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Problem-Solving Learning Model Based on Ethnomathematics to Improve Student's Creative Thinking in Elementary School

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Abstract

Integrating ethnomathematics into the problem-based model makes it more practical and capable of supporting the design of innovative learning processes for higher-order creative thinking skills. The present study aims to explore students' creative thinking via a problem-solving learning model based on ethnomathematics in elementary school. The study followed a mixed-methods explanatory sequential design. The study involved a total of 75 fourth-grade students and 4 teachers. All the teachers met the criteria set by Ende Flores for innovative educators who incorporate cultural elements into their teaching of mathematics. Information regarding students' creative thinking skills was collected through an essay test, while data regarding the teachers' perspectives and responses were obtained through a structured interview guide. We utilized interpretive and descriptive analysis. The results indicate that the implementation of a problem-solving model based on ethnomathematics of the traditional Sa'o Ria Flores traditional house on flat geometry material requires teachers to prepare learning documents to be able to support learning activities. At the same time, we observed positive changes in students' creative thinking abilities before and after implementing the problem-solving model based on the ethnomathematics of the Sa'o Ria Flores traditional house.

Keywords: creative thinking; ethnomathematics; mathematics education; problem-solving learning model; Flores traditional Indonesia.

1 Introduction

Mathematics holds a significant role in the primary education system, as it plays a vital role in a nation's everyday life, making it a mandatory subject at the elementary school level. The Indonesian Ministry of National Education (MONE) emphasizes that teaching arithmetic to students is not just about numerical skills but also about nurturing logical, analytical, systematic, and creative thinking abilities [6, 36]. MONE further underscores that the primary aim of teaching mathematics in elementary schools is to instill a comprehensive understanding of mathematical concepts [31]. This involves students explaining the interconnectedness of different mathematical ideas, using these concepts effectively to solve real-world problems, recognizing patterns and characteristics, employing mathematics in generating reports, and articulating mathematical concepts [6, 23]. Nevertheless, students, especially at the elementary school level, encounter various challenges when studying all subjects, with mathematics often being viewed as particularly challenging. This is due to the necessity to learn multiple formulas and grapple with context-specific problems that can be difficult to grasp [45]. The primary objective of elementary school mathematics education, as outlined by the National Council of Teachers of Mathematics (NCTM) standards, is to equip students with a firm grasp of mathematical principles and empower them to apply these principles to address everyday issues [19, 36]. There is general agreement that primary education has a greater impact on creative thinking than subsequent educational levels [43].

The Indonesian education system currently grapples with two significant challenges: a decline in the effectiveness of the learning process and a noticeable deficiency in students' thinking skills, particularly in the realm of creative thinking. There is a noticeable lack of emphasis on nurturing students' imaginative thinking during the learning process [5]. Consequently, students often struggle to generate original ideas or develop a conceptual understanding of mathematics. This deficiency hampers the development of their creative thinking abilities, which are essential for problem-solving, generating innovative ideas, and making informed decisions in mathematical contexts [54]. Many students tend to rely on memorizing formulas to solve problems, which limits their adaptability in addressing newly presented challenges [33]. As reported by Parwati et al. [36] the current state of teaching has led to suboptimal outcomes in terms of students' ability to address mathematical problems. Issues such as a lack of comprehension of the problems, difficulties in identifying appropriate problem-solving approaches, and errors in the computation process contribute to this challenge [47]. At the same time, through our interviews, we uncovered a concerning trend among primary school teachers. It became evident that many of them lacked a solid grasp of the fundamental skills required for effective mathematics learning, even though possessing these skills could significantly enhance the quality of mathematics education. Furthermore, our findings indicated that teachers were generally unaware of strategies and techniques to elevate the level of math instruction in primary schools, particularly concerning nurturing creative thinking abilities in students.

