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Traditional Houses in Ethnomathematical-Thematic-Connected-Based Mathematics Learning

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Abstract: Traditional houses are part of the culture of every country. *Indonesia* is a country that has a variety of traditional houses. The traditional Banyuwangi house is known as the *Using* house. This house can be explored in terms of ethnomathematics and used as part of learning mathematics. This research is focused on knowing and describing mathematics learning that integrates the ethnomathematics of *Using* house, thematic, and connected models. The research was also conducted to determine the effectiveness of the learning that has been carried out. The results showed that the use of the *Using* house in ethnomathematical-thematic-connected-based mathematics learning: (1) could be done using the trivium concept (literacy, matheracy, and technoracy); (2) can be done thematically by integrating four subjects (Indonesian, social sciences, fine arts, and mathematics); (3) can be connected by integrating two mathematical concepts (two-dimensional geometry and arithmetic); (4) through seven phases of learning; and (5) effective because 80% of students can solve problems as expected.

Keywords: *Math connection, ethnomathematics, problem-solving, culture-themed learning, Using traditional house.*

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Introduction

Mathematics is a science or knowledge about learning or logical thinking that is needed by humans to live which is the basis for the development of modern technology and plays an important role in various scientific disciplines and advances human thinking power (Kemendikbud, 2022). Mathematics is also one of the most ancient human intellectual disciplines and traditions, enabling all science and technology; provides powerful tools for analytical thinking as well as concepts and language for creating precise quantitative descriptions of the world; even basic mathematics involves subtle and beautiful knowledge and reasoning (Ball, 2003). This opinion shows that mathematics is one of the knowledge that has a big relationship and influence in various fields and everyday life.

One that is connected with mathematics is culture. Mathematics and culture are often interconnected and make mathematics in schools closely related to the society in which mathematics is taught (Madusise & Mwakapenda, 2014). Culture can be understood as all activities of social, physical, external, and internal life, including all tangible things such as building materials, furniture, clothing, musical instruments, and so on, as well as intangible things such as arts and crafts, customs and traditions, ideas, values, social and political norms and customs, and so on (Khan et al., 2012); a set of values and beliefs, or a group of behaviors that are learned and taught in a particular community so that it gives a sense of belonging and identity (Lebrón, 2019); or a set of spiritual, material, intellectual and emotional characteristics of a society or social group, and includes art and literature, lifestyle, way of living together, value systems, traditions and beliefs (Yazd, 2020). So, culture contains a variety of knowledge, one of which is mathematics.

The existence of mathematics in culture is interesting to be explored and implemented in learning. Because "mathematics is a compilation of progressive discoveries and inventions from cultures around the world during the course of history" (D'Ambrosio, 2001b, p.310) and "a culture base mathematics is a salient component to pedagogical practices because it affords educators real-life practices with cultural implications embedded with mathematical concepts" (Elpidang & Herrera, 2016, p.41). In addition, culture-based mathematics learning is one of the interesting,

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fun, and innovative learning alternatives because it allows contextual meaning based on the student experience as members of a cultural community so that it is expected to support the literacy movement (Surat, 2018).

The awareness to use mathematics in a socio-cultural environment outside of school is the driving force behind the emergence of the concept of mathematical literacy as a cultural identity (Danoebroto et al., 2020). So one way to achieve mathematical literacy is through culture-based learning. The Organisation for Economic Co-operation and Development (2019, p.75) stated that "mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged, and reflective citizens".

The achievement of mathematical literacy through culture is supported by the development of ethnomathematics. Ethnomathematics can be defined as (1) "the mathematics practiced by cultural groups, such as urban and rural communities, groups of workers, professional classes, children in a given age group, indigenous societies, and so many other groups that are identified by the objectives and traditions common to these groups" (D'Ambrosio, 2001a, p.1); (2) "a research program about the history and philosophy of mathematics, with obvious implications for teaching" (D'Ambrosio, 2001a, p.17); (3) "an approach of teaching and learning mathematics which builds on the student's previous knowledge, background, the role his environment plays in terms of content and method, and his past and present experiences of his immediate environment and the approach could be in a practical way" (D'Ambrosio, 2001b, p.308). These three notions show that ethnomathematics can be viewed as an object, a research program, and can then be applied in learning.

D'Ambrosio's opinion is reinforced by the development of a trivium curriculum for mathematics that allows learning activities in schools to be developed based on ethnomathematics and modeling (Rosa & Orey, 2016). This curriculum is based on three concepts, including literacy, matheracy, and technoracy (D'Ambrosio, 2001a; Rosa & Orey, 2015). Literacy is the ability of students to process and use information in everyday life in written and oral form, which includes reading, writing, arithmetic, representing, and using media and the internet (communicative instruments). Matheracy is a student's ability to interpret and analyze signs and codes, propose and utilize models and simulations in everyday life, and describe abstractions based on real representations (analytical instruments). While technoracy is the ability of students to use and combine instruments, both simple and complex, including their bodies, then evaluate the possibilities and limitations as well as their adaptation to various needs and situations (material instruments). The application of the trivium curriculum brings hope that ethnomathematics can provide enrichment and new topics that students have never seen before, which shows that applications of mathematics can be found not only in the fields of science, business, and everyday life but also in cultural practice (Rosa & Orey, 2016).

