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Ethnomathematics-Based Learning in Improving Students' Creative Thinking Skills

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Abstract
The integration of mathematics with local culture provides a new perspective in teaching that is contextual and close to students' daily life experiences. This study aims to describe the creative thinking ability of grade VII students of SMPN 1 Bolo through ethnomathematics-based learning. This study uses a descriptive qualitative approach with the subject of grade VII students. Data was collected through a test of creative thinking ability on congruence materials and semi-structured interviews, then analyzed based on four indicators of creative thinking according to Munandar: fluency, flexibility, originality and elaboration. The results of the study show that ethnomathematics-based learning gives rise to a variety of students' creative thinking skills. Subjects with better cognitive readiness exhibit strong fluency and flexibility of thinking as well as potential solution originality. However, almost all subjects are still weak in the elaboration aspect, especially in developing detailed explanations.
Keywords: Ethnomathematics, Creative Thinking Ability, Confluence, Bima Traditional House

Abstrak
Integrasi antara matematika dengan budaya lokal memberikan perspektif baru dalam pengajaran yang lebih kontekstual dan dekat dengan pengalaman kehidupan sehari-hari siswa. Penelitian ini bertujuan untuk mendeskripsikan kemampuan berpikir kreatif siswa kelas VII di SMPN 1 Bolo melalui pembelajaran berbasis etnomatematika. Penelitian ini menggunakan pendekatan kualitatif deskriptif dengan subjek siswa kelas VII. Data dikumpulkan melalui tes kemampuan berpikir kreatif pada materi kesebangunan dan wawancara semi-terstruktur, lalu dianalisis berdasarkan empat indikator berpikir kreatif menurut Munandar: kelancaran (fluency), keluwesan (flexibility), keaslian (originality), dan elaborasi (elaboration). Hasil penelitian menunjukkan bahwa pembelajaran berbasis etnomatematika memunculkan variasi kemampuan berpikir kreatif siswa. Subjek dengan kesiapan kognitif lebih baik menunjukkan kelancaran dan keluwesan berpikir yang kuat serta potensi keaslian solusi. Namun, hampir seluruh subjek masih lemah dalam aspek elaborasi, khususnya dalam mengembangkan penjelasan secara rinci.
Kata kunci: *Etnomatematika, Kemampuan Berpikir Kreatif, Kesebangunan, Rumah Adat Bima*

Introduction

Creative thinking skills are an important skill in 21st-century learning because they allow students to create something new or uniquely combine ideas. Creative thinking can be defined as the ability to create something new, or to place and combine a number of objects differently with comprehensible, useful, and innovative thinking (Mursidik et al., 2015). Creative thinking allows students to apply their imagination to generate ideas,

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statements, and hypotheses, experiment with alternatives, and evaluate their own end products and processes (Wolf, 2021).

According to Munandar (2009), creative thinking consists of four main indicators: fluency, flexibility, originality, and elaboration (Fatmawiyanti, 2018). These four aspects are important to develop in mathematics learning, as they help students in responding to various challenges and future innovations (Lestari & Ilhami, 2022).

However, the reality is that there are still many students who show low creative thinking skills. Based on interviews with mathematics teachers at SMPN 1 Bolo, most grade VII students have difficulty in meeting the four indicators of creative thinking. These barriers show the need for learning strategies that can stimulate students' creativity as a whole. One approach that can be applied is culture-based learning, such as ethnomathematics. This is in line with the view that a culture is never separated from learning, so that the diversity and richness of culture in Indonesia can be used to introduce mathematical concepts through culture-based learning (Murni et al., 2025). This approach allows students to connect learning with their real lives, as well as foster a sense of belonging to math lessons.

Ethnomathematics is a term first introduced by D'Ambrosio. In one of his explanations, (D'Ambrosio, 2001) states that *"Ethnomathematics is the mathematics practiced by cultural groups, such as urban and rural communities, working groups, the professional class, children of a certain age group, indigenous peoples, and many other groups who identify themselves with goals and traditions common to those groups."*. This statement emphasizes that mathematics is a cultural product that is born and develops in the social context of the society in which it is used. This means that mathematics cannot be separated from the values, experiences, and traditions of the cultural groups that practice it.

