

Analysis of Problem-Solving Ability with Ethnomathematics Nuances in the Marble Game in View of Students' Learning Style

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In this study, the mathematical problem-solving ability with ethnomathematics nuances of the marble game based on student learning styles has been examined. A qualitative methodology is used, with the research instruments being a learning style questionnaire, a problem-solving ability test, and interviews based on problem-solving ability indicators. The subjects of this study were 28 grade 7 students in Surakarta City. Students were given a learning style questionnaire, and then 9 students were selected through purposive sampling to conduct written tests and interviews. Based on the results of the study, it can be concluded that in the ability to solve mathematical problems with ethnomathematics nuances of the marble game, students with visual learning styles can fulfill three problem-solving indicators but are less able to fulfill the indicator of re-examining the solution obtained. Students with auditory learning styles can fulfill all problem-solving indicators well. Meanwhile, students with kinesthetic learning styles can fulfill three problem-solving indicators but cannot fulfill the indicator of checking back the answer. The results of this research have significant novelty in the field of ethnomathematics, specifically for basic algebra concepts and their applications in mathematics education.

KEYWORDS: Learning Style, Ethnomathematics, Mathematical Problem Solving Ability, Marble Game

Mathematics plays a very important role in shaping students' intellectual skills and critical thinking abilities. One of the competencies that students must have

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is the ability to solve mathematical problems. Students' mathematical problem-solving abilities can be assessed based on the Program for International Student Assessment (PISA) research scores. Every three years, the PISA international survey is conducted to evaluate educational systems worldwide by assessing the skills and knowledge of 15-year-old students who are nearing the completion of their mandatory schooling (Stacey, 2011). Of the 79 countries that participated in the 2018 PISA test, Indonesia ranked 74th.

The PISA questions are divided into six levels, with about 28% of Indonesian students reaching the second level or higher in mathematics and only 1% of students reaching the fifth level (OECD, 2018). This shows that at least 28% of Indonesian students can interpret problems and solve them, while only 1% can tackle complex problems. Problem-solving skills are crucial for students, especially in the mathematics learning process. This is confirmed by the NCTM (2000), which states that learning and problem-solving are essential components that cannot be separated in mathematics education. Therefore, one of the goals of learning mathematics is to train students to solve problems effectively.

Currently, the use of technology devices such as smartphones has become common among school students. On the positive side, students can stay updated with technological advancements and access learning resources and knowledge. However, many students use smartphones primarily for gaming. With the widespread use of smartphones, many students rarely or almost never engage in traditional games in person. Traditional games are typically played outdoors in groups. By participating in traditional games, students can gain numerous benefits, such as socialization, physical activity, and experiences that cannot be obtained through smartphone gaming.

In Indonesia, there are many traditional games that children used to play in the past. One example is the marble game, which is often referred to as 'nekeran' in Indonesian. It turns out that in these traditional games, there are many aspects of knowledge that students can gain, one of which is mathematical knowledge. These mathematical aspects can be explored through the concept of ethnomathematics. Research on this topic is significant, as it not only offers a new perspective on mathematics learning but also serves as a means of preserving culture, in this case, traditional games.

Problem-solving is an effort to achieve certain goals that are not inherently known or obvious, so problem-solving ability is defined as the ability of students to address unpredictable or non-routine problems (Anisah & Lastuti, 2018). Students can understand the problem, devise a plan to solve it, and determine the objective of the problem presented. Polya (1973) suggests that there are four stages in problem-solving: 1) understanding the problem; 2) devising a solution plan; 3) implementing the solution plan; and 4) reviewing the resulting solution. Therefore,

a person demonstrates good problem-solving skills when they can comprehend the problem and determine how to address the issue presented.

One of the topics taught in junior high school mathematics is the concept of algebra. Algebra is a foundational mathematical concept that plays an essential role in solving everyday problems. The NCTM (2000) stated that algebraic proficiency is crucial for success in adulthood, the workplace, and higher education. Algebra should be taught to all students. One critical area of study within algebra is the One Variable Linear Equation.

One Variable Linear Equation involves solving problems using linear equations. This material takes the form of an open sentence associated with an equal sign (=) and contains one variable. This topic is often regarded as challenging for junior high school students. Fitriani (2018) notes that One Variable Linear Equation problems are typically presented as story problems requiring critical thinking skills, making this material difficult within mathematics subjects. The statement indicates that a significant number of students still struggle with solving One Variable Linear Equation problems. Therefore, considering the importance of the One Variable Linear Equation concept in everyday life, students' problem-solving skills in this area must be developed. However, it is essential to recognize that each student's problem-solving ability varies. This is supported by Hidayatilah & Rahadi (2013), who state that each student possesses unique problem-solving abilities, requiring teachers to find appropriate learning strategies.

Research on ethnomathematics is growing rapidly. There is no denying the importance of geometry in teaching mathematics; geometry is a cross-cultural and cross-disciplinary science (Kyeremeh et al., 2023). D'Ambrosio (1989) coined the term ethnomathematics to describe mathematical practices used in specific cultures and is regarded as a study of mathematical ideas and culture. According to Rachmawati (2015), ethnomathematics is defined as mathematics applied by communities, cultural groups, work groups, children of certain age groups, indigenous peoples, and more. Bishop (1994b) explains that mathematics is a form of culture. Mathematics as a cultural aspect has become an integral part of people's lives. One aspect that can be incorporated into mathematics education is ethnomathematical problems.

Due to the rapidly changing natural and cultural environments, along with swift changes in the global economy, society, environment, politics, and culture, many diverse indigenous and local mathematical knowledge systems and traditions are at risk of extinction (Rosa & Orey, 2013). Therefore, integrating ethnomathematics into mathematics education can enhance student motivation and help preserve traditions and culture. In this study, the concept of mathematics is found in the marble game.

The marble game is a traditional game that has existed for a long time. Historically, the game originated in France and subsequently spread to Egypt and

Greece (Supriyono, 2018). In the marble game, the concept of One Variable Linear Equation is present in the rules of play. The activity of measuring the distance between the shooter and the partner's marble area using a hand coil exemplifies the application of One Variable Linear Equation concepts.

Additionally, the scoring rules of the marble game can also be related to One Variable Linear Equations. The shape of the marble is a small ball with a diameter of about 1.25 cm and weighs approximately 10 grams, with decorations inside (Febriyanti et al., 2019).

Besides cultural factors, students' learning styles can also significantly impact their problem-solving abilities. Each individual has a unique learning style, which affects their mathematical problem-solving skills. There are several types of learning styles, such as visual, auditory, and kinesthetic. Students with visual learning styles tend to learn through seeing and visual stimuli, while auditory learners acquire knowledge through listening, and kinesthetic learners learn through movement, touch, and action (De Porter & Hernacki, 2007). Each learning style has its advantages, leading to different outcomes in mathematical problem-solving abilities.