Currently, *Indonesia* is in the process of transitioning its curriculum, from the 2013 curriculum to the "*merdeka*" curriculum. The "*merdeka*" curriculum will be officially implemented starting in 2023. At the elementary education level, these two curricula are still focused on using integrated thematics as a learning approach. This is stated in the Regulation of the Minister of Education of *Indonesia* Number 57 of 2014 concerning the 2013 curriculum that learning at the elementary level is carried out with an integrated thematic approach that organizes the learning content of several subjects in certain themes. Meanwhile, in the "*merdeka*" curriculum structure, it is stated that elementary education can organize learning content using a thematic approach (Kemendikbudristek, 2022).

Thematic learning is a way or strategy or learning approach designed by connecting various curriculum areas and integrating various competencies from several subjects in a theme or learning process by combining several interesting activities that allow students to move actively and provide meaningful learning (Ashokan, 2014; Daryanto & Sudjendro, 2014; Efendi, 2009; Min et al., 2012; Puspita et al., 2020). Thematic learning is considered suitable for students in elementary education because it is under the characteristics of students who are still at the concrete operational cognitive level (Widyaningrum, 2012). Learning at the elementary level, especially in the lower class, also still emphasizes the very significant concept of literacy (Kennedy et al., 2012). However, that does not mean that students cannot be given other knowledge. If students do not fully understand the concept of literacy, then other knowledge will be difficult to learn.

Thematic learning allows literacy to grow progressively, in the form of strengthening related vocabulary, use of spelling, and writing sentences with more frequency, so that it can guide connected ideas to be followed easily (Ashokan, 2014). Literacy is a skill that a person has to interpret scribbles on a piece of paper as letters that when put together form meaningful words (Thoman & Jolls, 2005). The Organization for Economic Co-operation and Development (OECD) defines literacy as "the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts" (Kennedy et al., 2012, p.39). A person is said to be literate if he has a good understanding of reading and writing short statements about his daily life (Keefe & Copeland, 2011). Then, literacy is more than just recognizing letters and reading a few words (Fleer & Raban, 2007).

Assessment of student literacy in Indonesia has begun to be carried out intensively in line with the implementation of the Minimum Competency Assessment, which is an assessment of the basic competencies needed by all students to be

able to develop their capacity and participate positively in society (Kemendikbud, 2020). Minimum Competency Assessment is focused on measuring two basic competencies, reading literacy and mathematical literacy (numeracy). Numeracy is the ability to think using concepts, procedures, facts, and mathematical tools to solve everyday problems in various types of contexts that are relevant for individuals as citizens (Kemendikbud, 2020). Numeracy is still a problem for some students who do not fully understand mathematical concepts.

Students still have difficulty understanding the complex relationship between everyday language and mathematical language, and its mathematical representation (Solomon, 2009). The difficulty can occur because mathematics is a foreign language and not the first language for most students (unknown since learning the language except for the mention of small integer), which is learned almost entirely at school and is not spoken at home (Kenney et al., 2005); students need direction in using appropriate mathematical language and understand how to map words to symbolic forms and representations of mathematical concepts (Ippolito et al., 2017); or because students cannot relate the new knowledge they have received with other knowledge, causing misunderstanding or ambiguity in learning (Fakhruddin & Masrukan, 2018).

Student's difficulties in learning mathematics require a solution so that the results of learning mathematics can give meaning to them. This is emphasized in the "*merdeka*" curriculum that in activities that involve mathematics, students are expected to not only build their mathematical knowledge but also hone skills such as reasoning, communicating, applying, solving problems, and others, so that they get a complete and meaningful mathematical experience (Kamdi & Suryadi, 2020). For this reason, mathematics subjects in the "*merdeka*" curriculum are organized within the scope of five content elements (numbers algebra measurement, geometry, data and probability analysis) and five process elements (mathematical reasoning and proof, problem-solving, communication, mathematical representation, and mathematical connections) for elementary education (Kemendikbud, 2022). This is following the content standards and process standards set by the National Council of Teachers of Mathematics(NCTM) for school mathematics (Van de Walle, 2008).

The content elements that have been determined in the learning outcomes of mathematics subjects are then reduced to content standards with the scope of learning mathematics in elementary schools, namely: (1) the concept of numbers, the relationship between numbers and the properties of numbers to express quantities in various appropriate contexts; (2) arithmetic operations (addition, subtraction, multiplication, and division) on whole numbers, fractions, and decimals are performed efficiently to solve contextual problems; (3) identification of patterns, both numeric and non-numeric to explain things that are repeated; (4) spatial about two-dimensional and three-dimensional shapes and their properties to explain the surrounding environment; (5) measurement and estimation of object attributes that can be measured using various units (both standard and non-standard) and compare the results; and (6) interpretation of data showing diversity based on data display to draw conclusions (Kemendikbudristek, 2022). The six scopes seem separate, but in the learning process, there are connections in certain parts.

