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Pantun-Based Cognitive Activation And Local Inquiry: Enhancing Mathematical Critical Thinking Through Bilah Panai Cultural Practices

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Abstract

Mathematical critical thinking is a fundamental competency in mathematics education; however, instructional practices often provide limited opportunities for students to engage in reasoning, inquiry, and reflective thinking. While ethnomathematics has been increasingly integrated into mathematics learning, most studies emphasize cultural artifacts as contextual resources rather than cultural practices as mechanisms of thinking. This study explores the role of Bilah Panai cultural practices, namely pantun *and* merisik/telangkai*, in enhancing students' mathematical critical thinking skills. Pantun was implemented as a cognitive activation strategy to stimulate prior knowledge and interpretation, whereas* merisik/telangkai *was adapted as a local inquiry process that encouraged investigation, discussion, argumentation, and collaborative problem solving. The study involved Grade 10 students participating in mathematics learning activities grounded in Bilah Panai cultural practices. Data were collected through classroom observations, students' mathematical critical thinking assessments, and learning activity documentation. The findings indicate that* pantun *supported students in identifying mathematical ideas and constructing initial interpretations, while* merisik/telangkai *facilitated reasoning, analysis, and problem-solving processes. These cultural practices created meaningful learning experiences and promoted active engagement in mathematical inquiry. The study highlights the potential of local cultural practices to function not merely as learning contexts but as cognitive and inquiry mechanisms that support the development of mathematical critical thinking. This finding contributes to the advancement of ethnomathematics and culturally responsive mathematics education. Quantitative findings showed an improvement in students' mathematical critical thinking scores from a mean pretest score of 58.60 to a mean posttest score of 88.20, yielding a high normalized gain score (g = 0.715).*

Keywords: Mathematical Critical Thinking, Ethnomathematics, Bilah Panai Culture, Pantun, Local Inquiry, Culturally Responsive Mathematics Education.

1. INTRODUCTION

The development of mathematical critical thinking has become a major objective of mathematics education in the twenty-first century. Rapid advances in science, technology, and information have increased the demand for individuals who are capable of reasoning, evaluating evidence, solving complex problems, and making informed decisions. Accordingly, the Organisation for Economic Co-operation and Development (OECD, 2023) emphasizes critical thinking as an essential competency for students to successfully navigate increasingly complex social and professional environments. In mathematics education, critical thinking enables students to interpret information, analyze relationships, evaluate arguments, and justify solutions when confronting unfamiliar problems.

Despite its importance, many students continue to demonstrate low levels of mathematical critical thinking. Suryawan, Sudiarta, and Suharta (2023) reported that students frequently encounter difficulties in mathematical reasoning, argumentation, and solution verification. Similarly, Permatasari et al. (2024) found that conventional mathematics instruction often focuses on procedural mastery rather than reflective thinking and inquiry, limiting opportunities for students to develop higher-order cognitive skills. These findings suggest the need for learning approaches that actively engage students in reasoning, investigation, and meaningful knowledge construction.

One promising approach is the integration of culture into mathematics learning through ethnomathematics. Since its introduction by D'Ambrosio (1985), ethnomathematics has emphasized the relationship between mathematical ideas and cultural practices. Recent studies by Dhema, Cholily, and Rahardjanto (2024) and Sunzuma and Umbara (2025) demonstrate that integrating local cultural knowledge into mathematics instruction can improve students' engagement, conceptual understanding, and learning motivation. Furthermore, Gay (2018) and Ladson-Billings (2021) argue that culturally responsive teaching enhances learning by connecting educational experiences with students' cultural backgrounds.

However, a significant limitation remains in the current ethnomathematics literature. Most studies focus on cultural artifacts such as traditional architecture, handicrafts, weaving patterns, local games, and cultural products. According to Iskandar, Karjanto, Kusumah, and Ihsan (2022), culture is predominantly used as a contextual resource for illustrating mathematical concepts rather than as a cognitive process that supports thinking and learning. As a result, the potential of cultural practices to function as mechanisms of reasoning and inquiry remains largely unexplored.