Many students struggle with solving One Variable Linear Equation problems, which are typically presented as story problems. Angraeni (2022) supports this by demonstrating the low mathematical problem-solving abilities of students regarding Linear Equation One Variable material, where out of 25 students, 16 fell into the category of "low." Furthermore, Linear Equation One Variable material is classified as difficult due to its abstract nature (Angraeni, 2022).

Each student's mathematical problem-solving ability differs, with learning style being one contributing factor. Fadilah & Midjan (2018) explain that students' learning styles—visual, auditory, and kinesthetic—produce varying results in mathematical problem-solving abilities concerning Linear Equation One Variable material. The gaps identified in these two studies, alongside observations made at schools, underscore the necessity for this research, particularly with the inclusion of ethnomathematics content in One Variable Linear Equation material.

Previous research on ethnomathematics in marble games, such as that by Uskono et al. (2023), Febriyanti et al. (2019), and Ngaisah et al. (2023), has explored ethnomathematical concepts in similar mathematical aspects, including counting, multiplication, spatial geometry, flat geometry, and measurement. In contrast, this study utilizes activities in the marble game to illustrate mathematical modeling concepts related to One Variable Linear Equation.

The concept of One Variable Linear Equation in the marble game is identified in the activity of measuring distance with *kilan* and in the scoring rules, which will be constructed in advance through observations and interviews. It is

hoped that the marble game can assist students in understanding the One Variable Linear Equation material due to its close relation to their daily lives.

The purpose of this study is to explain a new ethnomathematics concept found in traditional games, specifically the marble game. The findings of this study are significant for expanding mathematical knowledge derived from various traditional activities within the community. Additionally, it aims to preserve traditional games so that they continue to be played by children, as traditional games contribute to the development of motor skills. This study will also examine the relationship between students' learning styles and the ethnomathematical aspects used in learning. The decision to focus on learning styles is deemed appropriate, as ethnomathematics-based learning will involve direct practice by students in traditional games, allowing them to learn through play. The results of this study are expected to provide valuable insights for teachers in implementing culturally responsive teaching to enhance students' understanding and appreciation of mathematics.

Research Questions

The research questions in this study are as follows:

1. The question focuses on investigating the cultural and mathematical elements embedded in the traditional game of marbles in Indonesia and how these can be integrated into mathematics learning to enhance understanding and engagement
2. How is the description of the problem solving ability of seventh-grade students in solving One Variable Linear Equation with ethnomathematics nuances in the marble game in terms of visual learning style?
3. How is the description of the problem solving ability of seventh-grade students in solving One Variable Linear Equation with ethnomathematics nuances in marble games in terms of auditory learning style?
4. How is the description of the problem solving ability of seventh-grade students in solving One Variable Linear Equation with ethnomathematics nuances in marble games in terms of the auditory learning style?

Etnomathematics of Marble game

This subsection will provide a literature review related to ethnomathematics, the marble game, and the construction of the marble game using linear equations with two variables.

Ethnomathematics

D'Ambrosio (1989) coined the term ethnomathematics to indicate that mathematics can be applied to identifiable cultural communities and is considered the study of mathematical ideas found within cultures. There are several characteristics of cultural problems that can be associated with ethnomathematics. Rosa and Orey (2011) mention several characteristics of ethnomathematics, namely: (1) it is consistent in form, (2) has specific characteristics, (3) contains mathematical patterns, (4) follows mathematical rules, and (5) relates to counting, measuring, weighing, and ordering systematically. According to Adam et al. (2003), there are five ways the ethnomathematics curriculum can be applied: (1) ethnomathematics is structured within a suitable context, (2) ethnomathematics is presented in a specific cultural content that differs from general mathematical concepts, (3) creating the idea that ethnomathematics is a developmental stage of mathematical thinking applied in education, (4) the idea of the ethnomathematics curriculum can become part of mathematical concepts, and (5) the ethnomathematics curriculum is an effort to integrate mathematical concepts and practices into students' culture.

Ethnomathematics-based mathematics learning has a positive impact on students' mathematical thinking skills (Widada et al., 2020). Ethnomathematics can be understood as the mathematical process from the real world through abstraction, thus generating knowledge related to mathematical science (Widada et al., 2018). Ethnomathematics-based mathematics learning can provide effective learning to enhance students' problem-solving and critical thinking skills, as mathematical problems are related to the culture and contextual issues surrounding students (Imswatama & Lukman, 2018).

A mathematical problem is a problem that must be solved through a mathematical process. Cultural contexts can become mathematical problems. Culture-related topics are a new innovation in mathematics learning. Cultural topics can build students' learning experiences and play a role in the process of knowledge assimilation (Saparuddin et al., 2019). Ethnomathematics-based mathematical problems are defined as mathematical problems containing cultural elements. Applying ethnomathematics in mathematics learning allows students to learn more easily because it relates to daily human activities. Many aspects can be explored in

ethnomathematics studies. Mathematics can be practiced within the life of a community group. For example, the people of Bali have implemented mathematics in traditional ceremonies and the construction of tower buildings (Darmayasa, 2016). The people of Papua, in building honai houses, thousand-leg houses, and batik patterns, have represented geometric forms in mathematics (Mumu & Aninam, 2018). The people of Maluku have also applied mathematics in trade activities, weaving motifs, and woven patterns (Laurens et al., 2019).

Game Description

The game of marbles is one of the most popular folk games. Marbles are the main component of this game. Marbles (see Figure 1) are usually made of glass or a cement and lime mixture that is formed into a round shape. This game requires special skills. The shape of the marbles is a small ball with a diameter of about 1.25 cm and a weight of about 10 grams, with decorations inside (Febriyanti et al., 2019).

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Figure 1. Marbles

Game Rules

The game of marbles is very popular among children, especially boys. This game is usually played with 2 to 6 players or more (Uskono et al., 2023). The game begins with players aiming their marbles to hit the marbles of other players that have been placed in a circle as agreed. Before playing, all players perform *hompimpah* first to determine the order of play. *Hompimpah* is a method used by at least three people to choose one person in a game related to the playing

order. *Hompimpah* is a traditional suit method in Indonesia. This method is similar to the suit (rock-paper-scissors), but this traditional method can be performed by more than three people.



Figure 2. *Hompimpah*

Then, after determining the aiming order, determine the distance between the attacker and the circular arena using the hand *kilan*. *Kilan* is a term used to express the length from the tip of the thumb to the tip of the little finger. The playing distance is determined by mutual agreement. The research of Uskono et al. (2023) stated that the distance of the player from the circle is as far as 2 meters. The attacker who takes the first shot is the player who gets the first order during *hompimpah*. When attacking, the attacker flicks the plug he has, intending to hit the partner's plug in the circle.

The way to flick the marble is to place the attacker's marble at the meeting point of the thumb and the middle finger. Aim and point the finger towards the marbles in the circle. If the attacker succeeds in removing the marbles from the circle, then the marbles belong to the attacker, and the attacker has the opportunity to attack again until they miss the target (Uskono et al., 2023). However, if the attacker is unsuccessful in aiming, it will continue to the next attacker until the marbles in the circle run out.