The connectedness of concepts in mathematics corresponds to one of the elements of the process, the mathematical connection. "A mathematical connection is a link (or bridge) in which prior or new knowledge is used to establish or strengthen an understanding of relationships between or among mathematical ideas, concepts, strands, or representations" (Eli et al., 2013, p.122). The definition shows the importance of connecting mathematical concepts in learning, connecting mathematics learning with other subjects, or with various problems in everyday life that are known to students. Connections are made to get meaningful learning outcomes for students, when students gain direct experience and are trained to be able to find the various knowledge they have learned for themselves, then connect it with other concepts that have been understood previously (Octaviani, 2017). The discussion above shows that there is an opportunity to develop a lesson that involves the trivium curriculum in ethnomathematics, thematic approaches, and connected approaches. The concept of the trivium curriculum shows that in its application, ethnomathematical-based learning can contain various concepts in mathematics or contain interrelationships between subjects that can be identified from a culture.

One of the interesting cultures to be explored in *Indonesia* is the traditional house. Each region generally has a traditional house that has certain characteristics. *Banyuwangi* is one of the regencies in the province of East Java which is located at the eastern tip of the island of Java. The indigenous people of *Banyuwangi* are called the *Using* tribe (Tim, 2020). The *Using* tribe has various forms of art, culture, and ethnic-based customs; both the original culture, the result of cultural acculturation, as well as cultural traditions that are inseparable from belief values (Makmur & Taufiq, 2016). The arts, culture, and customs are contained in various systems in the *Banyuwangi* community including language systems, knowledge, society, living equipment and technology, livelihoods, religion, and arts.

One of the systems of living equipment and technology owned by the *Using* community is the house. The *Using* traditional house is one of the traditional architectural works as a mirror of *Using* culture related to the customs that have been held for generations by the indigenous people of *Banyuwangi* (Pemkab Banyuwangi, 2019).

The typology of the *Using* house is recognized based on the shape of the roof, namely *tikel*/*tikel balung*, *cerocogan*, and *baresan*. The *tikel* house is an architectural house that has four *rabs*/roof areas (Wibowo, 2015), four *soko*, and four *songgo tepas* (Pemkab Banyuwangi, 2019). The *cerocogan* house is an architectural house with two *rabs* (Wibowo,

2015), with four *soko* without *songgo tepas* (Pemkab Banyuwangi, 2019). Meanwhile, the *baresan* house is an architectural house with three *rabs* (Wibowo, 2015), four *soko*, and two *songgo tepas* (Pemkab Banyuwangi, 2019).

Cerocogan *Baresan* *Tikel*

Figure 1. Type of Traditional House of Using (Pemkab Banyuwangi, 2019;Nur et al., 2010)

The walls of *Using*'s house use *gedhek* (woven bamboo) with a *piphil* motif without windows (Nur et al., 2010). While the floor is still raised ground or using tiles.

Previous studies have shown that there are mathematical concepts in *Using*'s house, namely: the concept of two-dimensional and three-dimensional geometric shapes, the concept of similarity and congruence, the concept of geometric transformation, and the concept of fractal geometry. In particular, in the two-dimensional and three-dimensional concepts, polygons and spatial structures are obtained which become learning materials in elementary schools (Hariastuti, 2018).

Furthermore, mathematics learning was designed using the *Using* house based on ethnomathematical-thematic-connected learning. So this study aims to determine the effectiveness of learning mathematics.

Methodology

Research Design

The research was designed qualitatively to determine the effectiveness of ethnomathematical-thematic-connected-based mathematics learning using the *Using* house. The research was conducted from December 2021 to January 2022 with the following design.

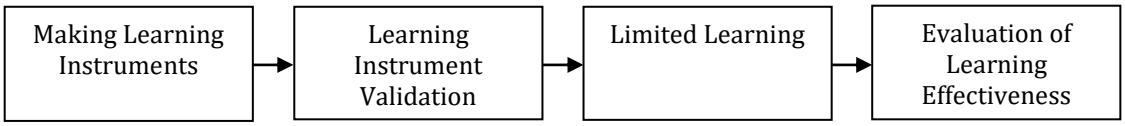

Figure 2. Research Design

Learning instruments are arranged thematically connected by using the ethnomathematical concept of the *Using* house. The instruments made are lesson plans and student learning sheets. The theme used is "*Using* traditional house (Rumah Adat Suku *Using*)". Thematic integrates four subjects, namely Indonesian, social sciences, fine arts, and mathematics. Connectivity is carried out on the concepts of flat shapes and arithmetic.

The validation was carried out by four education experts. The results show that the instrument is feasible to use in learning. Limited learning with a subject of ten people. These restrictions are due to the condition of *Banyuwangi* which is still in the COVID-19 pandemic. The results of the next study were analyzed qualitatively to determine the effectiveness of learning.

Respondent and Data Collection

The respondents of this study consisted of two types, experts who acted as validators and students who acted as learning test subjects. The validator consists of four education experts who have been involved in elementary-level learning. The subjects of the research trial were ten grade 3 students in an elementary school in *Banyuwangi*.

This research data is collected during the learning process through the use of a student learning sheet. Student learning sheets contain problem-solving tests. The previous student learning sheets have been validated by four learning experts. The instrument is said to be valid if it gets an average of at least 4 (Hobri, 2009). The validation results show an average of 4.61 which means that student learning sheets are feasible to use.

The problem-solving test is an open-ended problem that allows students to give different but logical answers under the learning concept. The test is in the form of cultural problems according to the subject's understanding zone.

Analyzing of Data

The data in this study were obtained in the form of subject performance results and problem-solving results. Subjects are said to be able to perform the work of making miniature traditional houses of the *Using* tribe if they can cut each miniature part precisely and assemble (fold and paste) each piece from the miniature correctly.