Correspondingly, mathematics is understood as the result of human ideas, creativity, rewards, and efforts to sustain his life rather than just a collection of abstract concepts detached from reality (Walle, 2008). Therefore, D'Ambrosio believes that when children learn mathematics, they will be influenced by the lives, experiences, and cultures that have been formed in them through the environment, family, and local communities (Kusaeri & Pardi, 2019).

By using an ethnomathematical study approach, students can learn mathematics in a contextual and relevant way to their lives, which ultimately positively impacts the improvement of creative thinking skills (Rohviana & Pardi, 2024). In addition, this approach also contributes to building students' mathematical connections, ranging from connections to understanding, representation, to the ability to provide justification for mathematical problem solving. These connections develop hierarchically through the stages of mathematicalization, starting from concrete models to formal models (Kusaeri & Pardi, 2019). In addition, culture-based learning also supports students' mathematical connectedness hierarchically through the mathematization process, starting from understanding, representation, to justification in solving problems. These three connections are interrelated at every stage, from concrete models to formal mathematics, and strengthen students' ability to solve problems thoroughly (Kusaeri et al., 2019).

Research shows that students taught with an ethnomathematical approach have higher creative thinking abilities compared to students who follow conventional learning. This approach not only makes the lessons more engaging, but also stimulates students to think outside the usual ways (Herianto et al., 2021).

Based on these considerations, this study aims to explore the use of Bima traditional houses as a medium in ethnomathematics-based learning. Previous research, for example by Yulianingsih (2021), only highlighted the structural aspects of the Bima traditional house

building from the perspective of architecture and cultural history, without utilizing these objects as a source of mathematics learning. In addition, most previous ethnomathematical research has tended to use other cultural contexts, such as batik or weaving, while studies that integrate Bima traditional houses in mathematics learning are still rare.

Therefore, this research seeks to fill this gap by raising Bima traditional houses such as Uma Lengge, Uma Jompa, Uma Leme, and Uma Ncuhi as a learning context to develop mathematical concepts, especially in building materials. Through this approach, it is hoped that students can understand mathematical concepts contextually while showing improvements in the four indicators of creative thinking, thereby contributing to the development of mathematics learning based on local culture that has not been explored much before.

Method

This study uses a qualitative approach with a case study design. This approach was chosen because the main focus of the research is to systematically describe the phenomena that occur in the field, especially related to the students' thinking processes as illustrated through test results, interviews, and observations during learning. Furthermore, according to Yin's view quoted by John W. Creswell, of. Al (2019), the design of the case study allows the researcher to explore, interpret, or describe a real and complex phenomenon in everyday life, so this method is considered relevant when wanting to understand events in their original context holistically. (Fiantika et al., 2022). The research was carried out at SMPN 1 Bolo, Rato Village, Bolo District, Bima Regency. The research subjects consisted of six students of class VII B who were selected by technique *Destination sampling* Based on the results of the pre-test and post-test analysis, which represent five categories of creative thinking skills, namely very good, good, adequate, lacking, and very lacking.

Data was collected through observation, written tests, semi-structured interviews, and documentation. Pre-test and post-test questions consist of three questions describing the material of creativity developed based on the indicators of creative thinking according to Munandar (2009), namely *Soft*, *flexibility*, *Originality*and *Elaboration*. The data analysis techniques used refer to the model (Miles et al., 2014), namely through three stages that are carried out simultaneously: data reduction, data presentation, and conclusion drawing and verification. To maintain the validity of the data, this study uses a triangulation method by comparing the results of tests, interviews, and observations.

Results and Discussion

Result

This research was conducted at SMPN 1 Bolo, precisely in class VII B which consisted of 26 students. The students have diverse backgrounds, both academically and socially, although they all come from the same local culture. This research was carried out through three main stages, namely pre-test, the implementation of ethnomathematics-based learning, and post-test. In addition, the researcher also conducted observations during the activity as well as in-depth interviews with several selected students.