Ethnomathematics of Marble_s Game on One Variable Linear Equation_

I

n the marble game, calculating the distance using units of handpieces represents the mathematical element, namely the material of One Variable Linear Equation. This is because the value of one hand coil has a certain value in cm units. This follows the research of Muslimahayati & Wardani (2019) in the ethnomathematics exploitation of the Suku Anak Dalam (SAD) community of Batanghari Regency, Jambi Province. In the study, it was explained that the SAD community has a habit of measuring objects with limbs, one of which is with *kilan*.

Furthermore, the study explained that the size of the *kilan* is equivalent to the length from the tip of the thumb to the tip of the little finger, related to the material of One Variable Linear Equation. For example, in the study, a problem states: Ridwan was asked to measure a rectangular table that has an area of not less than 40 dm^2 . It turns out that Ridwan uses his hand as a unit of measurement, and it is known that the length is 16 kilan , and the width is 10 kilan . What is the minimum length of the table in cm ?

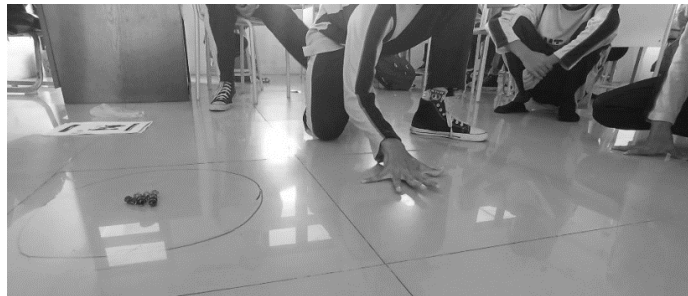


Figure 3. *Kilan*

In the game of marbles, the term *kilan* is used to measure the distance of the attacker aiming at the marble in a circle. For example, Rudi uses his hand as a unit of measurement in a game of marbles and knows that the length is 5 kilan . When measured using a ruler, the actual distance is 22 cm . What is the length of 1 kilan of Rudi's hand in cm ?

In addition, one of the scoring rules of the marbles game is that when the attacker can hit the marbles of other players, the marbles obtained will belong to the attacker. This activity applies the mathematical concept of multiples and can be related to the material of One Variable Linear Equations, namely when the attacker gets the same points in each shot. For example, a marble game consists of 3 children. In the game, each child has 3 chances to attack or aim. Dion managed to get 21 marbles in the game, and if Dion earned the same points in each shot, determine how many points Dion gets in each shot!

Methods

This study is based on two theoretical frameworks: ethnomathematics and pedagogical theory, particularly learning styles. The desired outcome is a profile of students categorized by learning style when cultural concepts are integrated into the learning process. Therefore, the appropriate research method is descriptive qualitative. However, in practice, a learning process is still conducted, as culturally based learning has not previously been implemented in the school. In this context,

students need to understand mathematical concepts present in the traditional game, allowing them to practice directly, which strongly supports the creation of learning style profiles. Data collection follows the procedures of descriptive qualitative research. The analysis conducted is an in-depth analysis to provide an overview of students' mathematical problem-solving profiles within ethnomathematics-based learning, viewed from the perspective of learning styles.

This research method is descriptive qualitative because this study aims to analyze and describe students' mathematical problem solving abilities with ethnomathematics nuances based on students' learning styles. This research uses stages, namely first the researcher conducts field observations to determine the problems that occur in the field. The next stage determines the research subjects, namely 9 students from 28 students in grade 7 in one of the schools in Surakarta, Indonesia. Determination of the subject is done by collecting data by filling out a learning style questionnaire (visual, auditory, kinesthetic) on each student with a questionnaire.

The questionnaire in this study was used to gather information on the students' learning styles, which will be categorized into visual, auditory, and kinesthetic learning styles. The learning style questionnaire consists of 36 questions, with 12 questions for each type of learning style. Before being administered to the students, the questionnaire will be evaluated. In the first stage, the learning style questionnaire will be tested for internal consistency using the product-moment formula developed by Karl Pearson and for reliability using the alpha formula by the researcher before the questionnaire is validated for content by a validator. The purpose of conducting internal consistency and reliability tests is to determine the quality of the questionnaire items. In this study, a closed-ended questionnaire was used, where respondents or research subjects select one of the available options that best suits their personality. The researcher developed the questionnaire items based on indicators of students' habits. The learning style instrument in this study uses a sensory preference approach, including visual, auditory, and kinesthetic learning styles. The questionnaire has been reviewed and validated by a guidance and counseling expert.

Table 1. Student Learning Style Grouping

No.	Learning Style Group	Number of Students	Percentage
1	Visual	7	25%

2	Auditory	11	39,29%
3	Kinesthetic	8	28,57%
4	Undefined	2	7,14%
Total		28	100%

The learning style questionnaire instrument that has been declared valid by the validator is then used in research. The questionnaire data that has been collected, is analyzed by calculating the score of each learning style of each student to find out students who excel in visual, auditory, and kinesthetic learning styles (see Table 1). Then using the purposive sampling technique, three subjects from each learning style were selected to conduct a test of mathematical problem solving ability with ethnomathematics nuances of the marble game.

The mathematical problem solving ability test instrument with ethnomathematics The test instrument for mathematical problem solving ability with ethnomathematics nuances in the marbles game which has been declared valid by the validator is then used in research. To find out students' mathematical problem solving skills in solving problems with ethnomathematics nuances in marbles games, the data were analyzed according to Polya's problem solving indicators, namely: understanding the problem, planning a solution, carrying it out, and re-examining the solution obtained.

Then, interviews were conducted with each subject in the selected visual, auditory, and kinesthetic learning style categories to validate student answers with indicators of mathematical problem solving ability so that students' problem solving ability in solving mathematical problems with ethnomathematics nuances in marbles games could be known.

There are two types of interviews in this study. The first type aims to gather information about marble games through informants. Therefore, before conducting the interviews, the instruments used were first validated by experts in the field of ethnomathematics. This validation was carried out to ensure that the interview instruments used by the researchers were appropriate for the context of questions in the field of ethnomathematics. Before conducting the ethnomathematics interviews about marble games, the researchers validated the prepared interview guidelines with mathematics experts.

The second type of interview aims to gather information about students' problem-solving abilities concerning ethnomathematics-related questions connected to the culture of marble games. The type of interview used in this study

is a structured interview. The structured interviews in this study consist of task-based and learning style-based interviews. Task-based interviews are conducted by asking students to solve a mathematics problem with an ethnomathematics theme, followed by an interview based on the problem the student has completed. This is intended to understand the students' thought processes and reasoning regarding the problems they have solved.