Subjects are said to be able to solve problems if they can determine the need for *gedhek* with the right reasons, determine the exact payment and pay attention to the discount. While learning is said to be effective if at least 80% of the research subjects can solve the given problem with various appropriate alternatives.

Findings / Results

This research uses learning plan instruments and student learning sheets. The results of the validation of learning instruments carried out by five validators showed an average assessment of 4.61. This means that the instrument is suitable for use in learning.

Student learning sheets contain (1) learning outcomes according to integrated subjects; (2) learning objectives; (3) cultural problems; (4) reading entitled "Rumah Adat Suku *Using*"; (5) questions related to reading; (6) pattern sheet to form a miniature of *Using*'s house; (7) reflection on the activity of making a miniature of *Using*'s house; (8) practice to remember the types of quadrilaterals; (9) the conclusion of the quadrilateral concept; (10) problem-solving sheet containing scaffolding.

Student learning sheets are arranged with the following learning framework.

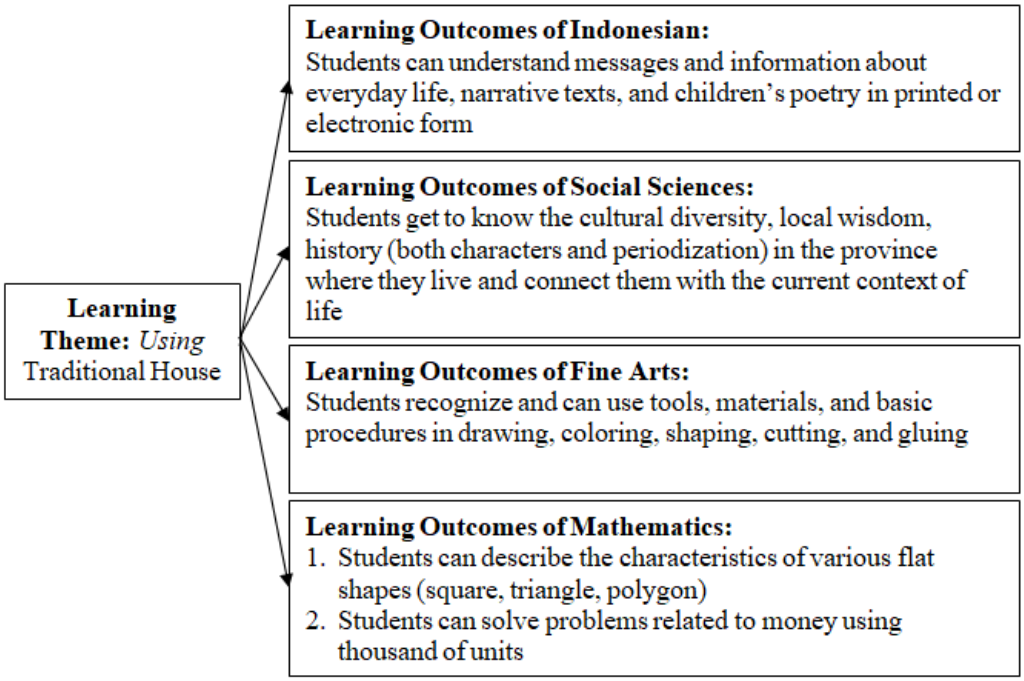

Figure 3. Learning Outcomes Framework (Kemendikbud, 2022)

The learning outcomes become the basis for determining learning objectives, namely: (1) students can answer questions according to the reading; (2) students can make a miniature *Using* house by cutting, shaping, and gluing each given part; (3) students can identify quadrilaterals (square, rectangle, parallelogram, trapezoid, rhombus, and kite) from the three pictures given; (4) students can identify the need for *gedhek* according to the shape of the sidewall of *Using*'s house; and (5) students can calculate the use of money according to the needs of the *gedhek* for the sidewall of *Using*'s house.

Cultural problems are given to students at the beginning of learning to determine students' ability to understand the problem. However, in general, students have not been able to complete it. The cultural problem given to students is related to the *Using* house, as shown in Figure 4.

Pay attention and understand the following problems.

***Gedhek* Needed for the Sidewall of a Traditional *Using* House**

An *Using-tikel* house had to be replaced with a side wall because there were holes caused by rodents.

Figure 2.1 Side wall of *Using*'s house **(researcher's documentation)**

The wall that must be replaced is illustrated as in the following Figure.

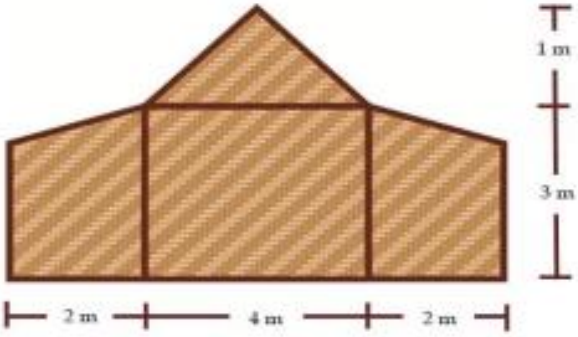

Figure 2.2 Illustration of the side wall of *Using*'s house **(Illustration: Lisa Fitriana)**

There are two side walls of *Using*'s house that must be replaced. The size of each *gedhek* sheet is 3 meters x 2.5 meters. The price of each sheet of *gedhek* is Rp. 68.000,00. However, the purchase of more than five pieces of *gedhek* will be given a discount of Rp. 3.000,00 each sheet. How many sheets of *gedhek* must be purchased to be able to replace the two side walls of the house? How much money should be spent for the purchase of the *gedhek*?.

