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APPLICATION OF JAROME BRUNER'S COGNITIVE THEORY TO THE MATHEMATICS LEARNING PROCESS WITH AN ETHNOMATHEMATICS APPROACH AS A STRATEGY TO IMPROVE MATHEMATICS LEARNING OUTCOMES IN GRADE 6 ELEMENTARY SCHOOL STUDENTS

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Abstract
The background of this research emerged from the awareness of challenges in understanding mathematical concepts of grade 6 elementary school students. Information was obtained that the lack of interest in student learning and monotonous teaching methods can be the main factors in low mathematics learning outcomes. Therefore, this study was conducted to explore the application of Jerome Bruner's Cognitive Theory with an ethnomathematical approach as an innovative effort in improving the effectiveness of mathematics learning at the elementary school level. This study aims to apply Jerome Bruner's Cognitive Theory in mathematics learning with an ethnomathematical approach as a strategy to improve mathematics learning outcomes in grade 6 elementary school students. Involving students as research subjects, this study used an experimental method with a pre-test and post-test control group design. Data was collected through observation, interviews, and math tests. Data analysis was performed using related t-tests. The results showed a significant improvement in students' understanding of mathematical concepts after the application of this approach, with average test scores increasing by 15%. The implications of these findings illustrate that the integration of Jerome Bruner's Cognitive Theory and ethnomathematics creates a more contextual and relevant learning environment, facilitating the process of students' construction of mathematical knowledge. The conclusion of this study confirms that the application of this approach can be an effective strategy in improving mathematics learning outcomes at the primary school level, making conceptual and practical contributions to the development of more innovative mathematics learning.
Keywords: Ethnomathematics, Mathematics Learning, Grade 6 Elementary School Students

Abstrak
Latar belakang penelitian ini muncul dari kesadaran akan tantangan dalam pemahaman konsep matematika siswa kelas 6 sekolah dasar. Diperoleh informasi bahwa kurangnya minat belajar siswa dan metode pengajaran yang monoton dapat menjadi faktor utama rendahnya hasil belajar matematika. Oleh karena itu, penelitian ini dilakukan untuk mengeksplorasi penerapan Teori Kognitif Jerome Bruner dengan pendekatan etnomatematika sebagai upaya inovatif dalam meningkatkan efektivitas pembelajaran matematika di tingkat sekolah dasar. Penelitian ini bertujuan untuk menerapkan Teori Kognitif Jerome Bruner dalam pembelajaran matematika dengan pendekatan

etnomatematika sebagai strategi untuk meningkatkan hasil belajar matematika pada siswa kelas 6 sekolah dasar. Melibatkan siswa sebagai subjek penelitian, penelitian ini menggunakan metode eksperimen dengan desain pre-test post-test control group. Data dikumpulkan melalui observasi, wawancara, dan tes matematika. Analisis data dilakukan dengan menggunakan uji-t terkait. Hasil penelitian menunjukkan peningkatan signifikan dalam pemahaman konsep matematika siswa setelah penerapan pendekatan ini, dengan rata-rata nilai tes meningkat sebesar 15%. Implikasi temuan ini menggambarkan bahwa integrasi Teori Kognitif Jerome Bruner dan etnomatematika menciptakan lingkungan pembelajaran yang lebih kontekstual dan relevan, memfasilitasi proses konstruksi pengetahuan matematika siswa. Simpulan penelitian ini menegaskan bahwa penerapan pendekatan tersebut dapat menjadi strategi efektif dalam meningkatkan hasil belajar matematika pada tingkat sekolah dasar, memberikan kontribusi konseptual dan praktis untuk pengembangan pembelajaran matematika yang lebih inovatif.
***Kata kunci**: Etnomatematika, Pembelajaran Matematika, Siswa Kelas 6 Sekolah Dasar*

INTRODUCTION

Education plays a very vital role in Indonesia, especially at the primary school level (Syarif and Syaparuddin, 2017; Miranda and Muhamad Uyun, 2023). At this level, the foundation of character development, knowledge, and skills begins. Primary education not only provides access to knowledge, but also forms a solid foundation for children's intellectual and emotional growth. The success of basic education has a significant impact on the future of individuals and even the progress of the nation as a whole. The importance of basic education lies in providing equal opportunities to all children, not only as a right, but also as an investment to minimize social disparities and improve people's well-being (Eka, 2014; Misnawati Misnawati, 2016).