The development of the interview guideline instruments began with reviewing mathematical problem-solving theories, which served as a basis for formulating the questions. The questions were designed to obtain comprehensive and in-depth information about students' mathematical problem-solving related to one-variable linear equations with an ethnomathematics context. Interviews can be conducted to gather additional information that is not written in the answer sheets. The problem-solving theory used is based on Polya's theory. This second interview guideline instrument has also been validated by experts.

The data validity test of this research was carried out by method triangulation. Triangulation of methods tests the credibility of data by testing data from the same source with different methods (Sugiyono, 2013). The triangulation method used is methodological triangulation. In this study, methodological triangulation was conducted by comparing the results of the test method, namely the student test sheets, with the results of the interview method, specifically the student interview results. Data from a subject is considered valid if the test results and interview results are consistent. If there is a significant difference between the test and interview results, then the data from that subject is considered invalid. If the data in a category, where invalid data is found, remains sufficient and representative, then no additional sampling is necessary. However, if the presence of invalid data causes the data to no longer be representative, additional sampling using purposive sampling criteria is required.

After being analyzed, at the last stage a discussion is compiled which contains a description of the research results obtained from filling out questionnaires, written tests of problem solving abilities, and interviews to then conclude. Furthermore, the data analysis method used in this research is according to Miles, Huberman, and Saldana (2014). They stated that data analysis is divided into three important elements, namely data reduction, data presentation, and conclusion drawing.

Miles, Huberman, and Saldana (2014) state that data analysis is divided into three key elements: data reduction, data display, and conclusion drawing. Data reduction involves summarizing important points in a focused manner to identify patterns and themes, providing a deeper understanding. Researchers must carefully consider the data obtained and reduce it as needed to make the data clearer and more usable.

Next is the data display process. After the data is reduced, it will be presented. The displayed data can be used to answer questions based on the research indicators. Data can be presented in the form of narratives, tables, or images. The third step is drawing conclusions. This process involves establishing the validity of a theory or fact that becomes a new finding. The new finding in this study is a description of students' mathematical problem-solving abilities in the context of one-variable linear equations with an ethnomathematics perspective of marble games, viewed from the students' learning styles.

In our study, we used students as research subjects with a purposive sampling method. Each student who was tested and interviewed had given their consent to participate as a subject in the research. They also agreed that their test results and interview responses could be displayed for academic reporting and publication purposes without revealing their full identity. Approval was also obtained from the school where the research was conducted. The permission process began with the issuance of a research permit letter from the affiliated institution, followed by submitting this request letter to the partner school.

Results

This study analyzes students' mathematical problem solving ability in ethnomathematics and nuanced problems on marble games based on visual, auditory, and kinesthetic learning styles. Below will be presented the results of student analysis in solving the test of mathematical problem solving ability with ethnomathematics nuances in the marbles game.

Presentation of the results of the ability to solve math problems with ethnomathematics nuances of the marble game in terms of visual learning styles

Students' problem solving ability in solving problems with ethnomathematics nuances of the marble game based on visual learning styles was selected by purposive sampling with subjects S1, S2, and S3. Figure 4 presents S1's answer to the math problem with ethnomathematics nuances of the marble game.

Diketahui :
 Farhan memiliki 60 biji neker
 Farhan bermain 6 kali bidikan
 Total neker setelah bermain 96
 Ditanyakan :
 Jumlah neker 1 bidikan Farhan
 Jawaban :
 misal x adalah jumlah neker yg diperoleh Farhan 1 bidikan
 maka, model matematika
 $60 + 6x = 96$
 sehingga :
 $60 + 6x = 96$
 $6x = 96 - 60$
 $6x = 36$
 $x = \frac{36}{6}$
 $x = 6$
 Jadi 1 bidikan Farhan yaitu 6 biji kelereng

Figure 4. S1 answer results

The results of the researcher's interview (I) with S1 are presented as follows.

I: From the problem given what information is known and asked in the problem?

S1: Farhan has 60 marbles and plays 6 shots.... how much is that, how many marbles does Farhan get each shot

I: Can you tell me how you solved the problem like what?

S1: For example, if x is the number of marbles obtained by Farhan in one shot, then the math model is $60 + 6x = 96$.

I: Then what did you do after that?

S1: Move the number 60, then to get the x, $6x = 96 - 60$, $6x = 36$, then the x is equal to $36:6 = 6$

I: So that you know the x value is 6, what did you do?

S1: Don't know

I: What is the conclusion of this problem?

S1: The question asked is how many marbles Farhan gets from one shot, so Farhan played one shot to get 6 marbles.

Based on the results of the interview with S1, the subject can fulfill the indicators of problem solving ability including understanding the problem, planning the solution, and performing the solution plan. S1 did not do the step of checking his answer again. This is shown from the answer sheet and interview results. Figure 5 is S2's answer sheet to the problem of solving math problems with ethnomathematics nuances of the marble game.

Diketahui:
 Farhan memiliki 60 biji neter.
 Farhan bermain 6 kali bidikan
 total neter setelah bermain 96.

ditanyakan:
 Jumlah neter 1 bidikan Farhan

Jawab:
 misal x adalah jumlah neter yang diperoleh Farhan 1 bidikan.
 maka, model matematika:
 $60 + 6x = 96$
 Sehingga

$$60 + 6x = 96$$

$$60 - 60 + 6x = 96 - 60$$

$$6x = 36$$

$$x = 36 : 6$$

$$x = 6$$

maka jumlah neter 1 kali bidikan farhan adalah 6

Figure 5. S2 answer results

The following are the results of the researcher's interview (I) with S2 regarding mathematical problems with ethnomathematics nuances of the marble game.

I: From the problem, can you tell what is known and what is asked?

S2: It is known that Farhan has 60 marbles, Farhan plays 6 shots, and the total number of marbles after playing is 96, and asked about the number of marbles in one shot.

I: What is your plan or strategy to solve it?

S2: 60 plus 6x

I: Where did you get the x?

S2: I get from the number of marbles in one shot of Farhan.

I: What are the steps to solve this problem?

S2: $60 + 6x = 96$ so $60 - 60 + 6x = 96 - 60$. Then 36 divided by 6 gets 6.

I: How do you prove that the x value is 6?

S2: Calculated again

I: Then what is the conclusion of the problem?

S2: The number of marbles once shot by Farhan is 6.

Based on the results of the interview with S2, the subject was able to fulfill three indicators of problem solving ability including understanding the problem, planning the solution, and carrying out the solution plan. S2 did not do the step of checking his answer again. This is shown from the answer sheet and interview results. Figure 6 is S3's answer sheet to the math problem solving problem with ethnomathematics nuances of the marble game.

Diketahui:
Farhan memiliki 60 biji neker. Farhan membidik 6 kali.
total neker setelah bermain 96 biji.