The results of the pre-test answers consisting of three descriptive questions related to the recovery material were used to obtain an initial picture of students' creative thinking skills. Based on the scores obtained, students are categorized into five levels of ability, which are

determined based on the percentage of scores and are displayed in the following table (Hafiza et al., 2022).

Table 1. Results of the Creative Thinking Ability Pre-test

Golongan	Number of Students
Excellent (81%-100%)	0
Good (61%-80%)	0
Adequate (41%-60%)	0
Less (21%-40%)	9
Very Less (0-20%)	17

After the pre-test, learning continued with an ethnomathematical approach that related the concept of mathematics with local culture, namely the Bima traditional houses: Uma Lengge, Uma Jompa, Uma Ncuhi, and Uma Leme, which contained elements of development. After learning, a post-test is conducted to measure the improvement of creative thinking skills, and the results are grouped into five levels of ability as in the pre-test.

Table 2. Post-test Results of Creative Thinking Ability

Golongan	Number of Students
Excellent (81%-100%)	1
Good (61%-80%)	1
Adequate (41%-60%)	1
Less (21%-40%)	2
Very Less (0-20%)	21

Based on the results of *the Post-Test*, the researcher selected six main subjects purposively: five representing the ability category (K1–K5), and one additional subject (K6) that experienced a decrease in results. All subjects were from class VII B and were further analyzed through triangulation of test data, observations, and in-depth interviews to explore their creative thinking characteristics in solving ethnomathematics-based problems.

K1 (Excellent) subjects show high activity, great curiosity, and are able to explain ideas in detail and in detail. K2 (Good) has a stable learning spirit, using two solution methods, but it takes time to understand the purpose of the problem. K3 (Sufficient) shows less logical answers, only one strategy, and less expanding ideas. K4 (Lack) difficulty understanding the problem, unable to develop a solution strategy, and not proposing alternative solutions. K5 (Very Lack) only relies on formulas without deep understanding, and is not able to explain the thought process. Meanwhile, K6 (Very Less) shows a decrease in scores, lacks focus during learning, and only gives answers without explanation.

This assessment is carried out based on four indicators of creative thinking according to Munandar, namely fluency (*Soft*), flexibility (*Flexibility*), authenticity (*Originality*), and elaboration (*Elaboration*) (Fatmawiyanti, 2018). These four indicators are a reference in analyzing data obtained from test results (pre-test and post-test), observations, and in-depth interviews with six selected subjects based on their ability categories.

Discussion

Subject Category Excellent (K1)

a. Fluency (*fluency*)

Figure 1. K1 answer to question number 1

Munandar (1985) stated that the characteristics of *Soft* includes the ability to spark many ideas, solutions, and approaches to solving problems (Mardhiyana & Sejati, 2016). K1 subjects show fluency in understanding the problem by rewriting it as an initial strategy. The subject actively digs out information and is able to solve the first problem by two different methods, reflecting the characteristics of the *Soft* although it does not always result in many alternatives.

b. Flexibility

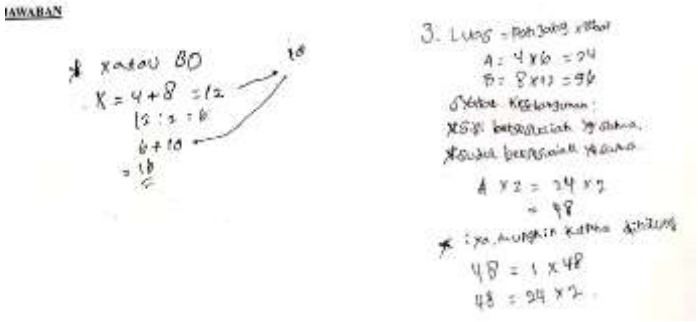

Figure 2. The second answer to K1 questions number 1 and number 3

Based on the theory of Munandar (1985), the characteristics of *Flexibility* Creative thinking includes the ability to generate varied ideas, see problems from various perspectives, and change approaches when facing challenges (Mardhiyana & Sejati, 2016). K1 subjects showed flexibility when solving one problem with two different methods, namely using mathematical formulas and an intuitive numerical approach. This reflects the flexibility of thinking according to characteristics *flexibility* according to the theory.