A second gap concerns the limited attention given to specific cultural practices that may directly support higher-order thinking skills. To date, few studies have investigated the educational role of *pantun* as a cognitive activation strategy in mathematics learning. As a traditional poetic expression, *pantun* requires individuals to interpret symbolic meanings, identify relationships between ideas, and construct contextual understanding. These cognitive activities are closely related to the processes of interpretation, inference, and reasoning that underpin mathematical critical thinking. Nevertheless, its potential as a cognitive activation mechanism has received little attention in mathematics education research.

Similarly, limited research has examined the role of local cultural inquiry practices in supporting mathematical thinking. In Bilah Panai culture, *merisik/telangkai* represents a process of information gathering, consultation, discussion, and collective decision-making. These characteristics closely resemble inquiry-based learning and collaborative problem-solving processes. According to Saleh et al. (2022), collaborative inquiry promotes critical thinking by encouraging learners to evaluate evidence, justify arguments, and negotiate solutions. However, the adaptation of *merisik/telangkai* as a local inquiry process in mathematics education remains underexplored.

This study addresses these gaps by examining the role of *pantun* and *merisik/telangkai* in enhancing students' mathematical critical thinking. In this study, *pantun* is conceptualized as a cognitive activation strategy that stimulates prior knowledge and interpretation before problem solving, while *merisik/telangkai* is positioned as a local inquiry process that facilitates investigation, discussion, argumentation, and collaborative reasoning. Unlike previous ethnomathematics studies that primarily employ cultural artifacts as contextual examples, this study focuses on cultural practices as cognitive and inquiry mechanisms within mathematics learning.

The novelty of this study lies in conceptualizing Bilah Panai cultural practices not merely as cultural expressions but as mechanisms of mathematical thinking. Specifically, the study positions *pantun* as a form of cognitive activation and *merisik/telangkai* as a local inquiry process that supports the development of mathematical critical thinking. Therefore, this study contributes to the advancement of ethnomathematics and culturally responsive mathematics education by demonstrating how local cultural practices can be integrated into learning processes to foster higher-order thinking skills.

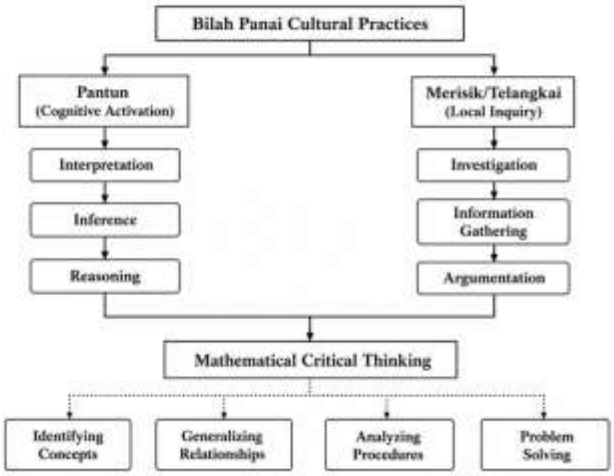

Figure 1. Conceptual Framework of Pantun-Based Cognitive Activation and Merisik/Telangkai-Based Local Inquiry

Figure 1 illustrates the conceptual framework underpinning this study. The framework positions Bilah Panai cultural practices as mechanisms of mathematical thinking rather than merely contextual resources. Pantun functions as a cognitive activation strategy that stimulates interpretation, inference, and reasoning processes, whereas merisik/telangkai serves as a local inquiry process that promotes investigation, information gathering, argumentation, and collaborative decision making. Together, these cognitive and inquiry processes contribute to the development of students' mathematical critical thinking, particularly in identifying mathematical concepts, generalizing relationships, analyzing procedures, and solving mathematical problems.

Research Questions

Based on the identified research gaps and the proposed conceptualization of Bilah Panai cultural practices as mechanisms of mathematical thinking, this study addresses the following research questions:

RQ1: How does pantun function as a cognitive activation strategy in mathematics learning?

RQ2: How does merisik/telangkai function as a local inquiry process during mathematical problem-solving activities?

RQ3: How do pantun-based cognitive activation and merisik/telangkai-based local inquiry contribute to the development of students' mathematical critical thinking skills?

RQ4: In what ways do Bilah Panai cultural practices support the conceptualization of culture as a mechanism of mathematical thinking?