Ditanyakan:
Jumlah neker 1 bidikan Farhan

Jawab:
Misal x adalah jumlah neker yang diperoleh Farhan 1 bidikan.
Maka model matematika:

$$60 + 6x = 96$$
 sehingga

$$60 + 6x = 96$$

$$60 - 60 + 6x = 96 - 60 \text{ (Dikurangi 60)}$$

$$6x = 36$$

$$x = 36 : 6$$

$$x = 6$$
 Maka jumlah neker 1 kali bidikan Farhan adalah 6

Figure 6. S3 answer result

The following are the results of the Researcher's interview (I) with S3 regarding the ethnomathematics question of the marble game.

I: Can you tell from the question what is known and what is asked?

S3: What is known is that Farhan has 60 marble seeds, Farhan shoots 6 times, and the total marble after playing is 96 seeds, what is asked is the number of marbles one shot Farhan.

I: What did you do to determine the number of marble one shot Farhan?

S3: Calculated $60 + 6x$

I: Where did you get the $6x$?

S3: 6 is the number of Farhan's shots, and x is for example the number of marbles obtained by Farhan's one shot.

I: Then after you've generalized what do you do afterward to get the answer?

S3: $60 + 6x = 96$, $60 - 60 + 6x = 96 - 60$ " $6x = 36$: 6, so $x = 6$ "

I: How do you check whether or not the x value is 6?

S3: Recalculated

I: The conclusion of this problem is what does the hue do?

S3: The number of marble one shot Farhan obtained was 6

Based on the results of the interview with S3, the subject can fulfill the indicators of problem solving ability including understanding the problem, planning the solution, and performing the solution plan. S3 did not take the step of checking back his answer. This is shown from the answer sheet and interview results.

Based on the analysis of the visual learning style, S1, S2, and S3 have the same problem solving stages, namely the stages of understanding the problem, making a solution plan, and carrying out the solution plan. At the review stage, the three subjects did not carry it out. The results of the analysis show that the idea of a solution plan and carrying out the solution plan by the three subjects is almost the same, namely solving by first postulating the number of marbles obtained by Farhan in one shot into x , then obtaining a mathematical model of the problem given. The

mathematical model obtained is then solved by simplifying it so that the value of x is obtained. It can be concluded that the desired information has been fulfilled and a strong theory, so the data for visual subjects stopped until the third subject.

Presentation of the results of the ability to solve mathematical problems with ethnomathematics nuances of the marble game in terms of auditory learning style

Students' problem solving ability in solving math problems with ethnomathematics nuances of the marble game based on auditory learning style was selected by purposive sampling with subjects S4, S5, and S6. Based on the results of the answers, the subject can solve problems with all stages of solving mathematical problems. Figure 7 shows the results of S4's answer.

Diketahui :

Farhan memiliki 60 biji netter
 Farhan bermain 6 kali bidikan
 Total netter setelah bermain = 96 (60 + 36)

Ditanyakan :

Jumlah netter 1 bidikan Andhi farhan

Jawab :

Misal x adalah jumlah netter yang diperoleh Andhi 1 bidikan.
 Maka, model matematika ~~35 + 4x = 51~~ $60 + 6x = 96$
 Sehingga
 $60 + 6x = 96$
 $60 - 60 + 6x = 96 - 60$
 $6x = 36$
 $x = \frac{36}{6}$
 $x = 6$

Jadi jumlah netter 1 kali bidikan Farhan adalah 6

Pengecekan :

Substitusi $x = 6$ ke $60 + 6x$
 $60 + 6(6) = 60 + 36$
 $= 96$

Figure 7. S4 answer result

The results of the Researcher (I) interview with S4 are as follows.

I: What is known from the question?

S4: What is known in the question is that Farhan has 60 marbles and plays 6 shots, and the total marbles after playing is 96.

I: What were you told to solve in the question?

S4: Find the number of marbles that Farhan gets in one shot.

I: What did you do to find the number of marbles in one shot of Farhan?

S4: So, Farhan's marble is 60, and then add 6, 6 is 6 times the shot, and then x is how many Farhan gets in one shot.

I: From the beginning to get the final value, how do you solve it?

S4: So it's $60 + 6$, x is searched first, then it becomes $60 - 60 + 6x = 96 - 60$, then yes, $6x = 96 - 60$ got 36, x is $36 : 6$, the x is then found 6

I: Are there any steps for Arsyad to check whether the answer is correct or not from this problem?

S4: Yes, I tried to change the x to 6.

I: What is the conclusion from the problem that you did?

S4: Yes, the conclusion is that the number of marbles obtained by Farhan in one shot is 6.

Based on the results of the S4 interview on the ethnomathematics problem of the marble game, the subject was able to fulfill all problem solving indicators, namely understanding the problem, making a solution plan, implementing the solution plan, and re-examining the solution obtained. This is shown from the answer sheet and the results of the interview with S4 who was able to explain the stage of re-examining his answer. Figure 8 shows the results of S5's answers to math problems with ethnomathematics nuances of the marble game.

Diketahui
 Farhan memiliki 60 biji neker
 Farhan bermain 6 kali bidikan
 Total neker setelah bermain 96 biji

Ditanyakan
 Jumlah neker 1 bidikan Farhan

Jawab :
 Misal x adalah jumlah neker yg diperoleh Farhan 1 bidikan
 Maka, model matematika
 $60 + 6x = 96$
 sehingga
 $60 + 6x = 96$
 $60 - 60 + 6x = 96 - 60$ (dikurangi 60)
 $6x = 36$
 $x = \frac{36}{6}$
 $x = 6$

Maka jumlah neker 1 kali bidikan Farhan adalah 6

Figure 8. S5 answer result

The results of the researcher's interview (I) with S5 are as follows.

I: From the problem that is here, what is asked and what is known?

S5: What is known is that Farhan has 60 marble seeds, Farhan plays 6 shots, and the total marble after playing is 96.

I: Then what is the question?

S5: The number of marbles in one shot of Farhan.

I: What did you do to solve the problem?

S5: Let x be the number of Farhan's marble in one shot. The math model is $60 + 6x = 96$.

I: Okay, what was modeled afterward?

S5: Add up, $60 + 6x = 96$, then $60 - 60 + 6x = 96 - 60$.

I: Then what is the final result?

S5: x equals 36 divided by 6, so $x = 6$

I: To check if the correct x value is 6, what did you do?

S5: The x is replaced by 6, which means 60 plus 6 times 6 equals 96.

I: Does that mean he got 96?

S5: Yes.

I: From this problem, what is the conclusion that you know?

S5: The number of marbles once shot by Farhan is 6.

Based on the results of the S5 interview on the ethnomathematics problem of the marble game, the subject was able to fulfill all indicators of problem solving, namely understanding the problem, making a solution plan, carrying it out, and re-examining the results. This is shown from the answer sheet and the results of the interview with S5 who was able to explain the stage of re-examining his answer. Figure 9 shows the results of S6's answers to math problems with ethnomathematics nuances of the marble game.