To nurture students' creativity, educators are employing a diverse range of teaching methods along with active learning strategies [20]. The elementary school teachers can be able to present various teaching styles creatively [27]. To transform the landscape of mathematics education, innovative instructional designs and models have been conceived. It's particularly fascinating to explore how the incorporation of ethnomathematics learning design, which aligns with the contemporary century we inhabit, could be harnessed to infuse the rich qualities of Indonesian local culture into mathematics instruction, leveraging them as valuable educational assets. This novel learning model has been meticulously structured with a didactic approach aimed at addressing educational challenges effectively. By implementing imaginative and engaging teaching techniques, the learning experience can become more profound and meaningful for students. It's worth noting that not every pedagogical paradigm is suitable or effective when it comes to tackling mathematical problems. Problem-based learning emerges as a potent instructional strategy for resolving mathematical challenges. Through the presentation of real-world problems relevant to students' daily lives, problem-based learning compels educators to apply contextually relevant teaching methods [33]. This approach not only enhances mathematical comprehension but also fosters problem-solving skills with practical applicability. To the best of our understanding, prior studies have yet to merge problem-based learning with ethnomathematics to enhance creative thinking among elementary school students. This underscores a significant void in the current body of literature. A thorough examination of the theoretical underpinnings linking problem-based learning and ethnomathematics to bolster creative thinking in elementary education can offer invaluable insights. Such an exploration promises to enrich our understanding of the subject, providing a more holistic perspective on effective strategies for nurturing creativity in young learners. Therefore, the current research investigates the enhancement of creative thinking in elementary school students before and after implementing an intervention using the problem-based learning model rooted in the traditional Sa'o Ria Flores house from the perspective of artifact ethnomathematics.

2 Research Questions and Hypothesis

The two principal research questions in the current study are as follows:

1. How do teachers apply the problem-solving learning model based on the ethnomathematics of Sa'o Ria Flores's traditional house?
2. How did elementary school students improve creative thinking after being given the intervention of the problem-solving learning model based on ethnomathematics of Sa'o Ria Flores's traditional house on geometry topics?

The following presents the hypotheses developed for this study:

1. There is no significant difference in creative thinking mean scores between pre and posttest in the treatment groups on geometry topics.

3 Literature Review

The problem-solving learning model, rooted in cognitive learning theory and constructivism, posits that students possess an inherent curiosity and actively construct their understanding of the world. It views the classroom as a microcosm of the broader community, providing students with a platform to develop skills in tackling real-world challenges and issues [4, 33]. To create new understandings, students need to engage in activities such as observing, guessing, experimenting, and attempting tasks [32]. With the support of prior knowledge, the constructivist approach positions students as active seekers of knowledge and collaborative creators who integrate new, relevant experiences into their existing mental frameworks or schemas [11]. A constructive problem-solving learning model based on actual challenges given during the learning process serves as the foundation of the classroom [55]. Students are taught to solve issues either alone or in groups using this learning model, which promotes student participation in the learning process. According to Roh [37], the pedagogical method known as issue-based learning provides students with extra chances to engage in critical thinking, articulate their unique perspectives, and collaborate mathematically with peers. This approach organizes mathematics instruction around problem-solving tasks, fostering interactive learning experiences.

Students get the opportunity to enhance their skills in adapting and changing strategies to match new scenarios in a problem-solving learning model setting. One way to implement the integration of local culture in mathematics learning is to make learning relevant to the context that now exists in the area around students. It is anticipated that future students will be better able to understand mathematics, and ethnomathematics helps build students' thinking spaces by educating them about the context of their surroundings [48]. As they build strategies for creating their procedures, students using the problem-solving learning model are integrating their conceptual knowledge with their procedural expertise [37]. A teaching strategy that links mathematical concepts with the dominant cultural backdrop in the classroom to make it more meaningful and foster students' creative thinking is referred to as the problem-solving learning model using ethnomathematics.

3.1 Problem-based learning model

The issue-based learning approach marks a shift from passive knowledge consumption to active, independent problem-solving for students [2]. Problem-solving has been widely regarded as a key objective in mathematics education, and for many, it is seen as synonymous with the concept of mathematical thinking [41]. This approach empowers students to actively cultivate their critical thinking abilities through a variety of techniques, providing them with more opportunities to apply their knowledge across different contexts, devise original solutions to problems, and engage in situations that demand logical reasoning [36]. Furthermore, as problem-solving is a foundational skill in mathematics education, it not only nurtures analytical thinking but also encourages students to become critical thinkers and creative problem solvers, while simultaneously enhancing their overall mathematical aptitude [16]. Indeed, the learning of mathematics remains incomplete without a robust emphasis on problem-solving. Through problem-solving, students gain new practical applications for their mathematical knowledge, deepen their understanding of mathematical concepts, and develop a sense of what it means to think like a mathematician [44]. According to Kordaki and Potari [23], the mathematical concepts taught in schools should be connected to students' everyday experiences. Traditional teaching methods often hinder students from making these connections and utilizing their knowledge to solve real-world problems [22, 54].

Students have the freedom to actively think during learning activities, both individually and in groups, thanks to the problem-solving model, which enhances their analytical skills and enables them to be applied to a variety of situations. This influential approach to learning involves students engaging with real-world problems to conduct a thorough investigation into what they need and what knowledge is required [25]. The learning process commences with a problem to solve, which serves as a pathway for students to acquire new knowledge [33]. The implementation of the problem-based learning model encompasses five phases:

(1) Introducing students to problems.