Can you help solve the problem above?

Figure 4. Cultural Problem

The cultural problem in Figure 4 shows the *Using* house (the first image) whose side walls need repair. The sidewall of *Using*'s house is made of woven bamboo called *gedhek*. An illustration of the wall that must be repaired is shown in the second image and its dimensions. The main focus of the problem is determining the amount of *gedhek* needed to replace the sidewall of *Using*'s house and the cost of buying *gedhek*.

The problem contains a statement that the replacement of the walls must be done on both sides of the house. *Gedhek* is sold in sheet form with a size of 3 × 2,5 meters and the price is 68,000 rupiah per sheet. However, if the purchase of *gedhek* is made of more than five pieces, the seller will give a discount of 3.000 rupiahs for each sheet.

To be able to solve these cultural problems, students are given readings entitled "*Rumah Adat Suku Using*". The reading contains information about the types of *Using*'s house, the materials used to make *Using*'s house, the division of space in *Using*'s house, and the *gedhek* or woven bamboo used as wall material for *Using*'s house. Literacy can be known through students' ability to read and answer questions according to reading.

Furthermore, learning is carried out with the concept of technoracy. In this concept, students are invited to make a miniature of a *Using*'s house the type of *tikel*. The learning sheet contains three parts of pictures pieces that students have to cut, shape, and paste, as shown in Figure 5.

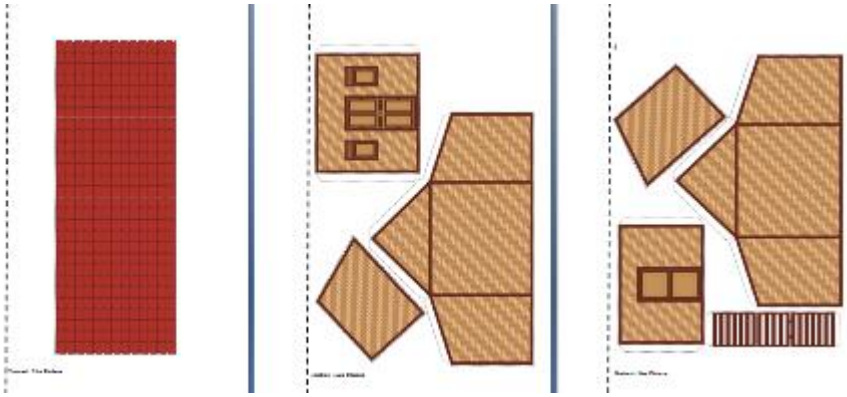

Figure 5. Pieces of Drawing Miniature Using's House

Reflection on the activity is done by asking students to write down their feelings after making a miniature of *Using*'s house and the reasons. In this learning sheet, it is assumed that students already know about two-dimensional shapes, especially triangles, quadrilaterals, and polygons. So that students can be given cultural problems that contain the concept of the two-dimensional shape. For this reason, students are given practice questions that function as reminders of the types of quadrilaterals.

Practice questions lead students to be able to distinguish different types of quadrilaterals. Also given a reminder about the meaning of quadrilateral that students have learned previously. The exercise and understanding of quadrilateral are expected to provide scaffolding for students in solving cultural problems.

In the last section, a problem-solving sheet and a brief scaffolding are given. Scaffolding is used to direct students to the measurement of *gedhek* needed for the two side walls of *Using*'s house, then determine the amount of money that must be spent on the purchase of *gedhek*.

The learning process is based on a lesson plan that has been declared feasible to use. Learning is designed with an ethnomathematical-thematic-connected model with the following syntax: (1) apperception and learning objectives; (2) provide cultural problems; (3) learning with the concept of trivium; (4) individual/group problem solving; (5) presentation of the results of problem-solving; (6) analysis of problem-solving results; (7) evaluation of the learning process. This model was developed under the learning carried out.

Apperception is done by reminding students of the two-dimensional shapes that have been studied previously. Learning objectives are delivered according to what is contained in the student learning sheet. The problem given to students is a cultural problem according to the theme of *Using*'s house. The problem is given at the beginning of learning to introduce students to conditions in everyday life related to culture that require the involvement of their knowledge.

In the third phase, learning is carried out with the concept of trivium which begins with reading and answering questions (literacy), making miniatures of *Using* houses (technoracy), and completing exercises on the types of two-dimensional shapes (matheracy). In this study, students were asked to solve problems individually to determine their creativity in determining the needs of *gedhek*. During the problem-solving process, the teacher provides scaffolding to students in turn according to student needs. Furthermore, students are asked to present the results of solving the problem in front of the class. Presentation of results is done with the aim that students can learn to control themselves and interact with others.

Analysis of the results of problem-solving is the process of achieving a common understanding of all the results that have been presented. In this phase, students are invited to determine the results of the presentation that are true or false and the reasons. The teacher is tasked with guiding students to be able to determine the truth of the results of the presentation and be able to convey the right reasons for their decisions. In the last phase, students are asked to evaluate all the processes that have been passed during learning that day. The teacher is in charge of guiding students to be able to make conclusions from the material that has been studied. Students are asked to rewrite the conclusion in their notes.