Accordingly, this study aims to explore how *pantun*-based cognitive activation and *merisik/telangkai*-based local inquiry contribute to the development of students' mathematical critical thinking skills in mathematics learning.

2. RESEARCH METHODOLOGY

2.1 Research Design

This study employed a mixed-methods approach with a qualitatively driven interpretive design to explore how Bilah Panai cultural practices, namely *pantun* and *merisik/telangkai*, contributed to the development of students' mathematical critical thinking skills. The study was conducted during the implementation of the Bilah Panai Culture-Integrated Problem-Based Learning Model (PBM–BP) in mathematics classrooms. The qualitative component focused on understanding the cognitive and inquiry processes that emerged during learning activities, particularly students' interpretation, reasoning, argumentation, and decision-making. The quantitative component was used to support the qualitative findings through students' mathematical critical thinking test results. This design was selected because the study aimed not only to measure learning outcomes but also to interpret how cultural practices functioned as mechanisms of mathematical thinking during classroom interactions.

2.2 Participants and Research Context

The study was conducted in a public senior high school in North Sumatra, Indonesia. The participants consisted of 36 Grade 10 students (aged 15–16 years) from SMA Negeri 1 Bilah Hilir. The learning process incorporated *pantun* as a cognitive activation activity at the beginning of instruction and *merisik/telangkai* as a collaborative inquiry process during problem investigation and discussion. Participants were selected purposively because they were directly involved in the implementation of culture-integrated mathematics learning and provided rich information regarding the relationship between cultural practices and mathematical critical thinking.

2.3 Data Collection

Data were collected through classroom observations, semi-structured interviews, and mathematical critical thinking tests.

Classroom Observations

Observations were conducted throughout the learning process to examine students' engagement in *pantun* interpretation and *merisik/telangkai*-based inquiry activities. Particular attention was given to behaviors related to interpretation, reasoning, argumentation, information gathering, and decision-making.

Interviews

Semi-structured interviews were conducted with selected students and teachers following classroom implementation. The interviews explored participants' perceptions of the learning activities and their experiences in using *pantun* and *merisik/telangkai* to understand mathematical concepts and solve problems.

Mathematical Critical Thinking Test

Students completed mathematical critical thinking tasks developed according to the indicators proposed by Syahbana (2012), namely:

1. Identifying and justifying mathematical concepts;
2. Generalizing mathematical relationships;
3. Analyzing algorithms and procedures;
4. Solving mathematical problems.

The test results were used to identify the extent to which students demonstrated mathematical critical thinking during and after the learning process.

2.4 Data Analysis

Qualitative data obtained from observations and interviews were analyzed using thematic analysis. The analysis followed three stages: data reduction, data display, and conclusion

drawing. Students' responses and classroom interactions were coded according to themes associated with cognitive activation and inquiry processes.
The themes were organized into two major categories:

1. Pantun-Based Cognitive Activation
   - Interpretation
   - Inference
   - Reasoning
2. Merisik/Telangkai-Based Local Inquiry
   - Investigation
   - Information Gathering
   - Argumentation
   - Decision Making

Quantitative data from the mathematical critical thinking test were analyzed using descriptive statistics, including mean scores, standard deviations, and normalized gain (N-Gain) analysis to examine students' improvement following the learning intervention.

2.5 Trustworthiness of the Study

To ensure the credibility of the findings, methodological triangulation was employed by comparing data obtained from observations, interviews, and mathematical critical thinking tests. In addition, member checking was conducted with participating teachers to verify the interpretation of classroom events and learning experiences. Through these procedures, the study sought to provide a trustworthy account of how *pantun* and *merisik/telangkai* functioned as cognitive and inquiry mechanisms in mathematics learning.

Table 1
Data Sources, Instruments, and Research Purposes

Data Source	Instrument	Purpose
Classroom Activities	Observation Sheet	To identify cognitive activation and inquiry processes during pantun and merisik/telangkai activities
Students	Semi-Structured Interview Guide	To explore students' experiences and perceptions
Students	Mathematical Critical Thinking Test	To assess critical thinking development
Teacher	Semi-Structured Interview Guide	To validate implementation fidelity

3. RESULTS

3.1 Theme 1: Pantun as Cognitive Activation

Classroom observations revealed that *pantun* functioned as an effective cognitive activation strategy at the beginning of mathematics lessons. Students actively interpreted the relationship between the *sampiran* and the *isi* and attempted to connect the meanings of the pantun with the mathematical concepts being introduced. During group discussions, students identified numerical relationships embedded in the pantun and linked them to algebraic concepts. This activity stimulated students' curiosity and encouraged them to activate prior knowledge before engaging in problem-solving tasks.