(2) Organizing students for learning.

(3) Guiding individual and group inquiries.

(4) Creating and presenting work.

(5) Analyzing and evaluating problem-solving processes [4].

By employing problem-based learning techniques, students can be encouraged to address real-world challenges, leading to benefits such as enhanced learning from real-life situations and increased motivation to solve them.

3.2 Ethnomathematics

Ethnomathematics refers to a cultural-based approach to learning mathematics, using culture as a lens to delve deeper into mathematical concepts. The intertwining of mathematics and culture has long been recognized as relevant to people's everyday lives [17, 15]. Essentially, human civilization's progress is intricately linked with the evolution of both culture and mathematics. However, due to differing perspectives, some skeptics question whether culture truly cannot be separated from mathematical activities, yet it cannot be disregarded or overlooked as a contributor to modern mathematics [30]. Therefore, it is highly appropriate to view mathematics as a product of culture [40]. The process of learning mathematics for students involves both the development and application of mathematical ideas within their socio-cultural context and the realities they encounter. Ethnomathematics serves as a bridge that connects mathematics with real-life experiences. By integrating ethnomathematics into education, students are expected to master mathematical skills while retaining and valuing cultural perspectives.

The incorporation of ethnomathematics-focused education in elementary schools has played a significant role in propelling Japan and China toward their status as advanced nations [3]. In Japan, for instance, mathematics students are presented with real-world problems closely tied to their everyday experiences. They adapt to these situations and employ their skills and attitudes to resolve them [14] . More recently, the Problem-Based Learning model has gained recognition as an educational approach capable of enhancing students' higher-order thinking abilities. This is achieved through the integration of ethnomathematics into innovations within mathematics education, to equip students with 21st-century skills, including creative thinking. Acknowledging the significant role of creative thinking in mathematics and the limited research on the creative thinking capabilities of primary school students, there is an urgent requirement to explore the creative thinking skills of students within the realm of mathematics. It is especially critical to examine primary students' creative thinking abilities in the context of both problem-posing and problem-solving tasks. This analysis serves as a foundational step in determining appropriate strategies, teaching materials, and the effective utilization of problem-based learning models infused with ethnomathematics culture in Flores. This innovative approach to learning signifies a significant advancement in the field of education.

Indonesia boasts a rich cultural diversity, with students coming from various cultural backgrounds. Elementary school students possess unique characteristics, necessitating the integration of culture into their learning. This approach aims to facilitate contextual learning, helping students transition from understanding concrete mathematics in real-life situations to mastering formal mathematics concepts. notable aspect of Indonesian culture is the traditional Sao Ria Flores house from East Nusa Tenggara. We selected the ethnomathematics of Sao Ria Flores due to its novelty, as it has not been previously explored in research. Our study employs contextual learning through ethnomathematics, using Sao Ria Flores to aid elementary school students in understanding mathematics concretely and fostering creative thinking to solve formal mathematics problems. Mathematics is inherently present in everyday life, and traditional houses offer a valuable learning resource. The Sao Ria traditional house, a revered structure among the Ende people of Flores, East Nusa Tenggara, was chosen for its unique natural building materials and design. Therefore, incorporating the culture of the Sao Ria traditional house into mathematics education is crucial.

3.3 Creative Thinking

Creative thinking plays a vital role in solving mathematical problems and generating innovative ideas [13, 46]. It is considered a hallmark of advanced cognitive abilities. According to Runco and Jaeger [39] a thought that generates fresh, independent, and innovative thoughts is known as creative thinking. A convergent step of solution matching and evaluation follows the first divergent stage of idea development in the creative process used by remote associates to solve problems [53]. It is crucial to recognize that variations in creativity are evident in the processes individuals employ. According to Bono [10], someone at Level 1 is ready to consider something, investigate a certain topic, and pay attention to others. Level 2 is described as observing the effects of one's actions and decisions, considering the opinions of peers, and contrasting different options. Level 3 is categorized as a thinking strategy, which includes the deliberate application of several thinking tools, structuring thinking as a series of processes, and reiterating the sense of purpose in thinking. Level 4 of reflection on thinking entails arranging thinking tasks and strategies for execution, the use of structured instruments, explicit awareness of reflective thinking, and appraisal of thinking by the thinker himself [42].

Creativity is a complex construct, it comprises a range of abilities divergent thinking has been found to include the following elements:

1. The capacity to quickly come up with new answers to situations that are brand-new or confusing is referred to as fluency;
2. Adaptability, or the capacity to concurrently provide many viewpoints on a certain issue,
3. Originality: the capacity to develop concepts that are original to the individual
4. The capacity to arrange and organize the specifics of an idea and apply this knowledge to carry out a task [26, 50].

