomathematics-based learning facilitates students' critical and logical thinking skills, with variations in indicator achievement according to students' ability levels. |
| 11 | (Andzin et al., 2024) | Imajiner: Jurnal Matematika dan Pendidikan Matematika | R&D; Ethnomathematics-based module | Junior high school students | The Borobudur Temple ethnomathematics-based mathematics learning module that was developed has been declared valid and suitable for use, and has the potential to |

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| | | (Indexed S4) | | | support the development of students' critical thinking skills. |
| 12 | (Ahmad et al., 2024) | Jurnal MathEdu: Mathematics Education Journal (Indexed S5) | R&D; Realistic mathematics education | Junior high school students | The ethnomathematics-based algebra teaching materials developed were found to be valid, highly practical, and effective, and contributed to the development of students' critical thinking skills. |
| 13 | (Pramasdyasari et al., 2024) | MOSHARAFA: Jurnal Pendidikan Matematika (Indexed S2) | R&D; PjBL-STEM-based digital books with an ethnomathematics approach | Junior high school students | PjBL-STEM-based digital books with an ethnomathematics approach are valid and effective in supporting the development of students' mathematical critical thinking skills compared to learning without treatment. |
| 14 | (Fitri et al., 2025) | AKSIOMA: Jurnal Program Studi Pendidikan Matematika (Indexed S2) | R&D; TPACK-based Virtual Reality integrated 3D ethnomathematics e-module | Junior high school students | The TPACK-based 3D ethnomathematics e-module integrated with Virtual Reality is valid, practical, and quite effective in supporting and improving students' critical thinking skills through the visualization of mathematical concepts. |
| 15 | (Putri et al., 2025) | PLUSMINUS: Jurnal Pendidikan Matematika (Indexed S3) | *Quantitative experimental*; Ethnomathematics-based learning using iron tools | High school students | Ethnomathematics-based mathematics learning with the context of blacksmithing tools has been reported to produce better critical thinking skills compared to conventional learning. |
| 16 | (Ikrimah & Argarini, 2025) | JI-MR: Jurnal Ilmiah Matematika | Qualitative descriptive; Ethnomathematics- | Junior high school student | Ethnomathematics-based mathematics learning can facilitate students' critical thinking skills in solving |

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| | | Realistik (Indexed S4) | based learning | s | contextual problems, with varying degrees of achievement in critical thinking indicators. |
| 17 | (Roh et al., 2025) | J-MPM: Jurnal Media Pendidikan Matematika (Indexed S3) | Qualitative descriptive; Learning based on traditional dam-daman ethnomathematis | Junior high school students | The ethnomathematics approach through traditional games can facilitate student engagement and critical thinking skills in solving mathematical problems. |
| 18 | (Gustia et al., 2025) | Jurnal Cendekia: Jurnal Pendidikan Matematika (Indexed S4) | Classroom Action Research (CAR); Ethnomathematics-based learning with the context of Sekapur Sirih | High school students | Ethnomathematics-based learning with the context of Sekapur Sirih dance shows an increase in students' mathematical critical thinking skills in one cycle of Classroom Action Research. |
| 19 | (Ahmad et al., 2025) | Perspectives of Science and Education (Indexed Q3) | R&D; Mandailing culture-based RME assisted by TPACK | Junior high school students | The locally-based RME model assisted by TPACK that was developed is reported to support the improvement of students' mathematical critical thinking skills. |

Based on a synthesis of 19 selected articles, it was found that the ethnomathematics approach has the potential to support the improvement of students' critical thinking skills. Articles with quasi-experimental and experimental designs generally reported an increase in critical thinking scores or significant differences between the experimental and control groups, while developmental and qualitative studies showed that ethnomathematics-based learning was able to facilitate the achievement of critical thinking indicators, such as analytical, interpretive, and mathematical reasoning skills. However, the strength of the evidence varied according to the research desigh and instruments used. Several studies reveal that mathematics learning with an ethnomathematics approach has a positive impact on students' critical thinking skills (Putri et al., 2025). The integration of cultural context in mathematics learning has been proven to increase student engagement, as the material taught is directly related to real life situations, making the knowledge gained more contextual and meaningful (Ahmad et al., 2024; Ikrimah & Argarini, 2025; Noviastuti & Aini, 2024; Roh et al., 2025; Victory et al., 2023). Gustia et al., (2025) emphasized that the application of cultural context in mathematics questions can also contribute to increasing students interest in learning.

