ACTA SCIENTIAE

ISSN: 2178-7727
DOI: 10.17648/acta.scientiae.7690

Applying Ethnomathematics in Learning Mathematics for Middle School Students

Nilam Sari [a,b]
Sahat Saragih [a]
E. Elvis Napitupulu [a]
Siti Rakiyah [b]
Dwi Novita Sari [a,c]
Syahriani Sirait [a,d]
Anim Anim [a,d]

[a] State University of Medan, Postgraduate Program, Jl. William Iskandar Psr V, Medan, Indonesia
[b] Universitas Quality, Jl. Ngumban Surbakti, Medan, Indonesia
[c] Universitas Muslim Nusantara Al-Washliyah, Jl. Garu 2 B, Medan, Indonesia
[d] Universitas Asahan, Jl. Jendral Ahmad Yani, Kisaran, Indonesia

Received for publication 9 Apr. 2023. Accepted after review 14 Aug. 2023
Designated editor: Claudia Lisete Oliveira Groenwald

ABSTRACT

Background: Mathematics is a scientific field inherently intertwined with everyday life. Nevertheless, the conventional approach to teaching math has been largely theoretical and detached from real-world situations, leading to challenges for students in comprehending mathematical concepts. **Objectives**: This study aims to determine how ethnomathematics influences students' understanding of learning mathematics for linear equations material. **Design**: The study used a problem-based learning model with contextual characteristics. The research method was descriptive and qualitative by analyzing students' activities. **Setting and Participants**: A total of 27 junior high school students from Medan, Indonesia, were involved in this research. **Data collection and analysis**: The data for analysis was obtained from student worksheets and observations of student activities conducted by the teacher. **Results**: The results indicate that: 1) Students could assume variables correctly, 2) Students could make mathematical models or equations correctly based on students understanding, which they saw directly from the illustration, 3) At the time of solving the problem, students could determine the method used, and 4) All students carried out the procedure correctly, but two groups got the wrong results because they made the wrong mathematical model. **Conclusions**: This study suggests this learning brought students into the context of the real world related to everyday life so that students easily understand the problem given.

Corresponding author: Nilam Sari. Email: nilamsarie@gmail.com

Keywords: Ethnomathematics; Problem-based learning; Linear equations systems.

Aplicando a Etnomatemática no Ensino de Matemática para Estudantes do Ensino Fundamental II

RESUMO

Contexto: A Matemática é um campo científico intrinsecamente interligado com a vida cotidiana. No entanto, a abordagem convencional de ensino da matemática tem sido amplamente teórica e desvinculada de situações do mundo real, o que resulta em desafios para os alunos compreenderem conceitos matemáticos. **Objetivos**: Este estudo tem como objetivo determinar como a Etnomatemática influencia a compreensão dos alunos na aprendizagem de matemática para o conteúdo de equações lineares. **Design**: A aprendizagem foi realizada utilizando um modelo de ensino baseado em problemas com características contextuais. O método de pesquisa utilizado foi descritivo e qualitativo, analisando as atividades dos estudantes. **Ambiente e participantes**: Um total de 27 alunos do ensino fundamental da cidade de Medan, na Indonésia, foram envolvidos nesta pesquisa. **Coleta e análise de dados**: Os dados para análise foram obtidos a partir das fichas de trabalho dos alunos e observações das atividades dos alunos realizadas pelo professor. **Resultados**: Os resultados indicam que: 1) Os alunos foram capazes de assumir variáveis corretamente, 2) Os alunos foram capazes de elaborar modelos matemáticos ou equações corretamente com base no entendimento dos alunos que foi visto diretamente da ilustração, 3) No momento de resolver o problema, os alunos foram capazes de determinar o método usado, e 4) Todos os alunos realizaram o procedimento corretamente, mas duas equipes obtiveram resultados errados porque elaboraram o modelo matemático errado. **Conclusões**: Este estudo sugere que essa abordagem de ensino inseriu os alunos no contexto do mundo real relacionado à vida cotidiana, permitindo que eles compreendessem facilmente os problemas propostos.

Palavras-chave: Etnomatemática; Aprendizagem baseada em problemas; Sistemas de equações lineares.