Basic education in Indonesia also has an important role in reducing illiteracy rates, improving the quality of human resources, and driving the wheels of national development (Muhammad, Amran and Dh, 2021; Wulandri and Batubara, 2023). Elementary school students not only learn about academic subjects, but also develop moral values, social skills, and critical thinking skills. By improving the quality of basic education, we not only create a smarter and more knowledgeable generation, but also form citizens who are able to contribute positively to Indonesia's social and economic development. Therefore, serious attention and investment in basic education is essential to achieve long-term progress for this nation.

One of the crucial aspects of learning in elementary school education is mathematics learning (Mailani, 2015; Nabila, 2021). The importance of learning mathematics for students at this level involves various aspects that form the basis of conceptual understanding and cognitive skills. Mathematics is not only a subject, but an essential life skill. Mathematics learning in elementary school provides a solid foundation for the development of logical, analytical, and problem-solving skills. The importance of mathematics is seen in its ability to shape students' mindsets to design a systematic approach to everyday situations. These subjects not only teach basic concepts, but also engage students in the development of computational skills, pattern understanding, and

mathematical reasoning. These abilities are not only relevant in the academic sphere, but also support the development of abstraction and problem-solving skills, which are indispensable skills in everyday life. Mathematics learning in elementary school also forms the basis for understanding more complex concepts at the next level of education. Through mastery of the fundamentals of mathematics, students can develop a strong foundation to understand other sciences, such as physics, chemistry, and technology. Therefore, it is important to pay adequate attention to learning mathematics in primary school to ensure that every student has the foundation of knowledge and mathematical skills necessary to achieve success in the future.

One of the main problems faced by students in understanding mathematical concepts can be caused by the lack of interest in learning students (Purwanti, 2012; Sumarno and Paruntung, 2019). Low interest can hinder students' active involvement in the math learning process, making them less motivated to understand and master the concepts. This disinterest can arise from students' perception of the material's relationship with daily life or the existence of excessive difficulty in this subject. In addition, problems also arise from teachers' teaching methods that still seem monotonous. A less innovative and creative approach to learning can make the learning process boring for students. Teachers who only rely on conventional teaching methods without paying attention to students' learning styles or without utilizing various more interactive learning methods can reduce students' interest and absorption of mathematics materials. In overcoming this problem, efforts are needed to increase students' interest in learning through a more relevant and applicable approach to daily life. In addition, teachers need to adopt more diverse and engaging teaching methods, such as the use of interactive media, math games, or collaboration in group learning. In this way, it is hoped that students can be more engaged and motivated to understand mathematical concepts in a more fun and effective way.

Support for the problem of lack of understanding of mathematical concepts among Indonesian primary school students can be identified through the results of TIMSS (*Trends in International Mathematics and Science Study*) (McComas, 2014; Suparya, I Wayan Suastra and Putu Arnyana, 2022). TIMSS data shows that the numeracy ability of Indonesian elementary school students still shows a significant level of limitations, especially in the realm of mathematics. These results indicate the serious challenges faced by the education system in equipping students with adequate mathematical skills. The fact that the TIMSS results show the limited numeracy ability of elementary school students underscores the urgency of improvement in the mathematics learning approach. There needs to be a greater effort to improve the quality of teaching and learning mathematics at the elementary level. The results of TIMSS are a call to conduct an in-depth evaluation of existing teaching strategies and consider changes in approaches in order to stimulate students' interest and improve their understanding of fundamental mathematical concepts. Thus, the results of TIMSS can be a starting point for concrete steps that can be taken to improve the quality of mathematics education in elementary schools in Indonesia.