Finally, using a problem-solving approach to learning is one of the most effective ways to encourage kids to think creatively [18]. Problem-solving styles have been described in terms of their creativity [52]. One of the key mechanisms behind the process of creative problem-solving. Osborn-Parnes categorizes the phases of creative problem-solving as follows:

1. Locating an item, which is the first step in determining the problem's scope.
2. Discovering reality, which is the stage of gathering information.
3. Finding the issue, which is the step in precisely defining the issue.
4. Generating ideas, often known as generalizing the problem's answers.
5. Finding the answer, which is the stage in which you evaluate every option and choose one.
6. Discovering acceptance, which is the stage of correctly applying chosen ideas [26, 29].

The result of creative thinking is issue-solving using context-specific problem situations to help students build higher order thinking skills that involve creativity and equip them to deal with any problems they may face in daily life.

4 Materials and Methods

4.1 Research design and sample of the study

This study employs a mixed-method approach utilizing the explanatory sequential design, which involves sequentially collecting quantitative and qualitative data [7]. By incorporating both quantitative and qualitative methods, this study can achieve a comprehensive comprehension of the phenomenon being studied. The quantitative aspect facilitates the assessment of students' creative thinking within the problem-solving learning model rooted in the ethnomathematics of Sao Ria Flores's traditional house. Conversely, the qualitative component enables a deeper investigation into teachers' experiences in implementing the problem-solving learning model based on the ethnomathematics of Sao Ria Flores's traditional house. This study employs a mixed-methods approach, involving two distinct phases. In the initial phase, quantitative data is gathered and analyzed, and subsequently, in the second phase, qualitative data is collected and analyzed in alignment with the findings from the quantitative phase. Four teachers were interviewed as part of the descriptive research method; data from the analysis of the interview transcripts was reduced in the first phase, which was followed by the presentation of the interview data in the second phase, and the formulation of conclusions regarding the application of the problem-based learning model based on the traditional Sa'o Ria Flores house in the third phase.

A sample group is constructed and exposed to a problem-based learning model based on the traditional Sa'o Ria Flores house in this quantitative design quasi-experiment, $O_1 - X - O_2$. Students in the sample group were assessed for their capacity for creative thought both before and after the intervention (as measured by pre-test O_1 and post-test O_2). Due to the lack of a comparison group in the design, only pretest and posttest results were utilized to evaluate how well the intervention problem-based learning model, which is based on the traditional Sa'o Ria Flores dwelling, improved students' creative thinking skills.

4.2 Population and sampling method

The population in this research is 75 fourth-grade students and 4 teachers with the criteria of innovative teachers learning mathematics using culture in elementary schools Ende Flores. Each school is grouped. Each region is taken one elementary school to represent the region. This research was conducted in each cluster in elementary schools in Ende-Flores Regency, namely Onekore 2 Catholic Elementary School and Onekore 2 Santa Ursula Catholic Elementary School. To investigate how to implement interventions, four teachers from a fourth-grade elementary school who studied mathematics using ethnomathematics of the traditional Sa'o Ria Flores house are being sampled for this qualitative study using the simple purposive sampling technique. The design pseudo experiment method of simple group random sampling was employed as the sampling approach for quantitative research, with fourth-grade students from elementary school who have studied mathematics as the sample using the ethnomathematics of the traditional Sa'o Ria Flores house.

4.3 Instrument research

In this research, we develop the interview question aimed at finding out the implementation for teachers to determine the intervention of the mathematical problem-solving model based on ethnomathematics in mathematics learning of the fourth grade of elementary school. The interviews took place during the final meeting following the teacher's application of the problem-based learning model rooted in ethnomathematics. These interviews were conducted individually with each teacher from the respective schools, facilitated by the researcher through in-depth, open, and transparent discussions without external influence. Qualitative data collection employed structured interview protocols during the implementation of problem-solving models based on the traditional Sa'o Ria Flores houses. Each teacher was interviewed twice per class, once before (pre-test) and once after (post-test) the learning process, as depicted in Table 1 below.

Table 1: Interview questions.

Indicator	**Interview Questions**
Preparing the learning document	What do you think about preparing the learning component for implementations of the problem learning model based on ethnomathematics of Sa'o Ria Flores's traditional house?
Introducing Flores culture to students in learning mathematics geometry material?	How do you introduce Flores's culture to learning mathematics
Implementations of the problem learning model based on ethnomathematics of Sa'o Ria Flores's traditional house	How do you carry out mathematics learning activities by applying syntax to the problem learning model based on ethnomathematics of Sa'o Ria Flores's traditional house?