Diketahui . Farhan memiliki 60 biji neker
Farhan bermain 6 kali bidikan
total neker setelah bermain 96 biji

Ditanya : Jumlah neker 1 bidikan Farhan

Jawab . misal x adalah jumlah neker yang diperoleh Farhan 1 bidikan
maka, model matematika

$$60 + 6x = 96$$
 sehingga

$$60 + 6x = 96$$

$$60 - 60 + 6x = 96 - 60 \text{ (kurang 60)}$$

$$6x = 36$$

$$x = \frac{36}{6} : 6$$
 maka jumlah neker 1 bidikan Farhan adalah 6

Figure 9. S6 answer result

The results of the researcher's interview (I) with S6 are as follows.

I: From the question what is known and what is asked?

S6: Farhan has 60 marble seeds, Farhan plays 6 shots, and the total number of marbles after playing 96, which is asked the number of marbles one shot Farhan.

I: How do you solve it to get the number of Farhan's one shot?

S6: The sum of Farhan's 60 marble seeds plus 6 shots and x is for example the number of marbles obtained by Farhan in one shot.

I: What did you do next to get the answer?

S6: The sum of 60 Farhan's marble seeds and 6 Farhan's shots is 96, 96 is the result of $60 + 6x$, $60 - 60 + 6x = 96 - 60$ so $6x = 36$ so $x = 36 : 6$.

I: Then to know the value is correct x is 6 what do you do?

S6: Yes, the result of $x = 36$ is divided by 6.

I: What is the conclusion of the question?

S6: It means that the number of Farhan's shots is 6.

Understanding the problem, making a solution plan, and implementing the solution plan are three indicators of problem solving that S6 fulfills based on the

interview results on the ethnomathematics problem of the marbles game. This is shown from the answer sheet and interview results with S6 who cannot explain the stage of re-examining his answer.

Based on the results of the analysis of the auditory learning style, it is known that there is invalid data on subject 5, namely at the recheck stage so the data at the recheck stage of subject 5 is ignored. It is known that S4, S5, and S6 have the same problem solving ideas. The three subjects started by first postulating the number of marbles obtained by Farhan in one shot into x . Then, from the postulate, the model was obtained.

The data obtained is sufficient to form a new theory so that taking subjects in the auditory learning style category is only up to three subjects. It can be concluded that auditory learning style subjects carry out mathematical problem solving on ethnomathematics nuanced problems with the stages of understanding the problem, making a solution plan, and implementing the solution plan. At the stage of checking back, the subject tends to carry it out but is not written on the answer sheet.

Presentation of the results of the ability to solve math problems with ethnomathematics nuances of the marble game in terms of kinesthetic learning styles

Students' problem solving ability in solving math problems with ethnomathematics nuances of the marble game based on auditory learning style was selected by purposive sampling with subjects S7, S8, and S9. Based on the results of the answers, the subject can solve problems with all stages of solving mathematical problems. Figure 10 shows the results of S7's answer.

Diket: Farhan memiliki 60 biji neker
 Farhan membidik 6 kali
 Total kelereng Farhan setelah bermain

Ditanya: Jumlah neker 1 bidikan Farhan

Jawab:
 misal x adalah jumlah neker yang diperoleh Farhan 1 bidikan.
 Maka model matematika
 $60 + 6x = 96$ biji
 sehingga
 $60 + 6x = 96$
 $60 - 60 + 6x = 96 - 60$ (dikurangi 60)
 $6x = 36$
 $x = \frac{36}{6}$
 $x = 6$

Maka jumlah neker 1 kali bidikan Farhan adalah 6 //

Figure 10. S7 answer result

The results of the researcher's interview (I) with S7 are as follows.

I: From the question what is known and asked?

S7: What is known is that Farhan has 60 marbles, then Farhan shoots 6 times, then the same total Farhan marbles after playing there are 96.

I: Then what is the question?

S7: The number of marbles in one shot of Farhan.

I: Then after that what do you do?

S7: Let's suppose x is the number of marbles obtained by Farhan in one shot, then the mathematical model is $60 + 6x = 96$.

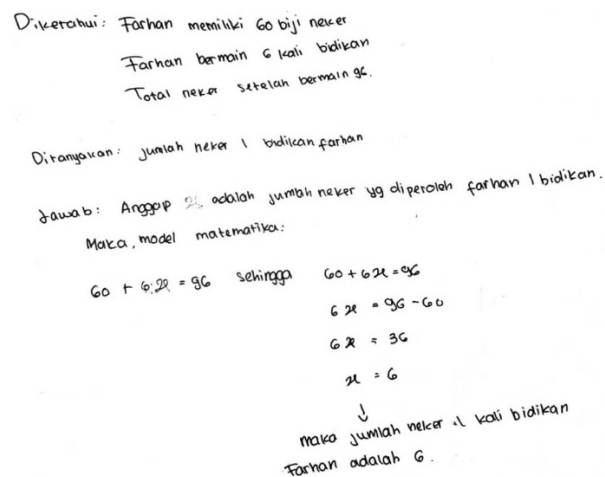
I: Then after it is generalized?

S7: Everything is the same minus 60, $60 - 60 + 6x = 96 - 60$, the result is $6x = 36$, that's $x = 36 : 6$, $x = 6$

I: What is the conclusion of this problem?

S7: Then the number of marbles once Farhan shot is 6.

Based on the interview results on S7, the subject was able to fulfill three problem solving indicators, namely understanding the problem, making a solution plan, and implementing the solution plan. This is shown from the answer sheet and interview results. Figure 11 shows the results of S8's work in solving math problems with ethnomathematics nuances of the marble game.



Diketahui: Farhan memiliki 60 biji neker
Farhan bermain 6 kali bidikan
Total neker setelah bermain 96.

Ditanyakan: jumlah neker 1 bidikan farhan

Jawab: Anggap x adalah jumlah neker yg diperoleh farhan 1 bidikan.
Maka, model matematika:
 $60 + 6x = 96$ sehingga $6x + 60 = 96$
 $6x = 96 - 60$
 $6x = 36$
 $x = 6$
↓
Maka jumlah neker 1 kali bidikan Farhan adalah 6.

Figure 11. S8 answer result

The results of the researcher's interview (I) with S8 are as follows.

I: What is known about this problem?

S8: Farhan has 60 marble seeds, Farhan has played 6 shots, and the total marble that Farhan has obtained is 96.

I: What is the question?

S8: The number of marbles in one shot of Farhan.

I: What did you do to determine the number of marbles in one shot?

S8: For the number of marbles obtained by Farhan in one shot, I consider it as x and the mathematical model is.... Farhan's 60 marble seeds plus Farhan playing 6 shots times x equals 96.

I: Can you explain the working steps until you get the number of marbles for one shot?

S8: So, $60 + 6x = 96$, then the 60 is moved internally so $6x = 96 - 60$, then subtracted so $6x = 36$, after that the 6 moves internally again so $x = 36 : 6$, the result is 6

I: Is there any way you can check your answer?

S8: No, there isn't.

I: Okay, what is the conclusion of this problem?