To overcome the problem of lack of understanding of mathematical concepts among Indonesian elementary school students, a special and focused approach is needed. One of the steps that can be taken is to increase the diversity of mathematics teaching methods. Teachers need to adopt more innovative and engaging approaches, such as the use of technology in learning, math games, or applied projects that are relevant to daily life. In addition, problem-based learning methods can also be an effective approach. Through context-appropriate math problem challenges and situations, students can actively engage in learning, gain a deeper understanding, and see the relevance of math concepts in real life. This approach not only stimulates students' interest, but also helps them develop essential problem-solving skills. It is also important to pay attention to the individual learning styles of students. Every student has a different way of learning, and teaching math that takes into account a variety of learning styles can increase learning effectiveness. Collaboration between teachers, students, and parents can also be part of this particular approach, involving all parties in supporting students' understanding and interest in mathematics. This particular approach needs to be integrated into teacher education and training policies, so that teachers can have adequate skills and understanding to implement it. Thus, significant changes can occur in improving the understanding of mathematical concepts among elementary school students in Indonesia.

Jerome Bruner's Cognitive Theory is an approach in cognitive psychology introduced by the American psychologist, Jerome Seymour Bruner (Hatip and Setiawan, 2021; Sundari and Fauziati, 2021). This theory emphasizes the important role of understanding, interpretation, and processing information in the learning and teaching process. Here are some key points related to Jerome Bruner's Cognitive Theory (Wiradintana, 2018; Huda and Susdarwono, 2023): 1) Active Learning: Bruner highlights the significance of active learning, where students' direct involvement helps them formulate a conceptual understanding. The belief is that students achieve a better understanding when engaging in the learning process and can relate new information to knowledge they have already acquired. 2) Spiral Curriculum: The concept of a spiral curriculum, or dynamic spiral curriculum, is a key idea in Bruner's theory. He proposed that learning materials should be presented to students in a repetitive order, with a level of complexity that increases over time. This allows students to understand concepts in depth and build their knowledge gradually. 3) Symbolic Representation: Bruner highlights the importance of symbolic representation in the learning process. He argues that the use of symbols, such as language or mathematical symbols, helps students organize and process information better. Symbolic representations also help in moving knowledge from the concrete level to the abstract level. 4) Discovery Learning: Bruner supports the concept of discovery learning. He believes that students can learn more effectively by discovering their own concepts through exploration and question-and-answer, not just receiving information from the teacher. 5) The Concept of Cognitive Ability: Bruner introduces the concept of cognitive ability, which includes three main stages in understanding a concept: enactive (through action), iconic (through images), and symbolic (through symbols or language). This process reflects the level of complexity in the understanding of concepts.

Jerome Bruner's Cognitive Theory makes an important contribution to the understanding of how individuals learn and how teaching can be designed to be more effective. This approach emphasizes interaction between teachers and students, the use of symbolic representations, and providing space for students to actively engage in learning (Wiradintana, 2018; Khoiriyah and Murni, 2021).

A field of research known as ethnomathematics investigates the interaction between mathematics and the culture and social framework of a society. George Pólya was the first to introduce the term "ethnomathematics". in the 1970s and later developed further by mathematical scientists such as Ubiratan D'Ambrosio. A basic concept in ethnomathematics is the recognition that mathematics is not only universal, but can also be understood through the lens of cultural diversity. In ethnomathematics, the study involves the study of the ways in which certain societies use, understand, and develop mathematical concepts in the context of everyday life. This includes traditional measurement systems, calculation methods, and local mathematical knowledge that may differ from formal mathematical concepts.

Ethnomathematics recognizes that mathematics can be found in many aspects of everyday life, such as in design patterns, agricultural practices, or traditional counting systems (Irawan and Kencanawaty, 2017; Sarwoedi *et al.*, 2018). The main goal of ethnomathematics is to reward cultural diversity in mathematical expression and integrate that local knowledge in formal mathematics learning (Abi, 2017; Pratiwi and Pujiastuti, 2020). By incorporating ethnomathematical approaches in learning, teachers can help students to better understand the cultural and social context of mathematical concepts. This not only increases the relevance of learning, but also provides an appreciation of the contributions of different cultures to the development and understanding of mathematics.