To initiate cognitive activation, students were introduced to a pantun related to mathematical pattern recognition before engaging in formal problem-solving activities. An example of the pantun used during the lesson is presented below:

Kalau pergi ke Kota Pinang,
Jangan lupa membeli ikan;
Kalau ingin mencari peluang,
Perhatikan pola dan hubungan.

The pantun was designed to encourage students to interpret the relationship between the symbolic message contained in the isi and the mathematical concept under discussion. During classroom interactions, students were asked to identify possible meanings embedded in the pantun and relate them to the mathematical task. Several students associated the phrase "*perhatikan pola dan hubungan*" with identifying relationships among numbers, variables, or mathematical representations before solving problems. This activity stimulated students' prior knowledge and encouraged them to engage in interpretation, inference, and reasoning processes before formal instruction began.

Analysis of classroom interactions indicated that students frequently identified key ideas embedded in the pantun and discussed possible interpretations with their peers. Evidence from student interviews further supported this finding. One student stated: "*The pantun helped me identify the pattern before solving the problem*." This statement suggests that pantun facilitated students' cognitive readiness by directing their attention to mathematical relationships and encouraging them to activate prior knowledge before engaging in problem-solving activities.

During interviews, several students reported that the pantun helped them focus their attention and provided an easier transition into mathematical discussions. The findings suggest that pantun facilitated cognitive engagement by encouraging interpretation, inference, and reasoning before formal instruction began. These observations support Ausubel's notion of meaningful learning, in which prior knowledge serves as the foundation for acquiring new knowledge. Through pantun-based cognitive activation, students were encouraged to connect cultural meanings with mathematical ideas, thereby creating a more meaningful learning experience.

3.2 Theme 2: Merisik/Telangkai as Local Inquiry

The findings further revealed that *merisik/telangkai* functioned as a culturally grounded inquiry process during problem investigation activities. Throughout group discussions, students gathered information, explored alternative solution strategies, exchanged ideas, and collectively evaluated possible answers before reaching conclusions.

An example of the merisik/telangkai process was observed during a lesson on mathematical problem solving. Students were organized into small groups and presented with a contextual problem involving numerical patterns. Before proposing solutions, group members were encouraged to engage in a structured consultation process inspired by the traditional merisik/telangkai practice. The activity began with information gathering, in which students identified known and unknown elements of the problem. Subsequently, they exchanged ideas regarding possible solution strategies and discussed the validity of each approach. Similar to the traditional merisik/telangkai process, students were expected to listen to different perspectives, negotiate meanings, and collectively reach an agreed solution.

For example, one group initially proposed different formulas for determining the nth term of a sequence. Through discussion and justification, students evaluated the strengths and weaknesses of each strategy before selecting the most appropriate solution. The final answer was accepted only after all group members agreed with the reasoning presented.

This process encouraged students to investigate evidence, justify arguments, evaluate alternatives, and make collective decisions, reflecting the core characteristics of inquiry-based learning and critical thinking.

Observation data showed that students actively questioned one another, justified their reasoning, and compared different approaches when solving mathematical problems. Interview data also provided evidence of students' experiences during the merisik/telangkai process. One student explained: *"The discussion process allowed us to compare different ideas before deciding on the best solution."* This response indicates that the merisik/telangkai-based inquiry process encouraged students to evaluate alternative strategies, negotiate meanings, and make collective decisions based on evidence and logical reasoning. These activities closely resembled inquiry-based learning and collaborative problem solving. Interview data also indicated that students felt more confident expressing opinions because the discussion process reflected familiar cultural practices of consultation and deliberation.