We collected data on students' creative thinking abilities through an essay test format, comprising four questions related to geometry concepts, specifically designed to assess creative thinking indicators in problem-solving. Prior to this, we conducted a preliminary study to select teachers proficient in implementing mathematics instruction using the ethnomathematics of Sao Ria traditional houses. These teachers introduced geometry concepts to students using miniatures of the Sao Ria traditional houses. Furthermore, teachers offer students the opportunity to directly explore Sao Ria traditional houses, allowing them to observe geometric shapes in these structures. This hands-on experience fosters creative thinking and helps students understand that geometry has been an integral part of everyday life, both historically and in the future.

We assess creative thinking abilities across four sub-dimensions: fluency, flexibility, originality, and elaboration. We created our own creative thinking assessment rubric, tailored specifically to the abilities of elementary school students in Ende Flores, East Nusa Tenggara. The test focused on flat building materials inspired by the traditional homes of Flores. This test was specifically developed for elementary school students to evaluate their creative thinking skills. Each test was reviewed and validated by an expert, confirming its validity as a data collection tool for this study. Quantitative data was collected using an open-ended written test that measures creative thinking in mathematics, with separate sessions conducted before (pre-test) and after (post-test) learning in each class. The reliability coefficient values for the pretest (0.814) and posttest (0.869) both exceed 0.6, indicating that the instrument possesses good reliability. The progress in elementary school students' creative thinking was evaluated based on their performance on this math exam focused on creativity. Details of the essay test format used to assess students' creative thinking rooted in ethnomathematics are outlined in Table 2

Table 2: Test instrument to students' creative thinking based ethnomathematics traditional house Flores.

Indicator creative thinking	**Mathematical test-based ethnomathematics**
Fluency may be defined as the ability to generate new solutions to new or ambiguous problems in a short time.	If the roof of the Flores *Manggarai* traditional house has an area of $8m^2$. Determine the base and height!
Flexibility refers to the capacity to offer multiple viewpoints or solutions to a specific problem simultaneously.	 Look at the picture above! At the entrance of the Sa'o Ria traditional house building is rectangular with an area of $240m^2$. Calculate the length and width of the door!
Originality refers to the capacity to generate ideas that have not been previously conceived or developed by the individual.	 Look at the picture above! Determine the formula for the surface area of the flat building that forms the roof of the Flores *Manggarai* traditional house!
Elaboration is the skill of structuring and arranging the details of an idea systematically, utilizing this information to complete a task effectively.	 Look at the picture above! Name the surface of the flat building name and its characteristics that form the roof of the Flores *Manggarai* traditional house!

The criteria for students' creative thinking can be seen in Table 3 below.

Table 3: Criteria for students' creative thinking.

Criteria	Classifications	Interpretation
Very creative	4	The student exhibits outstanding fluency, flexibility, originality, and elaboration in their thinking, presenting highly innovative and imaginative ideas.
Creative	3	The student demonstrates a solid level of fluency, flexibility, originality, and elaboration, generating ideas that are inventive and moderately imaginative.
Quite creative	2	The student exhibits a moderate level of creativity, showing some fluency, flexibility, originality, and elaboration. However, their thinking may lack depth and extensive imagination.
Not creative	1	The student demonstrates minimal fluency, flexibility, originality, and elaboration in their thinking, presenting ideas that are conventional and devoid of imagination

4.4 Analysis data

This research uses qualitative analysis data to gain the description implementation of problem-solving models based on ethnomathematics of traditional Sa'o Ria Flores traditional houses on learning geometry. After the collection of data, an interpretive and descriptive analysis is needed to determine the significance of the data's various descriptions and explanations. Four teachers who can apply problem-solving models based on ethnomathematics of traditional Sa'o Ria Flores dwellings on learning geometry were interviewed for the qualitative data analysis that we carried out. Additionally, to analyze quantitative data, the test results were compared to the hypothesis (H_0), which states that there were variations in the student's capacity for creative thought before and after the problem-solving model based on the ethnomathematics of Sa'o Ria Flores's traditional house on geometry material was implemented. This was done using the statistical paired sample t-test. Evaluations for normality were made on quantitative analysis data before statistical tests were run.