INTRODUCTION

Culture is inherent in society and embedded in every individual as the basis for forming the nation's personality. According to Haushchild (2017), culture is a trace of knowledge regarding how knowledge develops and grows in society. We can look at how culture colors the lives of the surrounding community. Culture is necessary, so everyone can interpret, appreciate, and realize the importance of practicing the nation's cultural values (Benedict, 2019). One of the efforts made to form a cultured character is through education in schools. Schools, as formal educational institutions, play a significant role in

influencing the cultural and moral character of students. In this regard, education is not only concerned with imparting knowledge and skills, but also with shaping attitudes, values, and beliefs consistent with the culture and national identity. Students can develop the capacity to discern and appreciate Indonesia's cultural diversity and values through education. Thus, pupils are able to comprehend the significance of culture for social life and the nation. In addition, education can serve as a means of imparting moral and ethical values applicable to society, allowing students to internalize and implement these values in their daily lives.

Mathematics is a science that cannot be separated from daily life. However, mathematics learning that has been carried out so far tends to be theoretical and not contextual (Fredricks et al., 2018), so students have difficulty understanding mathematics. Besides, students learn mathematics only to implement and fulfill the educational curriculum. Therefore, students need learning that bridges mathematical concepts in daily life and formal mathematical concepts. In other words, students require learning with contextual characteristics (Bergmann et al., 2016). Students are better able to comprehend and relate the material they are learning to their everyday lives when they are provided with the proper contextual information. In addition, contextualized learning increases student motivation because the material taught no longer appears foreign or irrelevant to their lives. Using ethnomathematics with a problem-based learning approach, for instance, can enrich the learning context so that students can more easily comprehend and implement the mathematical concepts being taught.

Education and culture cannot be neglected in daily life, as culture is a complete and all-encompassing entity that applies to society, and education is a fundamental necessity for every individual in that community. Education and culture are crucial in developing our nation's noble ideals and influencing character creation based on noble cultural values. Ethnomathematics can bridge the gap between culture and education. Ethnomathematics is a form of mathematics that is culturally affected or founded (Albanese et al., 2017). Through the application of ethnomathematics in education, particularly mathematics education, it is hoped that later, students will be able to understand mathematics and their culture better and that it will be easier for educators to instill cultural values in students so that cultural values that are part of a nation's character are instilled in students from an early age.

Through an ethnomathematics method of learning mathematics, teachers can explore the cultures in the student's environment and then analyze

the values of that culture. Teachers can explain and underline the significance of these cultures' values. In the future, it is intended that students not only comprehend mathematics but also have a greater appreciation for their cultures and be able to adopt the inherent values that impact national character development. The emphasis on cultural values is a crucial responsibility of educators. The focus is on how pupils might adapt to these cultural values through their studies (Wahyuni et al., 2013). In addition to imparting academic content, educators must also consider the cultural values of the students' surroundings. Students can develop a sense of tolerance and appreciation for the cultural diversity present in society if they are exposed to and taught cultural values. To create an inclusive and accessible learning environment for all students, educators must be able to integrate local culture into the curriculum. In this way, ethnomathematics can be an effective way to introduce and implement cultural values in mathematics education.

The research undertaken by D'Ambrosio (1986) served as a launching point for understanding the role of ethnomathematics in education. This argument is also supported by Bishop (1988) and has expanded to Africa (Gerdes, 1988) and Asia Pacific (Balamurugan, 2015). Seeing the cultural diversity in Indonesia, research and development of teaching materials integrating ethnomathematics are crucial as a means to motivate, stimulate, and overcome boredom among students as they provide new nuances concerning the study of mathematics. Because students are already familiar with ethnomathematics, it will be simpler for the teacher to guide students in identifying and relating cultural elements they are already familiar with to mathematical concepts (Abi, 2017).

Based on the observations at a private Middle School in Medan, students have difficulty working on Systems of Linear Equations in Two Variables (SLETV) questions and do not understand the concepts in the material. Therefore, this study proposed an implementation of the illustration of buying and selling traditional Malay snacks as an effort to apply cultural values through education. By applying this learning model, the researchers expect students to understand the SLETV material better. This study chose a private Middle School in Medan because most students live in the Malay Deli ethnic environment. Thus, by using media related to students' real lives, namely traditional Malay snacks, students would find it easier to understand mathematical concepts from the problems given. Therefore, this research aims to determine how ethnomathematics motivates students to learn SLETV material through a problem-based learning model.