S8: After calculating the number of marble once Farhan's shot is 6.

Based on the results of the interview with S8, the subject was able to fulfill three indicators of problem solving, namely understanding the problem, making a solution plan, and implementing the solution plan. This is shown from the answer sheet and interview results. Figure 12 shows the results of S9's work in solving math problems with ethnomathematics nuances of the marble game.

Diketahui : Farhan = 60 biji neker
 = 6 x bidikan
 = 96 biji neker setelah bermain.

Ditanya : Jumlah neker 1 bidikan Farhan?

Diyawab : Misal x adalah jumlah neker yang diperoleh Farhan 1 bidikan
 maka, model MTK

$$60 + 6x = 96$$

Sehingga

$$60 + 6x = 96$$

$$60 - 60 + 6x = 96 - 60$$

$$6x = 36$$

$$x = \frac{36}{6}$$

$$x = \underline{6}$$

Maka jumlah neker 1 x bidikan Farhan adalah 6.

Figure 12. S9 answer result

The results of the Researcher (I) interview with S9 are as follows.

I: From the question what is known and asked?

S9: What is known is that Farhan brought 60 marbles, then Farhan shot 6 times, and 96 marbles are the total marbles after playing.

I: Then what is asked?

S9: What is asked is the number of marbles in one shot of Farhan.

I: What did you do to find the number of marble one shot Farhan?

S9: The number of marbles obtained by Farhan is x , so the mathematical model is $60 + 6x = 96$.

I: Can you tell me the steps to do it briefly?

S9: Yes, so $60 - 60 + 6x = 96 - 60$, then it becomes $6x = 36$, the x is $36 : 6$ obtained 6

I: To know whether or not the x value is 6, what did you do?

S9: Just recalculate

I: What is the conclusion of the problem you are working on?

S9: Then the number of Farhan's shots is 6.

Based on the results of the interview with S9, the subject was able to fulfill three indicators of problem solving, namely understanding the problem, making a solution plan, and implementing the solution plan. This is shown from the answer sheet and interview results.

Based on the results of data analysis of students with kinesthetic learning styles, it is known that the three subjects, namely S7, S8, and S9, all data owned are valid. The three subjects solved the problem by using the problem solving stages of understanding the problem, making a solution plan, and carrying out the solution plan. However, the three of them did not do the stage of re-examining their answers. It is known that the three subjects have almost the same solution plan, namely by generalizing the information asked by the problem until the mathematical model is obtained. Furthermore, the obtained mathematical model is solved to obtain the x value. Therefore, the data needed is sufficient to define the stages of the problem.

Discussion

Based on the description of the results of data analysis, further discussion is carried out regarding the ability to solve mathematical problems with ethnomathematics nuances on Linear Equation One Variable material in terms of visual, auditory, and kinesthetic learning styles.

Visual Subject Category Mathematics Problem Solving

Subjects with visual learning styles read the problem to identify the information contained in the problem. The subject understood the problem given because it was related to the game of marbles. The results of the interview with the subject showed that the subject was able to mention the known and questionable information about the problem completely. Based on this explanation, the research results follow Maruf et al. (2020) that the indicator of students being able to understand the problem is that students can determine and write what is known and asked in the problem.

The visual learning style category subject tends to plan the solution by first memorizing the questioned item, namely the number of Farhan's marbles in one shot as x , then determining the mathematical model from the information presented in the problem. Maruf et al. (2020) stated that the indicator of planning problem solving is being able to determine concepts, formulas, or methods that support the information in the problem and support all the information in the problem and can

complete problem solving. Visual subjects have a concept to solve the problem by making a mathematical model first.

At the stage of carrying out the solution plan, the subject carries out the solution plan by solving the mathematical model created. The math model obtained is $60 + 6x = 96$. This is following the research of Maruf et al. (2020) which states that the indicator of the subject carrying out the solution plan is that the subject can perform calculations and carry out the steps of the solution plan. Visual learning style subjects can carry out the solution plan well.

In the review stage, visual learning style subjects do not review the results of their answers. Research by Maruf et al. (2020) explains that in the indicator of checking back the subject has not been able to do so. In contrast to Masdy (2021), students with a visual learning style are meticulous students which allows students to double-check their answers. However, not all students were able to recheck their answers because they felt confident and the time given was not enough to recheck their answers. In general, subjects with visual learning styles fulfill the three stages of problem solving according to Polya, namely understanding the problem, planning the solution, and carrying out the solution plan.

Auditory Subject Category Mathematics Problem Solving

In the process of solving math problems by auditory learning style category subjects, at the stage of understanding the problem it is known that the subject reads the problem and understands the information well. The results of written tests and interviews show that the subject understands well what is known and asked in the problem. This is supported by previous research that subjects with auditory learning styles can determine what is known and asked correctly and can explain the information from the problem given in their sentences (Masdy, 2021).

At the stage of planning problem solving, the subject plans the solution by first memorizing the thing asked in the problem as the form x , then the subject forms a mathematical model from the information obtained in the problem, namely $60 + 6x = 96$, and then solves it. The reason the subject chose this method was explained in the interview this method was the simplest and had been taught before. This shows that the subject can plan the steps needed to solve the problem presented and can plan the formula to be used to solve the problem (Umrana, Cahyono, & Sudia, 2019). Similar to previous research which states that subjects with auditory learning style categories can plan solutions according to procedures that lead to the right solution and the correct formula (Masdy, 2021).

Auditory learning style category subjects carry out the solution plan well. The subject simplifies the mathematical model obtained by subtraction and division operations so that the final value of x is 6. This is supported by Umrana (2019) that auditory learning style category subjects can carry out all important and mutually supporting steps in solving problems according to planning.

The re-examination stage is revealed in the written test results and interviews. Subjects with auditory learning style category carry out the recheck in another way, namely by substituting the value of x , namely 6, into the mathematical model $60 + 6x$. If the substitution result obtained is equal to 96, then the value of $x = 6$ is correct and is the answer to the problem. This follows previous research which states that subjects with auditory learning styles can re-examine the results of problem solving in ways other than those done in solving the problem at that time (Umrana et al., 2019).

Subjects with auditory learning style categories re-examine the results of their work by checking the information that has been identified and can explain other ways of solving the problem (Masdy, 2021). In general, subjects with auditory learning style category fulfill the four stages of problem solving by Polya

Kinesthetic Subject Category Mathematics Problem Solving

The problem solving process for kinesthetic learning style category subjects at the stage of understanding the problem can understand the problem information well. This is shown from the results of the written test and interview test, the subject can explain well the information presented in the problem. Masdy (2021) states that the subject of the kinesthetic learning style category can determine what is known, ask correctly, and explain the problem again in his sentence.

In the planning stage of solving the problem of the kinesthetic learning style category subject can plan the steps that will be used to solve the problem, namely memorizing the questioned item in x and then determining the mathematical model $60 + 6x = 96$. This follows Umrana (2021) that the subject of the kinesthetic learning style category can make important and mutually supportive solution plans to solve the problem at hand correctly.