During the learning process, it can be seen that not all students have good literacy. Of the ten students, there are two who are still slow in reading. This condition causes the process of answering questions longer than the other eight students.

The process of making a miniature *Using* house is carried out as a form of the concept of technoracy. In this process, students are asked to form and glue the pieces of the *Using* house picture pattern that has been given.

Of the ten students, there is one student who cannot make a miniature *Using* house according to the picture pattern provided. The student is one slow reading.

Figure 6. Comparison of Results of Miniature Using's House Front View that Matches the Pattern (left) and Those that Don't Match the Pattern (Right)

Figure 7. Comparison of the Results of Miniature Using's House Side View that Matches the Pattern (Left) and Those That Don't Match the Pattern (Right)

Ten students gave positive reflections after making a miniature of *Using*'s house. The reasons given were various, such as: being able to play cutting and pasting, (feeling) that there were no lessons, and being able to make (miniature) *Using*'s house. However, some students cannot give reasons but feel happy with the activity of making *Using*'s house miniatures.

The matheracy concept is done by solving choice questions about the types of quadrilaterals. The choice of images gives the basic motif of *gedhek*. Of the ten students, there are two who have not answered maximally. Both students are slow to read. They have not been able to determine the shape of a parallelogram, trapezoid, rhombus, and kite correctly.

The problem-solving process is carried out by students individually with scaffolding from the teacher. There are several variations of answers given by students in solving cultural problems. Two students who were slow to read determined that eight sheets of *gedhek* were needed because each section of the wall was replaced with one sheet of *gedhek*. Students answer without regard to the size of each part of the wall that must be replaced. When they confirmed their answers in the process of presenting the results of problem-solving, the students explained as follows.

Researcher	:	Why eight sheets of *gedhek*?
Student 1	:	If the wall is cut into pieces, there are eight parts (left and right sides). So it takes eight sheets of *gedhek* to cover it.
Researcher	:	How big is it?
Student 1	:	Just close it
Researcher	:	Why are eight sheets of *gedhek* needed?
Student 2	:	Each wall has four sections. Because two walls were replaced, there were eight sections. So eight pieces of *gedhek* were used.
Researcher	:	Do the eight pieces of *gedhek* fit the size of the wall?
Student 2	:	Ummm…don't know

Six students determine that ten *gedhek* sheets are needed. Each student gave a similar reason, namely: the triangular-shaped part can be replaced with one sheet of *gedhek* but cut into two parts and then joined together, each trapezoid-shaped wall can be replaced with one *gedhek* sheet, while each rectangular wall can be replaced with two *gedhek* sheets which are connected. The reason can be illustrated in Figure 8.

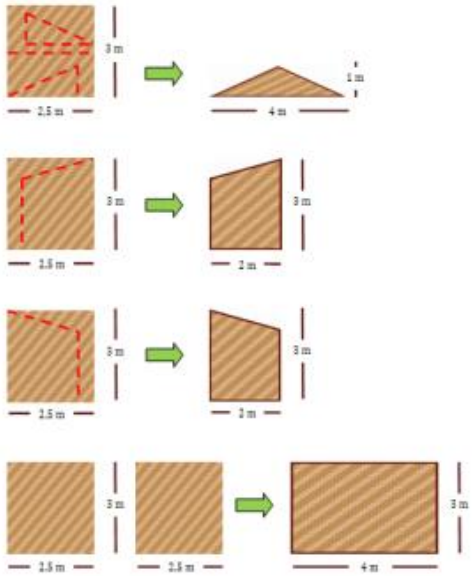

Figure 8. The Gedhek Forming Pattern for the Side Wall of a Using House by Six Students

One student makes a different pattern by determining that there are nine pieces of *gedhek* needed. Students explain that each rectangular part of the wall can be replaced with two pieces of *gedhek* that are joined together. The connection leaves two pieces of *gedhek* measuring 1 × 3 meters. The two pieces of *gedhek* can be used to replace one side of a triangular wall. While one side of the wall is triangular, the other is replaced with a sheet of *gedhek*. Each part of the trapezoidal wall can be replaced with one sheet of *gedhek*. This explanation can be illustrated in Figure 9.

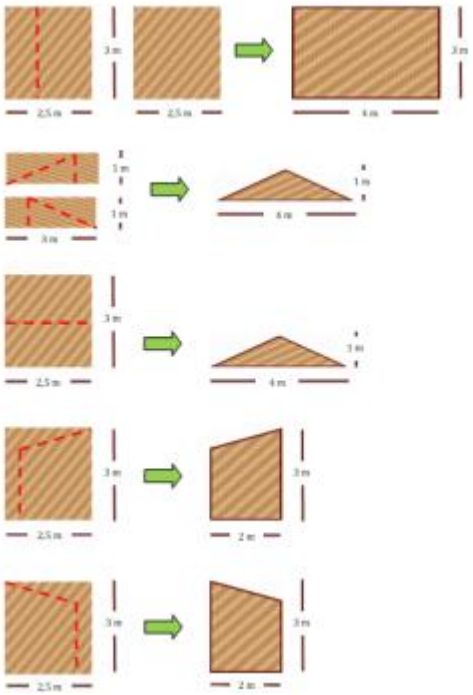

Figure 9. Gedhek Forming Pattern for the Side Wall of a Using House by One Student

Another student wrote that there were twelve pieces of *gedhek* needed. Students explained that for each trapezoidal section, one sheet of *gedhek* could be replaced. Each rectangular section is replaced by two *gedhek* sheets. And each triangular part is also replaced with two *gedhek* sheets.