THEORETICAL BACKGROUND

Ethnomathematics

Weinstein et al. (2004) stated that culturally responsive learning is a model of teaching that emphasizes student activities and their diverse cultural backgrounds, integrates into the learning process of specific subject areas, and utilizes various forms of assessment in evaluating learning outcomes. Culturally responsive learning can be categorized into three types: learning about culture, learning with culture, and learning through culture (Gorman & Balter, 1997). Four aspects need to be considered in culturally responsive learning: the substance and competency of the subject area, meaningfulness and learning process, assessment of learning outcomes, and the role of culture (Gay, 2002). Culturally responsive learning aims to achieve integrated understanding rather than just deep understanding.

In culture, mathematics is often used for practical purposes, such as in numbering systems, measurement, and economic, agricultural, or construction calculations. Additionally, mathematics can be found in other cultural aspects, such as art, music, and games (Gerdes, 1996). Ethnomathematics is a field of study that examines the relationship between mathematics and culture (D'Ambrosio, 1985). Mathematics and culture are interconnected because each culture has its way of viewing and using mathematics daily (Bishop, 1991). Therefore, ethnomathematics emerged as a field of study that investigates the relationship between the use of mathematics and a community's culture. By understanding the perspective and application of mathematics in a particular culture, we can develop more appropriate and relevant learning strategies for students and promote the development of a national character that is inclusive and values cultural diversity.

D'Ambrosio, a Brazilian mathematician, introduced ethnomathematics in 1977. The definition of ethnomathematics, according to D'Ambrosio, is:

> The prefix *ethno* is today accepted as a very broad term that refers to the social-cultural context and therefore includes language, jargon, and codes of behavior, myths, and symbols. The derivation of *mathema* is difficult, but tends to mean to explain, to know, to understand, and to do activities such as ciphering, measuring, classifying, inferring, and modelling. The suffix *tics* is derived from *techné*, and has the same root as technique (D'Ambrosio, 1990).

D'Ambrosio (1985) also stated that Ethnomathematics is the study of mathematics that considers the cultural considerations in which mathematics arises by understanding the reasoning and mathematical systems they use. The study of ethnomathematics in mathematics education encompasses all fields: architecture, weaving, sewing, agriculture, kinship relations, ornamentation, and spiritual and religious practices often align with patterns that occur in nature or govern abstract ideas systems. In practice, the study of ethnomathematics broadens students' understanding of numerous mathematical patterns and applications in culture and daily life. The application of ethnomathematics in mathematics education can aid in the development of multicultural awareness among students, allowing them to appreciate and utilize cultural diversity in their daily lives. The purpose of inclusive and ethnomathematics-based mathematics instruction is to enhance the quality of education and to prepare students for increasingly complex global challenges in the future.

Ethnomathematics studies and appreciates how people around the world view and use mathematics (Eglash et al., 2006). By studying ethnomathematics, we can understand how different cultures use mathematics in unique and varied ways to meet their needs. Additionally, ethnomathematics can provide benefits for students in several ways. Ethnomathematics can broaden students' perspectives, helping them expand their views on mathematics and culture and increase their appreciation for cultural diversity (Ascher, 1994). Furthermore, ethnomathematics can enhance students' understanding of mathematics. By learning how mathematics is used in everyday life across various cultures, students can better understand the importance of mathematics and how it can be applied in their own lives (Díez-Palomar et al., 2007).

Incorporating ethnomathematics into the mathematics curriculum can also increase students' motivation to study the subject. When students see the relevance and practical application of mathematics in their own lives and cultures, they may be more motivated to learn. This could result in enhanced academic performance and a more favorable attitude toward mathematics. Additionally, ethnomathematics can promote a more inclusive classroom environment by recognizing and valuing diverse cultural perspectives and practices. This is essential for fostering a positive learning environment, as it can foster a sense of belonging and respect among students from diverse cultural backgrounds.

Ethnomathematics uses mathematical concepts extensively about various mathematical activities, including grouping, counting, measuring, designing buildings or tools, playing, determining locations, and others, as stated by D'Ambrosio (1985). Ethnomathematics aims to acknowledge that there are different ways of doing mathematics by considering the mathematical knowledge developed in various sectors of society, as well as by taking into account the different ways of community activities, such as grouping, counting, measuring, designing buildings or tools, playing, and others. Students can develop a more comprehensive comprehension of mathematics if they recognize the diverse ways in which mathematics is utilized in various sectors of society. This can lead to a deeper appreciation for the subject and encourage students to investigate the practical applications of mathematical concepts. In addition, ethnomathematics can promote equity and inclusion in mathematics education by valuing diverse methods of knowing and learning. It enables students from various cultural origins to recognize their own cultural practices as valid and valued forms of mathematical knowledge, thereby fostering a more inclusive and diverse learning environment.