The *merisik/telangkai* process supported investigation and evidence-based reasoning by requiring students to examine relevant information before proposing solutions. Furthermore, students demonstrated increasing ability to defend their arguments and evaluate alternative viewpoints, indicating the emergence of critical inquiry behaviors. In Bilah Panai tradition, merisik/telangkai refers to a structured consultation process in which participants gather information, discuss alternatives, and collectively reach decisions.These findings suggest that *merisik/telangkai* served as a local inquiry mechanism that promoted investigation, information gathering, argumentation, and decision making within mathematics learning.

3.3 Theme 3: Contribution to Mathematical Critical Thinking

The analysis of students' mathematical critical thinking tasks demonstrated that both *pantun* and *merisik/telangkai* contributed to the development of critical thinking skills. Students showed improvements across the indicators of identifying concepts, generalizing relationships, analyzing procedures, and solving mathematical problems. Pantun-based activities primarily supported students in identifying mathematical concepts and constructing initial interpretations. Through the process of interpreting symbolic meanings, students became more capable of recognizing mathematical relationships and identifying important information.

Meanwhile, *merisik/telangkai*-based inquiry activities contributed more strongly to analytical and problem-solving processes. Students evaluated alternative strategies, justified conclusions, and selected appropriate solutions based on available evidence.

Table 2.
Relationship Between Bilah Panai Cultural Practices and Mathematical Critical Thinking Indicators

Cultural Practice	Cognitive Process	Critical Thinking Indicator
Pantun	Interpretation	Identifying mathematical concepts
Pantun	Inference and reasoning	Generalizing mathematical relationships
Merisik/Telangkai	Investigation and information gathering	Analyzing algorithms and procedures
Merisik/Telangkai	Argumentation and decision making	Mathematical problem solving

The findings indicate that the two cultural practices contributed differently but complementarily to the development of mathematical critical thinking. While pantun primarily activated students' cognitive readiness and conceptual understanding, merisik/telangkai facilitated inquiry, reasoning, and reflective problem solving. Overall, the results demonstrate that Bilah Panai cultural practices can function not only as cultural resources but also as cognitive and inquiry mechanisms that support the development of students' mathematical critical thinking skills. This finding provides empirical support for the proposition that culture can serve as a mechanism of mathematical thinking rather than merely a contextual element in mathematics education.

Table 3
Descriptive Statistics of Mathematical Critical Thinking Scores

Test	N	Mean	SD
Pretest	36	58.60	8.12
Posttest	36	88.20	7.45

Table 4
Improvement of Mathematical Critical Thinking

Indicator	Value
Mean Pretest	58.60
Mean Posttest	88.20
Gain Score	29.60
N-Gain	0.715
Category	High

To complement the qualitative findings, students' mathematical critical thinking scores were analyzed descriptively. The results showed a substantial improvement following the implementation of Pantun-Based Cognitive Activation and Merisik/Telangkai-Based Local Inquiry. The mean pretest score was 58.60 (SD = 8.12), while the mean posttest score increased to 88.20 (SD = 7.45). The normalized gain score was 0.715, which falls into the high category according to Hake's classification. These findings indicate that the integration of Bilah Panai cultural practices contributed positively to the development of students' mathematical critical thinking skills.

4. DISCUSSION

4.1 Pantun and Mathematical Critical Thinking: A Cognitive Activation Perspective

The findings indicate that *pantun* functioned as an effective cognitive activation strategy that supported the development of students' mathematical critical thinking. Through the interpretation of symbolic meanings embedded in the relationship between the *sampiran* and the *isi*, students were encouraged to identify ideas, infer meanings, and construct logical explanations before engaging in mathematical problem-solving activities. These processes correspond closely with the critical thinking dimensions of interpretation, inference, and reasoning proposed by Facione (1990) and Ennis (2011).

The role of *pantun* in activating prior knowledge supports Ausubel's (1968) meaningful learning theory, which posits that new knowledge is learned more effectively when it is connected to existing cognitive structures. In this study, *pantun* served as an advance organizer that prepared students cognitively before encountering mathematical problems. By linking familiar cultural expressions with mathematical ideas, students were able to establish meaningful connections between prior experiences and new concepts. Consequently, learning became more than a procedural activity; it became a process of constructing meaning through interpretation and reflection.