Ethnomathematics based mathematics learning is recommended because it can improve students critical and logical thinking skills through a systematic problem solving process that helps students analyze problems and identify patterns accurately (Wahyuni & Kusaeri, 2024). This approach also strengthens students conceptual understanding and critical thinking skills (Ahmad et al., 2024; Fitri et al., 2025; Lubis et al., 2023; Roh et al., 2025), and increasing enthusiasm through ancestral cultural elements, which has an impact on learning enthusiasm and higher critical thinking skills compared to the control class (Noviastuti & Aini, 2024). Furthermore, ethnomathematics encourages student to identify mathematical problems in everyday life and learn about the culture around them, making learning more interesting and less boring (Lubis et al., 2023; Victory et al., 2023). Apart from being a means of cultural preservation, this approach also changes the negative perception of mathematics as a difficult and abstract subject into a fun and relevant learning experience, while increasing students interest, motivation, and love for their culture (Fitri et al., 2025; Noviastuti & Aini, 2024). The ogoal of this learning is to develop the younger generation by hoing students knowledge and skills in understanding mathematical concepts rooted in the surrounding culture.

The use of teaching materials and culture-based learning approaches has proven effective in increasing student motivation and learning satisfaction, which play an important role in developing critical thinking skills. The relevance of learning materials to local culture makes students feel more involved and gain relevant meaning, making the learning process more meaningful and enjoyable. In addition, the integration of technology further enriches the ethnomathematics learning experience through models such as problem based learning (PBL), realistic mathematics education (RME), and the use of digital tools such as e-modules, Android applications, Virtual Reality, and TPACK technology. For example, the MathCityMap platform facilitates the exploration of mathematics in real world environments, while 3D e-modules and digital books play a role in helping to visualize abstract mathematical concepts.

The inquiry based and STEM-PjBL approaches, combined with ethnomathematics, encourage students to actively seek solutions and develop critical thinking skills through real world projects related to their culture. The application of these teaching materials and technologies makes the learning process more interesting and effectively improves students critical thinking skills as a whole. This approach combines mathematical concepts with real life contexts, thereby significantly increasing students relevance and understanding of the material. Give that many students still learn mathematics by memorizing formulas without understanding the concepts, ethnomathematics offers a more interesting and meaningful learning method, while also introducing local culture, which ultimately strengthens contextual understanding and critical thinking skills. Thus, ethnomathematics has great potential in shaping a young generation that is not only skilled in critical mathematics, but also more sensitive to their cultural environment.

An analysis of 19 selected scientific articles shows that there is consistency in that the ethnomathematics approach can significantly improve students critical thinking skills by linking mathematical concepts to local culture and real life contexts. This approach not only improves understanding of mathematical concepts, but also motivates students and makes learning more relevant and interesting through cultural integration and the use of technology such as 3D e-modules, Android applications, and virtual reality.

**Conclusion and Suggestion**

Based on the results of a systematic literature review of 19 scientific articles, it can be concluded that the implementation of the ethnomathematics approach in mathematics education, which links mathematical concepts to local culture and everyday life, have been proven effective in improving the critical thinking skills of junior high and high school students as a whole. Through the analysis of 19 scientific articles, this approach increases student motivation, engagement, and understanding by using systematic problem-solving methods and supporting teaching materials and interactive technologies such as 3D e-modules, Android applications, and Virtual Reality. In addition to strengthening critical thinking and creativity skills, ethnomathematics also contributes to the preservation of local culture and changes negative perceptions of mathematics into meaningful and enjoyable learning experiences, making it highly recommended as a contextual learning strategy that shapes a mathematically competent and culturally sensitive younger generation.

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