5 Results

5.1 Teachers apply the problem learning model based on ethnomathematics of Sa'o Ria Flores's traditional house

The learning process is effectively carried out when the teacher meticulously prepares the lesson through a well-structured lesson plan. This is corroborated by the remarks of two teachers from Katolik Onekore 2 elementary school and two teachers from Katolik Onekore 2 Santa Ursula elementary school, who affirm that the problem-based learning model rooted in ethnomathematics of the traditional Sa'o Ria Flores house yields positive outcomes when all necessary documents are thoroughly prepared. However, it is noted that the preparation of learning materials can be time-consuming, as evidenced by the transcript provided:

> *"The implementation of the problem learning model based on ethnomathematics of Sa'o Ria Flores traditional house will be maximized if all of the learning documents are well prepared and well planned, whereas making a good learning tool takes a long time."* (Interview Teachers).

Introducing Flores culture to students in learning mathematics geometry material

> *"The teacher said that to introduce Flores culture to students learning the teacher provided visual media in the form of pictures of Flores Sa'o Ria traditional houses to build students' initial knowledge before students learned to directly observe the wild environment and bring students to learn directly to see the Sa'o Ria Flores traditional house, so the goal is that students can observe geometric building houses. In addition, in mathematics learning, teachers provide puzzle games that provide opportunities for students to learn while playing by arranging geometric shapes to form a Flores Sa'o Ria traditional house building".* (Interview Teachers).

5.2 Implementations of the problem learning model based on ethnomathematics of Sa'o Ria Flores's traditional house

> *"Phases orientation of students to contextual problems related to Flores Sa'o Ria traditional house. The purpose of providing problems so that students can understand concrete concepts to learn to understand formal mathematics. Through observing the Flores Sa'o Ria traditional house, which was carried out directly, the teacher gave mathematical problems, and then students in groups were allowed to solve problems from the observation of the five senses of students".* (Interview Teachers).

> *"Phases organizing students to learn to solve mathematical problems using and searching for data/ materials/tools needed to find alternative solutions to solve mathematical problems. At this stage, provide students with direct learning opportunities to try according to their ability and understanding in observing each building of the Flores Sa'o Ria traditional house. This is because each student has different initial knowledge in understanding the problem".* (Interview Teachers).

> *"Phases guiding individual and group investigations, collecting and investigating (looking for data/ references/sources). At this stage, students are given the freedom to observe each building*

of the Flores Sa'o Ria traditional house, this aims to free students to gain extensive knowledge". (Interview Teachers).

"Phases develop and present the work that students have done as an effort to find solutions to mathematical problems. At this stage, each student discusses the results of their findings so that groups of students can together unite the findings to make a report on solving mathematical problems in the form of work". (Interview Teachers).

"Phases analyze and evaluate the problem-solving process. At this stage, the teacher guides students to give appreciation and input to each other according to the knowledge of each student, then the teacher reinforces the findings made by students and together concludes the material". (Interview Teachers).

5.3 Creative thinking student' after intervention of the problem-solving model based on ethnomathematics of Sa'o Ria Flores

Table 4: Pre-post-test normality analysis results of creative thinking.

Descriptive Statistics					
	N	**Skewness**		**Kurtosis**	
	Statistic	**Statistic**	**Std. Error**	**Statistic**	**Std. Error**
Pre-test	75	$-.506$	.277	$-.674$	.548
Post-test	75	$-.462$	.277	.132	.548
Valid N (listwise)	75				
Ratio Value		-1.822		-1.229	
		-1.664		0.241	

The results from Table 4 pretest statistical analysis used skewness -1.822 and kurtosis -1.229. While the result post-test statistical analysis used skewness -1.664 and kurtosis 0.241. It means then the variance of the data group is normal.

Table 5: Pre-post-test descriptive analysis results of creative thinking from paired sample t-test

Paired Sample Tests								
	Paired Differences					t	df	
		Std. Deviation	**Std. Error,** r	95% Confidence Interval of the Difference				Sig. (2-tailed)
	Mean	n	Mean	Lower	Upper			
Pretest-posttest	-4.12000	1.90986	.22053	-4.55942	-3.68058	-18.682	74	.000

The statistical analysis of the results in Table 5 employed the Paired sample t-test, with a significant value of $0.000 (p < 0.05)$. This indicates that the alternative hypothesis (H_a) is accepted, suggesting differences in students' creative thinking abilities before and after the implementation of the problem-solving model based on ethnomathematics of the Sa'o Ria Flores traditional house, focusing on geometry materials.

6 Discussion

The study involved implementing a problem-solving model rooted in ethnomathematics focused on flat geometry materials inspired by the traditional Sa'o Ria Flores house. The teacher applied this model using the five phases of the problem-based learning (PBL) approach, which include orienting students to problems, organizing them for learning, guiding individual and group investigations, developing and presenting work, and evaluating problem-solving processes [2]. This approach aimed at creating meaningful mathematics learning experiences that enhance students' creative thinking abilities.