The findings are also consistent with contemporary perspectives on cognitive activation theory, which emphasize the importance of engaging learners in intellectually challenging activities that stimulate reasoning and deep processing. Recent studies on cognitive activation indicate that cognitively demanding learning tasks promote students' engagement, conceptual understanding, and higher-order thinking by encouraging them to interpret information, explore relationships, and justify conclusions (Loughland et al., 2024; Earthadara et al., 2025; Zha et al., 2025). This finding also aligns with recent OECD (2025) reports emphasizing that cognitive engagement is a critical component of high-quality teaching and meaningful learning experiences. Within this framework, pantun can be viewed as a culturally grounded cognitive activation strategy that stimulates students' readiness for mathematical inquiry. Within this framework, *pantun* can be viewed as a culturally grounded cognitive activation strategy that stimulates students' readiness for mathematical inquiry. Unlike conventional warming-up activities that primarily focus on motivation or classroom management, *pantun* requires students to engage in interpretation and inference before formal instruction begins. Therefore, the contribution of *pantun* extends beyond cultural appreciation; it actively supports the development of cognitive processes that underlie mathematical critical thinking.

4.2 Merisik/Telangkai as a Local Inquiry Process

The findings further demonstrate that *merisik/telangkai* functioned as a culturally grounded inquiry process that supported students' investigation, argumentation, and problem-solving abilities. During learning activities, students gathered information, discussed alternative solutions, evaluated evidence, and collectively reached conclusions. These processes closely resemble the inquiry cycle commonly emphasized in contemporary mathematics education. From a sociocultural perspective, the findings support Vygotsky's (1978) view that knowledge is constructed through social interaction and collaborative meaning-making. The *merisik/telangkai* process provided opportunities for students to negotiate meanings, exchange perspectives, and co-construct mathematical understanding through dialogue. Such interactions enabled students to develop higher-order cognitive processes that would be difficult to achieve through individual learning alone.

The results are also consistent with the principles of Problem-Based Learning (PBL)**.** According to Hmelo-Silver (2004)**,** inquiry and collaborative investigation are central mechanisms through which PBL promotes critical thinking. Similar processes were observed during *merisik/telangkai* activities, where students investigated mathematical problems, justified solution strategies, and evaluated alternative approaches. These activities required learners to move beyond procedural execution and engage in reflective reasoning.

Furthermore, the findings align with recent research on collaborative inquiry, which highlights the role of discussion, argumentation, and evidence-based reasoning in fostering critical thinking. As reported by Saleh et al. (2022)**,** collaborative inquiry environments encourage learners to analyze information critically and make decisions based on evidence. The present study suggests that *merisik/telangkai* naturally embodies these inquiry characteristics within a culturally familiar framework. Therefore, *merisik/telangkai* should not be viewed merely as a cultural tradition but as a local inquiry mechanism that facilitates investigation, reasoning, argumentation, and collective problem solving in mathematics learning.

4.3 Culture as a Thinking Process: Extending Ethnomathematics Perspectives

The most significant contribution of this study lies in its extension of contemporary ethnomathematics perspectives. Existing ethnomathematics research has largely focused on identifying mathematical concepts embedded in cultural artifacts such as traditional houses, weaving patterns, handicrafts, games, and local products. While these studies have demonstrated the value of culture as a contextual resource, culture has generally remained external to the thinking process itself.

The present findings suggest a different perspective. Rather than functioning merely as a context for learning mathematics, Bilah Panai cultural practices operated as mechanisms that shaped how students interpreted information, conducted inquiry, constructed arguments, and solved problems. In this sense, culture became part of the cognitive process rather than simply a source of contextual examples.

This perspective is consistent with D'Ambrosio's (1985) view that mathematical knowledge emerges from cultural practices and human activities. It also extends the work of Rosa and Orey (2021) by demonstrating that cultural practices can contribute not only to contextualization but also to the development of mathematical thinking processes. Specifically, *pantun* supported cognitive activation through interpretation and inference, whereas *merisik/telangkai* facilitated inquiry through investigation, argumentation, and decision making. Consequently, this study proposes the concept of culture as a thinking process or culture as a mechanism of mathematical thinking. Under this perspective, cultural practices are not merely instructional contexts but epistemological resources that shape how learners think, reason, and construct mathematical knowledge. This contribution represents an important shift from artifact-based ethnomathematics toward process-oriented ethnomathematics.

