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CRITICAL THINKING SKILLS OF TEACHER PROSPECTIVE STUDENTS IN SOLVING ETHNOMATHEMATICS-BASED MATHEMATICS PROBLEMS

Abstrak
Penelitian ini bertujuan untuk menganalisis dan mendeskripsikan kemampuan berpikir kritis mahasiswa calon guru dalam menyelesaikan permasalahan matematika yang berbasis etnomatematika. Penelitian menggunakan pendekatan kualitatif deskriptif dengan subjek penelitian mahasiswa Program Studi Pendidikan Matematika. Pengumpulan data dilakukan melalui tes kemampuan berpikir kritis berbasis etnomatematika, wawancara mendalam, dan dokumentasi. Instrumen yang digunakan berupa soal-soal matematika yang diintegrasikan dengan konteks budaya lokal, mencakup aspek berpikir kritis yaitu interpretasi, analisis, evaluasi, dan inferensi. Hasil penelitian menunjukkan bahwa mahasiswa calon guru memiliki variasi kemampuan dalam menyelesaikan soal-soal matematika berbasis etnomatematika. Pada aspek interpretasi, mayoritas mahasiswa mampu memahami konteks budaya dalam permasalahan matematika dengan baik. Dalam aspek analisis, mahasiswa menunjukkan kemampuan mengidentifikasi hubungan antara konsep matematika dengan unsur budaya. Pada aspek evaluasi, beberapa mahasiswa masih mengalami kesulitan dalam memberikan penilaian terhadap argumen matematis yang berkaitan dengan konteks budaya. Sementara pada aspek inferensi, mahasiswa mampu menarik kesimpulan logis dari informasi yang diberikan. Penelitian ini mengungkapkan pentingnya pengintegrasian konteks budaya dalam pembelajaran matematika untuk meningkatkan kemampuan berpikir kritis mahasiswa calon guru. Implikasi dari penelitian ini adalah perlunya pengembangan model pembelajaran yang mengintegrasikan etnomatematika untuk mempersiapkan calon guru yang mampu mengajar matematika dengan pendekatan kontekstual berbasis budaya lokal.
Kata Kunci: Berpikir kritis, Etnomatematika, Calon guru, Pembelajaran matematika, Budaya lokal

Abstract
This study aims to analyze and describe the critical thinking ability of prospective teacher students in solving ethnomathematics-based mathematical problems. The research uses a descriptive qualitative approach with the research subject of students of the Mathematics Education Study Program. Data collection was carried out through ethnomathematics-based critical thinking tests, in-depth interviews, and documentation. The instruments used are in the form of mathematical problems that are integrated with the local cultural context, including aspects of critical thinking, namely interpretation, analysis, evaluation, and inference. The results of the study show that prospective teacher students have a variety of abilities in solving ethnomathematics-based math problems. In the aspect of interpretation, most students can understand the cultural context of mathematical problems well. In the aspect of analysis, students showed the ability to identify the relationship between mathematical concepts and cultural elements. In the evaluation aspect, some students still have difficulties in assessing mathematical arguments related to cultural contexts. Meanwhile, in the aspect of inference,

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students can draw logical conclusions from the information provided. This study reveals the importance of integrating cultural context in mathematics learning to improve the critical thinking skills of prospective teacher students. The implication of this study is the need to develop a learning model that integrates ethnomathematics toprepare prospective teachers who can teach mathematics with a contextual approach based on local culture.
Keywords: Critical thinking, Ethnomathematics, Prospective teachers, Mathematics learning, Local culture

INTRODUCTION

Critical thinking skills are a fundamental aspect that must be possessed by prospective teacher students, especially in facing educational challenges in the modern era. Critical thinking can be defined as the ability to think based on clear, logical, and rational reasoning to analyze a fact in forming a judgment (Mangelep, 2017; Ningsih & Kusnafizal, 2020; Nyihana, 2021). This ability is becoming increasingly important considering the role of students as agents of change (Istichomaharani & Habibah, 2016), agents of social control (Jannah & Sulianti, 2021), and iron stocks that require a vision of critical thinking in responding to various phenomena (Sutiyoso et al., 2022; Ismaidar & Putra, 2024).