c. Originality

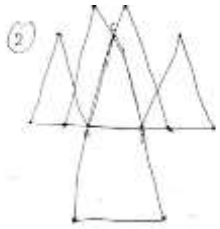

Figure 3. K1 answer to question number 2

The characteristic of originality, according to Munandar, is "thinking of unusual ways of expressing oneself" and "making unusual combinations of elements"(Mardhiyana & Sejati, 2016). K1 shows this feature when drawing a triangle by extending the sides of the old triangle to form a new triangle. This answer is classified as original because it is a creative interpretation of the instruction about the awakening, in line with the concept *Originality* (Munandar, 1985).

d. Elaboration

Based on the results of tests and interviews, the ability to elaborate K1 is still relatively low. Although the subject is able to solve the problem visually and numerically, K1 has difficulty in describing his or her thinking process systematically. When asked to explain the reasons and how to get an answer, the explanation tends to be general and does not touch on the details of the process that is going through. Subjects more often refer to steps globally, such as "divided and multiplied" or "it's from one's own mind," without elaborating on the conceptual interconnectedness in more depth. This shows that the ability to detail, develop, and describe ideas has not developed optimally, in accordance with the characteristics of *elaboration* in creative thinking according to Munandar (1985).

Good Category Subject (K2)

a. Fluency (*fluency*)

Figure 4. Answer to K2 question number 1

Fluency refers to the ability to generate multiple ideas or solutions smoothly. In the K2 subject, this indicator can be seen from his efforts to systematically rewrite the information about the question and continue with the calculation process until the final result is obtained. This shows that there is smoothness in organizing information and responding to questions. However, in the other part, K2 does not

list the steps in full as at the beginning, which indicates that his fluency in thinking is not completely consistent.

b. Flexibility

This indicator shows students' ability to think from various points of view and use different approaches in solving problems. K2 subjects showed thinking flexibility, as illustrated in **Figure 4**, where the subjects tried to solve problems with alternative approaches that were not completely structural. Even though they did not follow the complete formal procedure, K2 was still able to get the correct answer. This shows that K2 can move from a procedural approach to a more intuitive numerical thinking strategy, indicating flexibility in its thinking process.

c. Originality

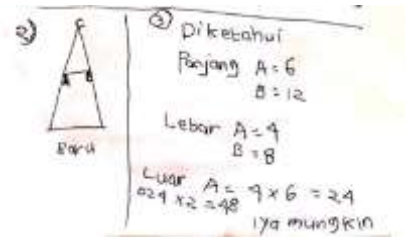

Figure 5. K2 Answers to Questions 2 and 3

This indicator is reflected in the K2 Subject's answer to question number 2, where the subject tries to form a new triangle as part of the completion process. Although this approach seems simple because it only forms a new triangle, it shows the ability to think *originally*, i.e. an attempt to solve problems with an independently developed strategy.

d. Elaboration

Elaboration is related to the ability to develop ideas in depth. In this case, the K2 subject has not been able to explain or expand his mathematical reasoning, either in writing or orally during the interview. The explanations given tend to be concise and have minimal excuses. The inability to explain alternative solutions, despite being aware of their existence, shows a lack of elaboration. The subject has not been able to describe his thought process logically or visually. This shows the need for training in communicating ideas systematically and deeply.