The findings therefore provide empirical evidence that local cultural practices can function as cognitive and inquiry mechanisms capable of supporting mathematical critical thinking. This perspective offers new opportunities for culturally responsive mathematics education and contributes to the ongoing development of ethnomathematics as a theoretical and pedagogical framework.

The quantitative findings further support this interpretation. Students' mathematical critical thinking scores increased from a mean of 58.60 in the pretest to 88.20 in the posttest, yielding a high normalized gain score ($g = 0.715$). This improvement suggests that the integration of pantun and merisik/telangkai not only enhanced students' engagement in culturally meaningful learning activities but also contributed to measurable gains in higher-order mathematical thinking. The results strengthen the argument that local cultural practices can function as cognitive and inquiry mechanisms that facilitate the development of mathematical critical thinking.

4.4 Theoretical Contribution

This study offers several theoretical contributions to the fields of ethnomathematics and mathematics education. First, it extends the concept of ethnomathematics by shifting the focus from cultural artifacts to cultural practices. While previous studies have primarily used culture as a contextual resource for illustrating mathematical concepts, the present study demonstrates that cultural practices can function as mechanisms of mathematical thinking.

Second, the study introduces pantun as a culturally grounded form of cognitive activation. Through interpretation, inference, and reasoning, pantun facilitates students' readiness for mathematical inquiry and supports meaningful learning.

Third, the study conceptualizes merisik/telangkai as a local inquiry process that promotes investigation, information gathering, argumentation, and collaborative decision making. This finding provides a culturally responsive interpretation of inquiry-based learning within the context of Bilah Panai culture.

Finally, the study proposes a process-oriented ethnomathematics perspective in which culture is viewed not merely as a learning context but as a cognitive and epistemological mechanism that shapes mathematical thinking. This perspective contributes to the development of culturally responsive mathematics education and opens new directions for future ethnomathematics research.

5. CONCLUSION

This study explored the role of Bilah Panai cultural practices, namely *pantun* and *merisik/telangkai*, in supporting the development of students' mathematical critical thinking skills. The findings indicate that these cultural practices contribute to mathematical learning through different but complementary cognitive processes. *Pantun* functioned as a cognitive activation strategy that stimulated interpretation, inference, and reasoning by encouraging students to connect prior knowledge with new mathematical ideas. Meanwhile, *merisik/telangkai* operated as a local inquiry process that facilitated investigation, information gathering, argumentation, and decision making during mathematical problem solving.

The study demonstrates that integrating cultural practices into mathematics learning can create meaningful opportunities for students to engage in higher-order thinking. Through *pantun*, students developed the ability to identify and interpret mathematical ideas, whereas *merisik/telangkai* supported analytical reasoning, collaborative inquiry, and reflective problem solving. These processes contributed to the development of key dimensions of mathematical critical thinking, including identifying concepts, generalizing relationships, analyzing procedures, and solving mathematical problems.

The primary contribution of this study lies in extending current ethnomathematics perspectives by positioning culture not merely as a contextual resource but as a mechanism of mathematical thinking. Unlike artifact-based approaches that focus on cultural products, this study highlights how cultural practices can directly support cognitive and inquiry processes in mathematics learning. Specifically, *pantun* serves as a mechanism of cognitive activation, while *merisik/telangkai* functions as a mechanism of local inquiry.

These findings provide implications for culturally responsive mathematics education by demonstrating that local cultural practices can be integrated into instructional processes to foster critical thinking. Future research is recommended to examine the applicability of similar cultural practices in different educational and cultural contexts and to investigate their influence on other higher-order thinking skills, such as mathematical reasoning, creativity, and communication. Overall, this study contributes to the advancement of ethnomathematics by proposing a process-oriented perspective in which culture functions as an active component of mathematical thinking and learning. This study introduces a process-oriented ethnomathematics perspective that conceptualizes cultural practices not merely as contextual resources but as mechanisms of mathematical thinking. Through pantun-based cognitive activation and merisik/telangkai-based local inquiry, culture becomes an integral part of how students interpret, reason, investigate, and solve mathematical problems.

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