In the context of higher education, critical thinking skills allow students to gain a more complex understanding of the information presented (Mangelep et al., 2020; Nurhayati & Ervianan, 2024; Dewi et al., 2024). This includes the ability to think more openly (Koriyah & Harta, 2015); Mangelep et al., 2023), formulate problems clearly (Hamdani et al., 2019), collect relevant information (Manurung et al., 2023), and communicate effectively in finding solutions to problems (Sari et al., 2022; Mangelep et al., 2023). According to the Carin & Sund category, critical thinking includes the ability to classify, assume, predict, interpret data, make conclusions, measure, design investigations, observe, graph, minimize errors, evaluate, and analyze (Rahayu et al., 2022; Mangelep et al., 2024).

Ethnomathematics emerges as a bridge that connects formal mathematical concepts with the results of the human mind that need to be considered in learning (Nur et al., 2019; Danoebroto, 2020). D'Ambrosio defines ethnomathematics as mathematics practiced among cultural groups, which can be identified in a variety of social and professional contexts (Sirate, 2015; Arwanto, 2017). Therefore, this approach provides opportunities for students to analyze, formulate, and verify various mathematical facts in the context of daily life.

Ethnomathematics-based learning can be an effective alternative in improving students' mathematical understanding. Ethnomathematics serves as a link between mathematics and culture, allowing learning materials to be directly connected to the cultural context of students (Mangelep et al., 2023; Yuniar et al., 2024). This is in line with D'Ambrosio's opinion that to understand how mathematics is created, it is necessary to understand the problems that drive it in a cultural context (Budiarto, 2016; Mangelep et al., 2024).

The implementation of ethnomathematics-based mathematics learning faces various challenges, especially in integrating cultural aspects into the formal curriculum. However, research shows that ethnomathematical approaches can increase learning motivation by representing unique mathematical ideas (Muzdalipah & Yulianto, 2018; Dosinaeng et al., 2020). Mathematics learning linked to cultural activities is an effective way to connect formal mathematics with the context of daily life (Shavira, 2021; Setiana et al., 2021).

As prospective teachers, students need to develop critical thinking skills through continuous habituation. The habit of critical thinking gradually tends to make students increasingly look at various things around them with curiosity (Muhaiminu & Nurhayati, 2016; Ermiati, 2022). In the context of ethnomathematics-based learning, students are not only required to understand mathematical concepts but also integrate cultural values in learning (Shofiyati, 2021; Ismail et al., 2022).

Educators have the responsibility to develop an informal curriculum that refers to the reality of student life, while integrating traditional values in a cultural-educational context in the mathematics learning process (Nadhief et al., 2024). This requires efforts from educators to master various components related to materials, values, skills, and philosophical foundations that apply in society. Through the ethnomathematics approach, it is hoped that prospective teacher students can develop the critical thinking skills needed to solve contextual mathematics

problems. This approach not only helps in understanding mathematical concepts but also encourages an appreciation of local cultural values and holistic character development.

METHOD

This study uses a qualitative approach with a descriptive type of research. The qualitative approach was chosen because this study aims to explore and deeply understand the critical thinking skills of prospective teacher students in solving ethnomathematics-based mathematical problems. This type of descriptive research is used to systematically describe the facts and characteristics of the object being studied precisely.

The subject of this research is a student of the Mathematics Education Study Program in the fifth semester of the Faculty of Mathematics of Natural and Earth Sciences (FMIPAK) at Manado State University who is taking the Realistic Mathematics Learning course. The selection of subjects was carried out using a purposive sampling technique by considering the following criteria: (1) students have taken basic mathematics courses, (2) students have diverse cultural backgrounds, and (3) students are willing to be research subjects. The number of subjects to be studied is 75 students.

The main instrument in this study is the researcher himself. Researchers play the role of planners, implementers of data collection, analysts, data interpreters, and reporters of research results. The supporting instruments used include:

1. Critical Thinking Ability Test Sheet.
   The critical thinking ability test is developed based on the indicators of the Ennis framework which include: (a) bringing an elementary explanation of a problem, (b) gathering basic information, (c) making inferences, and (d) making further explanations.
2. Observation Sheet
   Observation sheets are used to observe student activities during the process of solving ethnomathematics-based mathematical problems. The observed aspects include interpretation, analysis, evaluation, and decision-making skills.
3. Interview Guidelines
   The interview guidelines were prepared to delve deeper into the critical thinking process of students in solving ethnomathematics-based mathematical problems. The interview was conducted in a semi-structured manner to provide flexibility in digging up information.