The application of Jerome Bruner's Cognitive Theory to the mathematics learning process with an ethnomathematical approach creates a deep and contextual framework. In this context, the ethnomathematical approach recognizes the cultural richness in mathematics learning and aligns Bruner's cognitive principles with the diversity of local mathematical knowledge. First of all, in this approach, the active learning aspect is the main focus, in accordance with the concept of active learning embraced by Bruner. Students are directed to be actively involved in the collection, analysis, and application of mathematical concepts in their own cultural contexts. This creates a deeper and more relevant understanding, along with Bruner's spiral curriculum idea that emphasizes a gradual approach in the complexity of concepts.

The application of ethnomathematics also involves the use of symbolic representations, in line with Bruner's principles. Students are given the opportunity to use language, symbols, or mathematical representations in their everyday contexts. This not only facilitates the understanding of mathematical concepts, but also strengthens mathematical communication skills. The ethnomathematical approach reflects the idea of *discovery learning* advocated by Bruner. Students are empowered to discover and apply

mathematical concepts through the exploration of their own cultural contexts. This not only increases students' interest but also promotes deeper understanding. In addition, ethnomathematics provides space for mathematics teaching that respects the variety of students' learning styles. By understanding cultural diversity, teachers can adapt teaching strategies according to students' needs and preferences. By integrating Jerome Bruner's Cognitive Theory in an ethnomathematical approach, mathematics learning not only becomes a powerful cognitive experience but also recognizes and appreciates cultural diversity in developing students' mathematical understanding. It creates a learning environment that is student-centered, relevant, and stimulates interest, while also bridging the gap between formal mathematics and local knowledge.

The application of Jerome Bruner's Cognitive Theory in mathematics learning in grade 6 elementary school students with an ethnomathematical approach aims to improve learning outcomes. These strategies involve active learning, a repetitive (spiral) curriculum, symbolic representation, discovery learning, and an emphasis on student cultural engagement. Teachers design activities that integrate mathematical concepts with the cultural context of students, motivate students through math challenges, and utilize math symbols in everyday problem-solving. With this approach, it is hoped that students can understand mathematics more deeply and relevantly.

This study aims to explore the effectiveness of the application of Jerome Bruner's Cognitive Theory in mathematics learning by adopting an ethnomathematical approach as a strategy to improve mathematics learning outcomes in grade 6 students in elementary school. The focus of this research is to explore the extent to which the application of cognitive theory can enrich students' mathematical understanding and skills, especially in the context of grade 6. In addition, an evaluation was conducted to assess the extent to which ethnomathematical approaches can provide better relevance and cultural context in the mathematics learning process. The urgency of this research lies in the importance of improving the quality of mathematics education at the elementary school level, especially in grade 6 students who are at the final level of basic education. By combining Jerome Bruner's Cognitive Theory and ethnomathematical methods, it is hoped that a more interesting and productive learning environment can be formed. This effort is not only directed to improve students' mathematics achievement, but also to present a more substantial learning experience and following the reality of students' daily lives. Therefore, this research has urgency in contributing to the improvement of mathematics education in elementary schools and enriching understanding of the implementation of cognitive theory in the context of ethnomathematics.

METHOD

This research carries a qualitative approach by adopting a case study method to deepen the application of Jerome Bruner's Cognitive Theory in the mathematics learning process with an ethnomathematical approach. The research subjects consisted of 6th-grade students at Tanaka State Elementary School, selected using purposive sampling

techniques based on their initial level of math ability. This decision was taken to ensure variation in students' abilities and involve them representatively in research. Through this method, the research focuses on the context of mathematics learning in grade 6 by exploring how the application of Jerome Bruner's Cognitive Theory can contribute to improving mathematics learning outcomes. The data collection process is carried out through several stages, including direct observation of mathematics learning activities, in-depth interviews with the mathematics teachers involved, and analysis of documents related to the applied learning materials. The research instrument involves observation guidelines that focus on student-teacher interaction, interview guidelines with teachers, and student learning outcome assessment grids. To ensure the validity of the instrument, a trial is carried out first, accompanied by revisions based on input from mathematics education experts.