This study highlights the importance of teachers implementing problem-solving models in mathematics education using the ethnomathematics framework of Sa'o Ria Flores traditional houses. Such an approach requires thorough preparation of learning tools and significant time investment. Teachers allowed students to directly explore and observe the geometric features of the Sa'o Ria traditional house, recognizing that students possess varying levels of creative thinking abilities. During direct observation, students can discuss their findings and collaboratively solve mathematical problems, particularly in geometry.

In the learning process, teachers utilized miniatures of the Sa'o Ria traditional house as a medium to help students transition from understanding concrete geometric concepts to formal mathematics. After implementing the problem-solving model focused on the ethnomathematics of the Sa'o Ria Flores traditional house, teachers assigned open-ended mathematical tasks to measure students' creative thinking. The study reveals a significant improvement in students' creative thinking abilities before and after the implementation. This indicates that the problem-solving model centered on the ethnomathematics of the Sa'o Ria Flores traditional house effectively enhances the creative thinking abilities of elementary school students in mathematics.

The gap between this research and this study lies in the stages of learning carried out by the teacher providing contextual problems about geometry material that students can find in the Sa'o Ria Flores traditional house building by providing opportunities for students to solve problems according to their students' creative thinking. When solving contextual issues as part of culturally appropriate primary school mathematics that emphasizes the function of mathematics in a sociocultural milieu, an ethnomathematical viewpoint should be applied [30, 35]. The results of this study are in line with the research conducted [51] that students who obtain learning with an ethnomathematics-based problem-solving learning model have better-improved convergent and divergent problem-solving abilities. Meanwhile, research conducted by Kamidah et. al [21] shows that utilizing an ethnomathematics-infused problem-based learning approach enhances students' critical thinking skills.

A method for studying mathematics that enhances the capacity to understand mathematics is problem-solving learning model-based ethnomathematics [24]. The assertion that the Problem-Based Learning (PBL) model rooted in ethnomathematics enhances mathematical creative thinking skills by fostering problem-solving habits reinforces the connection between learning ethnomathematics and developing creative thinking abilities.

The implementation of the problem-solving model rooted in ethnomathematics from the Sa'o Ria Flores traditional house had a notable effect on enhancing the creative thinking abilities of elementary students, specifically in geometry concepts. These findings are crucial to the development of fundamental competencies in math education in the twenty-first century. This finding is consistent with that of earlier studies, which showed that an educated problem-solving approach based on ethnomathematics might foster students' innovative thinking. Based on the results of research by Suryonegoro and Hidayah [49] the impact of Gedongsongo's ethnomathematics using the PBL approach on critical thinking abilities. According to Adnan et al. [1], ethnomathematics help students develop and improve their creative and artistic thinking talents. Integrating character education is beneficial to individual personality development and should begin at a young age.

The PBL model based on ethnomathematics learning of Sa'o Ria Flores traditional house is a cultural artifact that can build students' knowledge in learning geometry, so this learning stresses students' creative thinking processes, it can be used to enhance primary school students' mathematical thinking processes. Ethnomathematics is one of the innovations in mathematics education that blends cultures to protect local cultural values. By including cultural elements in mathematics learning activities, it can be made easier for students to comprehend the subject being taught. This can be achieved by creating alternatives that seek to instill a passion for Indonesia's history and culture in addition to introducing it. Ethnomathematics includes artifacts mathematical objects, and learning materials derived can be adopted in learning as a context related to daily. The artifacts of ethnomathematics of Sa'o Ria Flores's traditional house on geometry material are a subject that needs to be explored to improve conceptual understanding [31]. The findings from this study as well as the results of relevant studies, the problem-solving model-based ethnomathematics of Sa'o Ria Flores traditional house can be easy to mathematical concepts by understanding geometry and applied in routine mathematics learning so that students' creative thinking skills can continue to develop.

This research is in line with research by Faiziyah et al. [12], which showed that students' creativity could be increased through culture-based learning. Instead of providing students with ready material, problem-based learning techniques guide them to solve theoretical and practical issues to gain knowledge and skills. Students take an active role in problem-based learning by conducting independent knowledge searches. This encourages their growth, independence, and l thinking, as well as the acquisition and development of competencies [29]. The problem-solving model aims to engage students in enjoyable and captivating learning experiences while fostering the development of creative thinking skills [28].