Data collection is carried out through several techniques:

1. Written Test
   Written tests are given to measure students' critical thinking skills in solving ethnomathematics-based mathematical problems. The test is in the form of a description that contains contextual problems related to mathematical concepts in local culture.
2. Observation
   Observation was carried out to observe the problem-solving process carried out by students. Researchers observe and record each activity that shows an indicator of critical thinking skills.
3. Interview
   The interview was conducted to confirm and dig deeper into the students' critical thinking process. The interview is conducted after the student completes the written test.
4. Documentation
   Documentation is used to collect supporting data in the form of photos of activities, student work results, and other relevant documents.

Data analysis was carried out qualitatively using the Miles and Huberman model which included three stages:

1. Data Reduction
   At this stage, selection, concentration of attention, and simplification of coarse data that emerged from field records were carried out. The reduced data provides a clearer picture of students' critical thinking skills.
2. Data Presentation
   The data is presented in the form of narrative descriptions, tables, and diagrams to facilitate concluding. The presentation of data is compiled based on indicators of critical thinking ability that have been set.

3. Drawing conclusions
   The initial conclusions presented are still provisional and will change if strong evidence is found to support the next stage of data collection. Conclusions were verified during the study.

To ensure the validity of the research data, the following are carried out:

1. Triangulation
   Triangulation is carried out by comparing data from various sources (source triangulation), various data collection techniques (triangulation techniques), and various data collection times (time triangulation).
2. Member Check
   The data and interpretation of the data obtained are reconfirmed to the research subject to check the correctness of the data and its interpretation.
3. Extended Observation
   Researchers return to the field to conduct observations and interviews with data sources that have been encountered and new.

RESULT AND DISCUSSION

Result

Based on the data analysis that has been carried out, the results of research related to the critical thinking ability of prospective teacher students in solving ethnomathematics-based mathematics problems are as follows:

1. Ability to Provide Simple Explanations

Teacher candidates with high mathematical disposition skills showed good ability in providing simple explanations related to ethnomathematics-based mathematical problems. They can identify relevant information from the given problem and can explain the relationship between mathematical concepts and local cultural contexts. This can be seen from the way they analyze mathematical problems that are packaged in a cultural context in a systematic and structured manner.

Meanwhile, students with medium and low mathematical dispositions still have difficulty in providing simple explanations. They tend to have difficulty identifying important information and making connections between mathematics and the cultural context presented. This indicates the need to strengthen the ability to analyze and interpret problems in the student group.

2. Building Basic Skills

In the aspect of building basic skills, students with a high disposition show good ability in using mathematical concepts to solve ethnomathematics-based problems. They can integrate formal mathematical knowledge with the local cultural context effectively. This ability is very important considering that ethnomathematics-based mathematics learning can facilitate students to construct mathematical concepts based on knowledge of their socio-cultural environment.

Students with medium and low dispositions still need guidance in building basic skills. They often experience confusion in connecting mathematical concepts to a given cultural context. This shows the importance of developing learning strategies that can help students build a better understanding of the relationship between mathematics and culture.

3. Making a Conclusion

The ability to make conclusions in students with high dispositions is prominent in solving ethnomathematics-based mathematical problems. They can draw logical conclusions and explain the reasons behind each settlement step taken. This is in line with the goal of ethnomathematics-based mathematics learning which not only focuses on mastering concepts but also the development of critical thinking skills.

Students with medium and low dispositions showed difficulty in making comprehensive conclusions. They tend to draw conclusions that are not supported by strong arguments and lack consideration of cultural context in problem-solving.

4. Providing Further Explanation

In providing further explanations, students with a high disposition can describe solutions to ethnomathematics-based mathematical problems in detail and systematically. They can explain the connection between mathematical concepts, cultural contexts, and their applications in

everyday life. This ability is especially important given that ethnomathematics can help students understand mathematics in their own social and cultural contexts.

Students with medium and low dispositions still experience obstacles in providing in-depth explanations. They often provide superficial explanations and lack consideration of cultural aspects in their arguments.

5. Setting Strategies and Tactics

The ability to set strategies and tactics is the most challenging aspect for all student groups. However, students with high dispositions showed better ability in planning and implementing problem-solving strategies. They can choose the right approach and use the cultural context as a foundation in the development of problem-solving strategies.