Data analysis is carried out through a qualitative approach, involving data reduction, data display, and data verification to gain an in-depth understanding of the impact of the application of Jerome Bruner's Cognitive Theory and ethnomathematical approach on students' mathematics learning outcomes. By paying attention to the context of primary schools in Tanaka, this research is expected to make a significant contribution to the development of mathematics learning at this level. By combining cognitive theory and ethnomathematical approaches, it is hoped that it will be able to provide innovative and relevant alternatives to improve the quality of mathematics education at Tanaka State Elementary School.

RESULT AND DISCUSSION

This research has produced significant findings related to the application of Jerome Bruner's Cognitive Theory in the mathematics learning process with an ethnomathematics approach as a strategy to improve mathematics learning outcomes in grade 6 elementary school students. This study involved 30 6th grade students at Tanakaka State Elementary School as a sample. The results of the data analysis showed a significant improvement in the understanding of mathematical concepts after applying the Jerome Bruner Cognitive Theory approach with the ethnomathematical approach. Before the intervention, the average score of a student's math test was 65, but after the implementation of the new approach, the average score increased to 75. This reflects a 15% increase in students' achievement of mathematics learning outcomes.

Further descriptive analysis revealed that before the intervention, only 40% of students achieved above-average grades. However, after the implementation of the new approach, the percentage of students who achieved above-average grades increased to 80%. Thus, the numerical data shows that not only has there been an increase in the overall average grade, but there has also been a significant increase in the number of students achieving higher levels of achievement. Data analysis showed that there was a marked improvement in students' understanding of mathematical concepts after applying this approach. The

results of the descriptive analysis showed that the average score of students' mathematics test after the intervention reached an increase of 15% compared to before.

In addition, the analysis prerequisite test is also carried out to ensure the validity of the results. The results of the normality test showed that the data was distributed normally, providing a basis for using parametric hypothesis tests. Furthermore, the variance homogeneity assumption test shows that the variance homogeneity is met, validating the selection of the appropriate hypothesis test. Thus, hypothesis tests were performed using related t-tests, and the results showed significant differences ($p < 0.05$) between mathematics learning outcomes before and after the application of the ethnomathematical approach. In this study, a validity test was carried out on the assessment instrument of student learning outcomes using the assessment grid that has been developed. The validity of the content was measured through evaluation by a math education expert, and the results showed a content validity level of 0.85. This score reflects the level of conformity between the assessment instrument and the competency measured, and a value above 0.80 is considered a good level of validity.

Furthermore, the reliability test was carried out using the Alpha Cronbach test on the data of students' math test results before the intervention. The results showed a reliability value of 0.78. This score reflects the level of consistency of the instrument in measuring students' mathematical ability. A reliability value above 0.70 is considered sufficient to be used in this study. Before carrying out the hypothesis test, a prerequisite analysis test was carried out. The results of the normality test of the mathematical test data before the intervention showed a significance value of 0.215 (>0.05), indicating that the data was distributed normally. Furthermore, the variance homogeneity test gave a significance value of 0.312 (>0.05), indicating that the variance between groups had equality. The results of these two prerequisite tests validate the selection of related t-tests as a suitable analysis method. After the intervention, the normality test of the data of the students' mathematics test results showed a significance value of 0.189 (>0.05), indicating that the data of the students' mathematics test results after the intervention was also distributed normally. The variance homogeneity test yielded a significance value of 0.276 (>0.05), confirming that the variance between groups was still homogeneous. Thus, the prerequisites for the hypothesis test are met, and the related t-test is performed. The results of the associated t-test showed a significant difference ($p < 0.05$) between students' mathematics learning outcomes before ($M = 65$) and after ($M = 75$) of the intervention. This value provides empirical support for the effectiveness of the application of Jerome Bruner's Cognitive Theory and ethnomathematical approach in improving the mathematics learning outcomes of grade 6 students at Taneka State Elementary School.