Adequate Subject Category (K3)

a. Fluency (fluency)

Figure 6. K3 answer to question number 1

Based on the test results, K3 subjects were able to solve problem number 1 correctly even though they only obtained *an x* score through one method. However,

this fluency has not fully shown strong *fluency*, because the subject does not show an effort to answer the question request in its entirety. Thus, the fluency of thinking of K3 subjects is able to answer quickly and correctly, but has not shown exploratory abilities in finding various possible solutions.

b. Flexibility

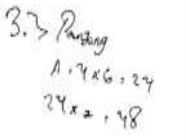

Figure 7. K3 answer to question number 3

Flexibility shows the ability to think from multiple points of view or in a non-rigid way. In the case of K3 subjects, no evidence was found that subjects tried other approaches outside of conventional means. Moreover, even if the Subject completes it correctly, the Subject is not able to re-explain the steps in detail. Overall, the *flexibility ability* of K3 subjects appears to be the absence of an effort to think outside one method or adjust strategies with varied question instructions.

c. Originality

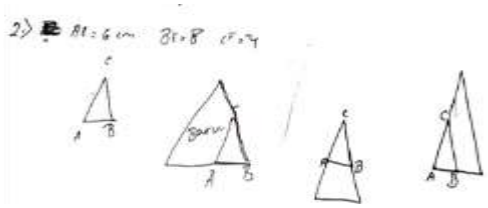

Figure 8. K3 answer to question number 2

Originality has to do with the ability to generate unusual ideas. Based on the results of the test above, K3 subjects showed a unique approach in solving problems. However, in other problems, the subjects were unable to show creative thinking skills, an indicator of *originality*. Thus, the ability of K3 subjects in this case is still relatively low.

d. Elaboration

Based on tests and interviews, K3 subjects have not shown this ability optimally. Although the answers to questions 1 and 2 are correct, the explanation given is brief and does not explain the logical relationship between the steps. The subject's statement in the interview that the subject immediately understands the problem but is not accompanied by an in-depth description, thus showing a low elaboration ability in explaining the thought process.

Less Subject Category (K4)

a. Fluency (*Fluency*)

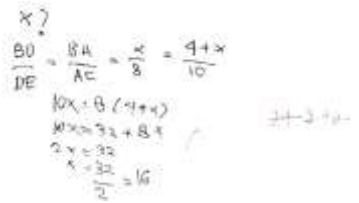

Figure 9. K4 answer to question number 1

K4 subjects showed fluency in thinking when working on question number 1 even though it was not completely correct, characterized by the use of the right formula. This reflects the fluency aspect according to Munandar. However, the subjects only use one method of solving and do not consider other alternatives according to the question order.

b. Flexibility

Figure 10. K4 answer to question number 3

The subject's flexibility is relatively low. Subjects tend to use one approach, and do not provide a variety of solutions, and do not solve the questions they are instructed to do. This does not reflect the characteristics of *flexibility* according to Munandar, such as generating varied ideas or changing the approach to thinking.

c. Originality

The subject does not show a unique or unusual strategy in solving the problem. All the steps taken are conventional and follow the general pattern of classroom learning. This shows that the indicator of *originality* , according to Munandar, namely the ability to think unusually or combine elements uniquely, has not been seen significantly in K4 subjects, both in test results and interviews.

d. Elaboration

The ability to elaborate on the subject is relatively low. Although there are structured completion steps, the subject does not enrich the explanation with additional details. When interviewed, the subject stated that he did not explain the thought process in detail.

Subject Category Very Insufficient (K5)

a. Fluency (*Fluency*)

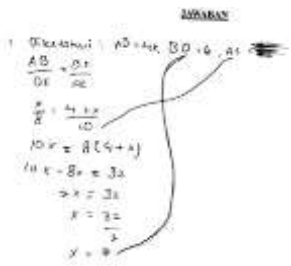

Figure 11. K5 answer to question number 1

K5 subjects are able to identify complete and systematic problem information at the beginning, as well as determine the purpose of completion, which is to find the value of the variable *x*. The completion steps are also arranged in a sequential manner until the final result is obtained. However, the fluency of the subject is still limited to one pattern that has been mastered, so it is not able to explain or develop alternative solutions.

b. Flexibility

Figure 12. K5 answers to questions 2 and 3

The flexibility of K5 subjects is still limited. The subject uses only one method of settlement without trying alternative strategies, as it is affirmed in the interview that there is no other solution than the one he is working on. This shows that the ability to move to other approaches has not yet developed.

c. Originality

K5 subjects solve problems based on previously learned notes, without showing new ideas, so the aspect of authenticity in thinking has not yet seemed significant.

d. Elaboration

In the elaboration aspect, K5 subjects are able to explain the initial information quite well, but the detailed explanation in each step is still limited. Then the answers given tended to be short without further elaboration, although in the interview there was a little description of the thought process.