Discussion

1. The Role of Ethnomathematics in the Development of Critical Thinking Skills

Ethnomathematics has a strategic role in developing the critical thinking skills of prospective teacher students (Arwanto, 2017). Through ethnomathematics-based learning, students not only learn mathematical concepts formally but also understand how mathematics is integrated in the context of local culture (Budiarto, 2016). This is in line with the opinion that ethnomathematics can bridge the gap between culture and mathematics education.

Ethnomathematics-based mathematics learning creates a more meaningful and contextual learning environment (Danoebroto, 2020). This helps students develop their critical thinking skills as they can see the relevance of mathematics in their daily lives and culture (Dosinaeng et al., 2020). In addition, this approach also helps students build connections between formal mathematical knowledge and mathematical practice in a cultural context.

2. Mathematical Disposition and Critical Thinking Skills

The results of the study showed that there was a strong correlation between mathematical disposition and students' critical thinking skills (Muzdalipah & Yulianto, 2018). Students with high mathematical dispositions tend to show better critical thinking skills in solving ethnomathematics-based mathematical problems (Nur et al., 2019). This indicates the importance of developing mathematical disposition as a foundation for building critical thinking skills.

Good mathematical disposition encourages students to be more diligent and systematic in dealing with mathematical problems (Setiana et al., 2021). They tend to be more open to new approaches to mathematics learning, including the use of cultural context in learning (Shofiyati, 2021). This is in line with the ethnomathematics-based mathematics learning objectives that encourage students to appreciate mathematics as part of their culture.

3. Challenges in the Implementation of Ethnomathematics-Based Learning

Although ethnomathematics-based learning shows great potential in developing critical thinking skills, there are several challenges in its implementation (Sirate, 2015). One of the main challenges is the difficulty of students in integrating formal mathematical knowledge with cultural contexts (Yuniar et al., 2024). This is especially seen in students with medium and low mathematical dispositions.

Another challenge is the need to develop appropriate and contextual teaching materials. The teaching materials used must be able to facilitate the development of critical thinking skills while still maintaining the essence of mathematics and cultural values. It requires creativity and a deep understanding of both mathematics and the local culture.

4. Implications for Mathematics Education

The findings of this study have important implications for mathematics education, especially in the context of the formation of prospective mathematics teachers (Arwanto, 2017). First, there needs to be a greater emphasis on the development of students' mathematical dispositions as a foundation for building critical thinking skills. Second, mathematics learning needs to be designed by considering the local cultural context to create more meaningful and contextual learning.

In addition, the results of the study also show the importance of continuous professional development for lecturers and prospective teachers in implementing ethnomathematics-based learning. They need to be equipped with adequate knowledge and skills to integrate mathematics with cultural contexts effectively.

Based on the findings of the research, several recommendations can be put forward for the development of ethnomathematics-based mathematics learning, including (1) Development of teaching materials that integrate mathematics with local cultural contexts systematically, (2) Strengthening the ability of lecturers and prospective teachers in implementing ethnomathematics-based learning, (3) Development of assessment strategies that can measure critical thinking skills in the context of culture-based mathematics, (4) Increased collaboration between educational institutions and local cultural communities to enrich the context of mathematics learning.

This research opens several directions for future research. First, further research is needed on the effectiveness of various learning strategies in developing critical thinking skills through an ethnomathematical approach. Second, longitudinal research is needed to understand how critical thinking skills develop over time through ethnomathematics-based learning. In addition, future research can also focus on developing learning models that are more effective in integrating mathematics with cultural contexts. This includes the development of learning technology that can support the implementation of ethnomathematics-based learning more effectively.

CONCLUSION

This study shows that the critical thinking ability of prospective teacher students in solving ethnomathematics-based mathematical problems is greatly influenced by their mathematical disposition. Students with a high mathematical disposition showed better abilities in all aspects of critical thinking, while students with a moderate and low disposition still needed additional support.

Ethnomathematics has been proven to be an effective approach to developing students' critical thinking skills. Through the integration of mathematics with cultural contexts, learning becomes more meaningful and helps students build connections between formal mathematics and mathematical practices in daily life.

However, the implementation of ethnomathematics-based learning also faces various challenges that need to be overcome through continuous professional development and collaboration between various stakeholders. Thus, continuous efforts are needed to develop and improve ethnomathematics-based learning approaches to improve the critical thinking skills of prospective mathematics teacher students.

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