Based on the needs of *gedhek*, students then determine the money to be paid for the purchase of *gedhek*. Student 1, who is slow to read, writes down the money to be paid as 544,000 rupiahs. Meanwhile, student 2, who is also slow to read, wrote down the money to be paid was 520,000 rupiah. Students 3 to 8 write down the money to be paid as 650,000 rupiahs. Student 9 wrote down the money to be paid was 585,000 rupiah. While student 10 wrote down the money to

be paid was 780,000 rupiah. The answer shows that nine students already understand if there is a discount for purchasing a minimum of five pieces of *gedhek*.

After presenting the results of solving the problem, all students are invited to discuss to analyze each answer given. Ten students agreed that the answers of students 1 and 2 were incorrect because they did not pay attention to the size of the walls, especially the rectangles and triangles. In addition, student 1 is also not right in determining the money to be paid for the purchase of *gedhek*. Nine students agreed that student 1 did not pay attention to the discount if more than five pieces of *gedhek* were purchased.

Students 3 and 5 did not agree with student 10's answer because it was considered too wasteful in using *gedhek*. However, student 10 explained the reason as follows.

Researcher	:	Why do you need twelve pieces of *gedhek*?
Student 10	:	There are four trapezoidal ones, so they are replaced with four *gedhek*.
		The rectangular shape is not enough if one *gedhek* is replaced, it must be two. because the length of the *gedhek* is less.
		So for the rectangle, it takes four *gedhek*.
		The triangle is also not enough if it is replaced by one *gedhek*, the length is the same as the rectangle. So it takes four *gedhek* too.
Researcher	:	Is there no leftover that can be used for other parts?
Student 10	:	Yes, but if other parts are made, the results will be bad.

After the analysis phase, an evaluation is carried out as a closing. In this phase, the teacher and students together make conclusions about the learning that has been done that day. Students are asked to write conclusions in their notebooks. The teacher also determines the level of effectiveness of the learning that has been carried out. Based on the results of problem solving and explanations given by students, it can be seen that eight students were able to solve the problems as expected. Meanwhile, two students still did not give the right answer because of literacy problems.

Discussion

The results show that learning outcomes and learning objectives have included the concept of the trivium, namely: (1) literacy in the form of reading entitled "*Rumah Adat Suku Using*" and questions related to reading; (2) matheracy in the form of solving cultural problems related to the concept of two-dimensional shapes and arithmetic; (3) technoracy in the form of making miniature *Using* houses by cutting, shaping, and gluing techniques. The concept of the trivium is following the understanding conveyed by Ubiratan D'Ambrosio (D'Ambrosio, 2001a; Rosa & Orey, 2015).

The existence of a trivium curriculum in mathematics class also makes students active in the learning process. Such as the results of research by Chukwuebuka and Rosa (2022) which showed that the integration of the trivium curriculum in learning can help teachers meet student needs, help students become active, and achieve desired learning outcomes. In addition, the cultural context also allows the use of etnomodeling to develop mathematical competence.

Previous studies also obtained results that support the integration of ethnomathematics in learning in schools. Ozofor and Onos (2018) revealed that the ethnomathematical approach was more effective in facilitating student achievement. This does not contain differences in achievement between male and female students. This means that both male and female students can achieve the same learning outcomes. This opinion is also supported by Fouze and Amit (2018) who view ethnomathematics as a means to improve students' mathematical achievement, and teachers are responsible for the learning process including curriculum development and learning strategies based on the integration of cultural elements and values.

Thematics is shown in the integration of four subjects, namely: Indonesian language, social sciences, fine arts, and mathematics. The four subjects are integrated into the cultural theme "*Rumah Adat Suku Using*". The implementation of the thematic method can run optimally because learning is not only focused on the teacher but involves students in activities. As stated by Chumdari et al. (2018) that thematic learning in elementary schools can be carried out properly, but student learning activities are less than optimal because learning is still teacher-centered. The effect of thematic learning in elementary schools also shows more significant and influential results in achieving learning outcomes compared to conventional learning (Nurlaela et al., 2018).

The connected model is shown in the integration of two-dimensional constructs and arithmetic concepts in mathematics. The learning is carried out within a cultural framework related to the *Using* house. In general, the results obtained are quite maximal because eight out of ten students can solve problems that connect the concepts of two-dimensional construction and arithmetic. These results are supported by the research of Kusaeri et al. (2019) which shows that culture-based mathematics learning can provide space for teachers to be able to better understand students' mathematical connection abilities.

The connected model can also be viewed as an intertwined concept in mathematics learning. One of the benefits of the intertwined concept in learning mathematics is that it can make students not rely on procedures or formulas to solve a problem, to increase student creativity (Yulianto, 2018).

Learning is carried out using an ethnomathematics-thematic-connected model that contains seven phases. The first phase contains apperception and learning objectives. This is following Bruner's theory which states that to achieve knowledge built from experience requires mastering simple skills to understand more complex skills (Amri, 2013; Pound, 2014). This is also following Vigotsky's theory which states that understanding is obtained by linking new knowledge with previous knowledge (Rusman, 2012).