We created an ethnomathematics framework based on the Sa'o Ria Flores House, a residence and communal space within the Lio community. This structure embodies the principle of harmony among people and between humans and the universe, with the Creator representing the equilibrium of human existence. Situated in the Ende Regency of Flores, NTT, Indonesia, this house holds a distinctive historical significance within traditional architecture, as depicted in Figure 1.

Figure 1: Sa'o Ria Flores house.

Figure1 shows the house of Sa'o Ria Flores's traditional mathematics learning content on geometry material about flat buildings. The door of the house is rectangular so that students learn directly by observing and discovering mathematical concepts, students can solve mathematical problems.

Figure 2: Sa'o Ria Flores house.

Figure 2 shows the house of Sa'o Ria Flores's traditional mathematics learning content on geometry material about flat buildings. On the roof of the house forms a triangular flat built. In the learning process students are allowed to construct their knowledge to observe the characteristics of the triangular roof so that by teaching students contextually using culture, students can understand concepts and solve formal mathematical problems.

Figure 3: Sa'o Ria Flores house.

Figure 3 shows the house of Sa'o Ria Flores's traditional mathematics learning content on geometry material about flat buildings. On the roof of the house forms two dimensions buildings that are fused, namely a rectangular flat building and a trapezoid. In the learning process, students observe and find solutions to mathematical problems that connect two dimensions buildings.

The integration of ethnomathematics into an instructional method in practice, the biggest mean increase in the acquisition of creative skills was achieved using the problem-solving model based on ethnomathematics through indigenous knowledge [34]. Applying ethnomathematics as a pedagogical act in mathematics learning restores a sense of pleasure or involvement and can increase creativity in mathematics [17, 8]. It is essential to develop creative thinking skills to be able to come up with fresh ideas and solutions to issues to prepare them for life in the real world [38].

7 Conclusions

Based on the findings and discussions presented, it can be inferred that there is a noticeable enhancement in students' creative thinking following their engagement with the problem-solving model based on ethnomathematics artifacts from the Sa'o Ria Flores traditional house, which includes mathematical objects and learning materials derived from ethnomathematics. These materials can be integrated at the outset of learning to provide a context relevant to students' daily lives. Through the problem-solving model rooted in ethnomathematics, students can explore mathematical concepts within diverse cultural contexts, fostering a deeper understanding of mathematical information. This approach is vital in educational settings as it indirectly imparts cultural values to children while allowing them to grasp mathematical concepts through real-life scenarios that resonate with their own identities. By incorporating the problem-solving model based on ethnomathematics, education becomes more practical and conducive to innovative learning designs, ultimately enhancing students' cognitive abilities and facilitating their achievement of learning objectives in the 21st century.

7.1 Limitations and recommendations

While this research represents a groundbreaking effort to enhance elementary school students' mathematical learning experiences, it's essential to recognize that this study has certain limitations. Specifically, it focused on a particular subject group consisting of two schools deliberately chosen by the researchers due to their utilization of ethnomathematics, which primarily revolved around the application of Sa'o Ria traditional house artifacts in the study of geometry on flat surfaces. Considering our findings, we strongly advocate for the adoption of a problem-solving learning model that fosters the development of students' mathematical reasoning skills. This model encompasses a wide array of mathematical concepts that can be explored within different cultural contexts. By doing so, we can illustrate the intimate connection between mathematics and culture, revealing how mathematical principles can genuinely emerge from cultural contexts [34]. This approach could serve as a tangible and effective resource for teaching mathematics across various educational settings, emphasizing the idea that mathematics can be unveiled within the tapestry of culture. For future research endeavors, it is imperative to focus on delving into the intricacies of Flores culture to foster innovation in mathematics education. This exploration can be facilitated by gaining a deeper understanding of the various aspects of Flores culture, such as traditional games, crafts, activities, and community practices that are tangible and integral to the culture. By incorporating ethnomathematics-based problem-solving models, elementary school students can learn mathematics more effectively, making it more relevant to their daily lives. This approach bridges the gap between mathematics and culture, empowering students to apply mathematical concepts in practical and culturally meaningful ways.

7.2 Research implication

The problem-solving learning approach integrates meaningful learning by introducing problems that resonate with learners' daily experiences, utilizing ethnomathematics. As noted by D'Ambrosio [9], educators can enrich classroom experiences by acknowledging and leveraging the diverse mathematical practices observed worldwide. This research represents an innovative step in elementary mathematics education, employing a problem-solving model grounded in ethnomathematics inspired by the Sa'o Ria Flores traditional house. This approach aims to simplify mathematical concepts, particularly in geometry, fostering the continuous development of students' creative thinking abilities to bolster their proficiency in mastering essential mathematical competencies in the 21st century.

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