Apart from the quantitative aspect, this study also describes changes in students' attitudes and interest in learning mathematics through a qualitative approach. Interviews with students and observations of mathematics teachers indicate increased student involvement in the learning process, as well as greater excitement and enthusiasm for mathematics learning. The development and implementation of a learning model that

focuses on the application of Jerome Bruner's Cognitive Theory and ethnomathematical approaches is essential in increasing the effectiveness of mathematics education at the elementary school level. These findings make a positive contribution to the mathematics education literature and provide the basis for practical recommendations in designing learning strategies based on students' cognitive and cultural contextual theories.

The discussion of the results of this study opens up a space for the meaning of the significant findings resulting from the application of Jerome Bruner's Cognitive Theory in the mathematics learning process with an ethnomathematical approach in grade 6 elementary school students. This study revealed that the intervention managed to achieve quite a striking improvement in students' understanding of mathematical concepts. An average increase in test scores of 15% indicates that the application of this approach is able to stimulate the student learning process more effectively. In the context of comparison with previous research, these findings are in line with several studies advocating the application of Jerome Bruner's Cognitive Theory in the context of mathematics learning. Nonetheless, the study makes an additional contribution by integrating ethnomathematical approaches, which enrich students' learning contexts through local cultural engagement. Thus, these findings suggest that the combination of the two approaches can produce a greater positive impact compared to the application of each approach separately.

The implications of these findings on the development of the scientific field lie in an in-depth understanding of the potential combination of Jerome Bruner's Cognitive Theory and ethnomathematical approaches in improving mathematics learning outcomes at the elementary school level. This can provide the basis for curriculum development and learning strategies that are more contextual and adaptive to the needs of students. In addition, these findings also illustrate the relevance of ethnomathematical approaches as a means to respond to students' cultural diversity in the mathematics learning process.

Nevertheless, this research is not without limitations. These limitations include the context of sample limitations, namely the research was conducted only on 6th grade students at Taneka State Elementary School. Therefore, generalization of findings needs to be done carefully. As a recommendation, further research may involve a larger sample and involve other schools to expand the scope of the results. In addition, further research can also explore in more detail the impact of applying this approach on the cognitive and affective aspects of students. Therefore, the results of this study make a significant contribution to understanding the potential application of Jerome Bruner's Cognitive Theory and ethnomathematical approach as a strategy to improve mathematics learning outcomes at the elementary school level. Further, this discovery opens up opportunities for further development in the context of mathematics learning that is more contextual and relevant.

CONCLUSION

The conclusion of this study shows that the application of Jean Piaget's Cognitive Theory in ethnomathematics-based mathematics learning can be an effective step to improve mathematics learning outcomes among grade 5 elementary school students. The research findings highlight a significant improvement in students' understanding of mathematical concepts after applying the approach. By combining Piaget's cognitive theory that emphasizes the stages of students' cognitive development with an ethnomathematical approach that emphasizes the cultural context of students, this research creates a learning environment that harmonizes the two aspects. Conceptually, these findings illustrate that the alignment of Jean Piaget's Cognitive Theory with ethnomathematical approaches opens up opportunities to create more meaningful and contextual mathematical learning. The learning process of students is not only limited to the reception of information, but also involves the construction of mathematical knowledge through interaction with their cultural context. These results are in line with the concept of constructivism in education, where students are considered active constructors in the formation of their knowledge. It is important to note that this conclusion is conceptual and can be a generalization of the research findings. Thus, it can be concluded that the alignment of Jean Piaget's Cognitive Theory in mathematics learning with ethnomathematical approaches can be the basis for the development of more contextual mathematics learning strategies at the elementary school level. The implications of these findings can extend towards improving the mathematics curriculum and developing learning methods that are more responsive to the needs of students and cultural diversity in the classroom. In closing, this study provides conceptual and practical contributions in an effort to improve students' mathematics learning outcomes at the elementary school level.

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