The subject can carry out the solution plan well according to the plan, namely simplifying the mathematical model by subtraction operation so that a simple form $6x = 36$ is obtained. This is supported by previous research which states that kinesthetic subjects can carry out all important and mutually supporting steps as planned, but the subject is less able to perform calculations according to the planned formula (Umrana et al., 2019).

Subjects in the kinesthetic learning style category did not reexamine their answers. In addition, the subject also did not know other alternative ways that could be used to answer the problem. In general, subjects with kinesthetic learning styles fulfill the 3 stages of problem solving according to Polya, namely understanding the problem, making a solution plan, and implementing the solution plan.

Based on the results of the discussion presented, there is one differing perspective based on previous research, specifically concerning subjects with a visual learning style. In this study, students with a visual learning style did not perform the last step of Polya's method, which is to review their work. According

to Masdy (2021), students with a visual learning style are expected to be meticulous, making it very likely for them to review their work.

An alternative perspective we can offer to support our viewpoint is that, in reality, not all students will go through the step of rechecking their work due to various factors, such as already feeling confident in their answers or having insufficient time. This can be addressed by designing questions that better consider the time required for completion and by motivating the importance of thoroughness in the problem-solving process.

Mathematical problem-solving in the context of One-Variable Linear Equations (PLSV) with an ethnomathematics approach for students with a visual learning style does not fully meet Polya's problem-solving steps. Students only perform the steps of understanding the problem, devising a plan, and executing the plan. After reading the question, the subjects tend to clearly and concisely write down what is known and what is being asked. The subjects generally create a solution plan by first making assumptions about the known information until they arrive at a mathematical model, which they then simplify to reach a conclusion. Visual learners tend not to review their work because they are confident in their answers.

In general, this ethnomathematics-based learning process is quite suitable for students with a visual learning style, as the cultural concept, in this case the marble game, can be clearly observed visually. However, students should still be encouraged to take the time to review their answers after completing the task.

Mathematical problem-solving in the context of One-Variable Linear Equations (PLSV) with an ethnomathematics approach for students with an auditory learning style fully follows Polya's problem-solving steps. The steps carried out by the subjects include understanding the problem, planning the solution, executing the solution plan, and reviewing the work. After reading and understanding the problem, students with an auditory learning style tend to write down the known information completely and clearly. The problem-solving process is carried out thoroughly, and the review process is also performed. Students with an auditory learning style are the most suitable for ethnomathematics-based learning.

Mathematical problem-solving in the context of One-Variable Linear Equations (PLSV) with an ethnomathematics approach for students with a kinesthetic learning style does not fully meet Polya's problem-solving steps, specifically understanding the problem, planning the solution, and executing the solution plan. After reading and understanding the problem, students with a

kinesthetic learning style tend to write down the known information and the question in a clear and concise manner.

The review step was not performed or explained by the students with a kinesthetic learning style, as they only rechecked their calculations. The final step in problem-solving, which is reviewing the solution, is rarely done by the students. This is evident from the written test results, where students rarely wrote down the step of reviewing their answers. However, there were a few students who did perform the review step.

This research has significant urgency in exploring mathematical concepts within the cultural context around us, particularly traditional games. The developmental and learning processes of elementary and secondary school students are generally still dominated by motor skill activities. Thus, traditional games can be encouraged for students to engage in as a means of practicing motor skills while learning and improving their socialization with peers. This also aims to reduce students' reliance on electronic devices. Besides playing, they can also learn basic mathematical concepts to enhance their mathematical understanding in an enjoyable way. Furthermore, this research activity serves as a means to preserve traditional games, which are gradually fading and no longer being played. In the learning context, the results of this study can be used as a reference for implementing culturally based mathematics learning.

Conclusion

This study has successfully explained the ethnomathematical concepts of the marble game, which is one of the popular traditional games in Indonesia. Based on the construction of the game that has been described, the marbles game can be used to explain the concept of a linear equation with one variable.

Based on the results of the analysis and discussion in this study, it is concluded that the ability to solve mathematical problems on problems with ethnomathematics nuances of the marble game in terms of visual, auditory, and kinesthetic learning styles. In students with a visual learning style, the stages of solving mathematical problems carried out are the stages of understanding the problem, planning a solution, and carrying out a solution plan. Students with a visual learning style category have not carried out the re-examination stage, because they feel confident in their answers.

In addition, students with visual learning styles do not have alternative ways to solve the problem. At the problem-understanding stage, students can understand what is known and asked about ethnomathematics and nuanced problems easily and well. Understanding the problem is related to students' experience with the cultural

concept raised, namely the marble game. Students are familiar with the marble game. At the stage of planning a solution, students with a visual learning style think by generalizing what is asked and then determining the mathematical model to be solved. At the stage of carrying out the solution plan, students tend to simplify the mathematical model obtained by subtraction and division operations until the conclusion asked from the problem is obtained.

The stages of solving math problems carried out by auditory learning style category students fulfill the stages of problem solving by Polya, namely the stages of understanding the problem, planning the solution, carrying out the solution plan, and checking back. At the stage of understanding the problem, students with the auditory learning style category can understand the information presented in the problem with ethnomathematics nuances completely and can explain well what is known and asked in the problem. Students experience the ethnomathematical context presented, namely the marble game. This makes it easier for students to imagine the problems presented.

At the stage of planning a solution, auditory learning style category students can model the mathematics of the problem presented. Students model what is asked in x and this will be solved by simplifying the mathematical model. At the stage of carrying out the solution plan, auditory learning style category students can carry out the solution plan well from simplifying the mathematical model to the conclusion. At the stage of checking back, students with the auditory learning style category were able to check the answer with another step, namely by substituting the x value obtained in the mathematical model.

Students with the kinesthetic learning style category fulfill the three stages of problem solving according to Polya, namely the stages of understanding the problem, planning the solution, and implementing the solution plan. At the stage of understanding the problem, students can write and explain in full the information known and asked in ethnomathematics nuanced problems. This is because students have experience in playing the marble game which is the ethnomathematics cultural context of the problem.

At the stage of planning a solution, students tend to think about generalizing what is asked and modeling mathematics from the information contained in the problem. At the stage of carrying out the solution plan, students with the kinesthetic learning style category carry out the solution according to the plan well. Students simplify the mathematical model obtained by subtraction and division operations until the conclusion is obtained from what is asked in the problem. Students with the kinesthetic learning style category have not carried out the stage of looking

back, students also do not know other alternative ways to answer the questions given.

The findings of this study have significant implications for the application of culturally responsive teaching practices. This is because many traditional games can be used as learning resources to introduce mathematics more effectively. These results also serve as an effort to continue preserving traditional games as cultural heritage among students, who have increasingly shifted toward the use of gadgets and technology. Moving forward, it is hoped that there will be more exploration of ethnomathematical aspects in various traditional games.

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