In the second phase, students were given a cultural problem with the theme "*Rumah Adat Suku Using*". Giving problems at the beginning of learning is supported by Vigotsky's theory which states that the learning process can occur if students complete tasks that have not been studied as long as the task is still within the range of their understanding or zone of proximal development (Amri, 2013; Pound, 2014; Slavin, 2018). So, giving problems must be related to concepts that students have learned before.

The third phase is a learning process using the trivium concept which is part of ethnomathematics-based learning developed by D'Ambrosio (D'Ambrosio, 2001a; Rosa & Orey, 2015). The concept of the trivium is under the focus of Vigotsky's learning theory which contains three key elements, namely: aspects of play, language, and socio-culture (Pound, 2014). The activity of making a miniature *Using* house that looks like a game for students can make them active in fun situations. This is following Dewey's learning theory which directs children to learn by doing and being active and basing education on real-life situations (Pound, 2014).

The problem-solving phase is done by students individually. Scaffolding is given during the problem-solving process by the teacher to bring out students' creativity in determining *gedhek* needs. Scaffolding is needed either between students or from the teacher so that every student gets the same understanding (Slavin, 2018). Creativity is needed because cultural problems are open-ended problems that allow students to be creative according to their understanding. However, this understanding is still directed at the same context, namely replacing the sidewall of *Using*'s house with a predetermined shape and size. An open-ended problem is a problem that is formulated to have several openly correct answers (Becker & Shimada, 1997). So, students are allowed to give different answers as long as these answers can solve the problem and students have the right reasons.

The presentation of the results of problem-solving is intended so that students can learn to control themselves and interact with others. According to Gardner (Pound, 2014), every child has intrapersonal intelligence (self-understanding) and interpersonal intelligence (interacting with others) that need to be trained. In this phase, the teacher's task is to help students prepare the presentation and guide them during the presentation process so that it runs optimally.

Analysis and evaluation are a phase to determine students' ability to distinguish between true and false results and then make conclusions. This ability needs to be developed to build a system of meaning in students' understanding. This is following Piaget's theory which states that cognitive development is a process that occurs actively when children build systems of meaning and understanding of reality through experiences and interactions (Amri, 2013).

The results of solving problems given by students show that eight out of ten students can give various correct answers. The variety of answers is still under the specified context. The results of problem-solving showed two ideas were unique and different from those of the other six students. This unique idea is part of the originality that is judged in an open-ended problem (Becker & Shimada, 1997).

Conclusion

The collaboration between ethnomathematics which contains the trivium curriculum, thematic models, and connected models in learning, shows the existence of a process that makes students more active and gets maximum problem-solving results. This learning can be said to be effective because 80% of students can solve problems according to the given context.

The finding in this study is that there are students who can give answers that are different from the general answers. Because the type of problem given can be categorized as open-ended, every possible answer is accepted. In addition, the existence of two students who are constrained in reading skills needs to be a certain evaluation in learning. These obstacles affect literacy, matheracy, to technoracy. it can be said that the ability to read has a large enough impact on the learning process.

Recommendations

The pandemic period raises various limitations in the learning process. So that after the pandemic ends, similar research can be carried out on a larger scale to find out the implementation and effectiveness of learning further.

The selection of cultural themes can also be adapted to the conditions that are close to students. This means that similar research can be carried out in any area by first identifying the ethnomathematics that will be implemented in the

learning process. Traditional houses are an example of a culture that can be used in learning. Various countries have unique traditional houses that can be used as learning materials. Arts such as dance and traditional music as well as traditional games are also part of the culture that can be integrated into learning.

Ethnomathematical-thematic-connected models can also be developed in learning at the secondary level. However, this application requires a long discussion and agreement on various matters between teachers before integrating various subjects into a theme.

Limitations

This study has limitations because it was carried out in conditions of the COVID-19 pandemic. So that the researchers were constrained by permission from the school in involving students during the learning process. This research is also limited to the cultural theme in *Banyuwangi* Indonesia. This was done because of the location of the research conducted in the area. Time constraints also cause only one cultural problem given to students.

Authorship Contribution Statement

Hariastuti: Conceptualization, design, analysis, writing. Budiarto: Reviewing, supervision. Manuharawati: Reviewing, supervision.

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Appendix

Baresan	:	Traditional *Using* house architecture has three roofs (*rab*) with four *soko* (pillars) and two *songgo tepas.*
Cerocogan	:	Traditional *Using* house architecture has two roofs (*rab*) with four *soko* (pillars).
Gedhek	:	Woven bamboo with a certain pattern used as wall material for *Using*'s house.
Piphil	:	2 × 2 woven bamboo pattern used to make *gedhek.*
Rab	:	Roof plane on the architecture of a *Using*'s house.
Soko	:	Four uprights logs function as the basic framework (pillars) of the house and are positioned in the corner of the house.
Songgo tepas	:	Wood that supports the roof of the front and/or back of the house.
Tikel/Tikel Balung	:	Traditional *Using* house architecture has four roofs (*rab*) with four *soko* (pillars) and four *songgo tepas.*
Using	:	Indigenous tribes in Banyuwangi Indonesia.