Subject Category Very Insufficient (K6)

a. Fluency (Fluency)

Figure 13. K6 answer to question number 1

Based on the results of the test question number 1, K6 subjects only used one standard method without exploring alternative solutions. relying on the comparison formula of the value that has been memorized, and during the interview stating that they do not know any other way. This reflects low *fluency* ability, as the subject does not show fluency in generating various ideas or solution strategies.

b. Flexibility

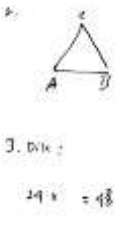

Figure 14. K6 answers to questions 2 and 3

The subject does not show any effort to look at the problem from a different point of view, and the idea of a solution is based solely on the memory of the formula that has been learned. This indicates that the ability to *flexibility* The subject is classified as low, because there is no flexibility in thinking and modifying the solution strategy.

c. Originality

The subject's answer to question number 1 is procedural without showing a unique approach or combination of new ideas. In question number 3, there is an indication of the inauthenticity of the answer because it does not follow logic and resembles an imitation result, even though the subject claims that it is his own thought. The lack of explanation that strengthens the authenticity of the answers indicates that *the originality* indicator in K6 subjects is relatively low.

d. Elaboration

In solving problem number 1, the subject does not include a detailed explanation of his thought process, only presents the final result briefly. Even during interviews, explanations are limited to the use of basic formulas and simple mathematical operations. In question number 2, the subject did not give any answers at all, showing a lack of effort to develop ideas. Thus, the subject*'s elaboration* ability is relatively low.

Variation in Creative Thinking Ability Between Subjects

This analysis aims to elaborate on the variation in creative thinking skills between subjects by emphasizing the differences in each indicator, namely *fluency*, *flexibility*, *originality*, and *elaboration*, as well as identifying category changes that occur between pre-test and post-test.

K1 subjects showed superior creative thinking skills compared to other subjects. This achievement can be seen from the indicators *Soft*, *flexibility*and *Originality* which is good enough, even though *Elaboration* is still general and lacks detail. K2 subjects also showed quite good ability in *Soft* and *flexibility*but *Originality* does not stand out and *Elaboration* still low. In contrast to the two subjects, K3 stands out in *Originality*, while the other three indicators are relatively low. Based on comparison *Pre-tests* and *Post-Test*, these three subjects experienced a category upgrade: K1 from less to excellent, K2 from less to good, and K3 from less to adequate.

K4 subjects showed efforts in solving problems on *fluency* and *flexibility* indicators that were better than K3. However, K4'*s originality* ability is still below K3, and like other subjects, K4 also has a low *level of elaboration*. The K5 subjects showed very little consistency in the category, as they only had enough fluency ability, while the other three indicators were very low, not even trying to give a complete finish on the test. On the other hand, K6 actually decreased from the less to very poor category, despite a small effort to

generate *fluency* indicators. However, the other three indicators remained low in both tests and interviews.

Limitations

This research is still limited to the material on regeneration in class VII. Researchers are then advised to develop a similar approach to other math subjects, or to different levels of education. Additionally, it is important to consider non-cognitive factors such as motivation, confidence, and a student's cultural intelligence that may also influence creative thinking abilities.

Conclusion

Ethnomathematics-based learning can improve the creative thinking ability of grade VII students who are varied in solving mathematics problems in building materials. This variation is reflected through the four indicators of creative thinking ability, namely fluency, flexibility, originality, and elaboration, which complement each other in describing the characteristics of students' creative thinking. The improvement of students' creative thinking skills occurs in most students who already have better cognitive readiness. Meanwhile, some students still need reinforcement of learning that encourages the exploration of ideas, the development of alternative points of view, and mathematical communication training so that creative thinking skills can develop optimally in all indicators.

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