Mathematics that arises and develops in society and aligns with local culture is the center of the learning process and teaching method (Jaworski, 2006). This opens up pedagogical potential by considering the learners' knowledge acquired through learning outside the classroom. By taking a specific theme, mathematics learning can be done contextually, providing new experiences and insights for learners. Learning can be more effective through ethnomathematics as it introduces traditions and local cultures still recognized and practiced by specific community groups (Simamora & Saragih, 2019). This can increase students' interest in learning because they will feel engaged in learning that is relevant to their daily lives and culture. In addition to bridging cultural disparities in mathematics education, ethnomathematics can strengthen a region's cultural identity. Consequently, the ethnomathematics approach to mathematics education is a highly promising innovation for enhancing education quality in a country.

Ethnomathematics in Learning Mathematics

Mathematics education requires a specific approach to ensure effectiveness in its implementation (Yi et al., 2019). One of education's objectives is for students to master the content or material taught and apply it to problem-solving. One factor that influences learning is the culture within the community in which students reside (Semken et al., 2009). Culture plays a

significant role in shaping students' perspectives and attitudes toward certain subjects, including mathematics (Stodolsky et al., 1991). If a particular mathematical concept is far removed from their cultural schema, it can be challenging for them to comprehend. Therefore, an approach to mathematics education is needed to bridge mathematics with their culture.

Exploring cultural studies through mathematics-related activities will provide new information on the diverse local cultures in Indonesia (Risdiyanti & Prahmana, 2017). The purpose of this is to deepen the understanding of the connection between mathematics and culture, to achieve a more accurate perception of mathematics among students and the community, to enable the adaptation of mathematics education to the cultural context of students and the community, and to facilitate a better understanding of mathematics by eliminating the perception of it as a foreign subject among students and the community (D'Ambrosio, 1994). By optimizing the application and benefits of mathematics for the lives of students and the wider community, students and the community will receive optimal benefits from learning mathematics (National Research Council, 2004).

Applying ethnomathematics in mathematics education can be done in several ways. Teachers can ask students to find examples of mathematics from their own culture or other cultures and present them in class. This can help students understand that mathematics occurs not only in academic contexts but also in everyday life and various cultures. Applying ethnomathematics can help enhance students' appreciation and understanding of cultural diversity (Rosa & Gavarrete, 2017). Mathematics is considered an abstract and universal subject, but mathematics is also a cultural product (Bishop, 1991). By studying mathematics in different cultural contexts, students can broaden their perspectives on mathematics and culture and increase their appreciation for cultural diversity.

The application of ethnomathematics in education in Indonesia is still relatively new and has not been widely implemented (Hartinah et al., 2019). However, there have been some efforts to integrate ethnomathematics into mathematics learning in Indonesia. Further efforts are needed to integrate ethnomathematics into the education curriculum in Indonesia and provide adequate training to teachers to apply ethnomathematics in mathematics learning (Suryawan & Sariyasa, 2018). This is important to enrich mathematics learning and enhance students' interest and understanding of mathematics and culture in Indonesia. In order to promote the application of ethnomathematics

in the field of education in Indonesia, multiple stakeholders, including the government, educators, and researchers, must collaborate.

METHODOLOGY

The method used in this study is descriptive qualitative. The purpose of qualitative descriptive research is to explain and describe a problem by studying an individual or a group as well as an event. The instruments used in this study were observation sheets and student worksheets about SLETV material. The research procedures include classroom learning, working on student worksheets by problem-based learning, analyzing student worksheets, documentation, and observation. The sample in this study consisted of 27 eighth-grade students who were purposively and randomly selected based on the criteria that they had not yet received instruction on SLETV.

The consent of the parents or guardians of the students who participated in our study was obtained by having them sign an Informed Consent Form under the supervision of the homeroom teacher. However, we did not pursue an ethical assessment, due to time constraints that would have impeded the progress of the research, specifically because the material we presented to the students had to be covered within a specific timeframe and could not wait for the ethical assessment. In accordance with Resolution No. 510, dated April 7, 2016, of the National Health Council of Brazil, we are also fully aware that Acta Scientiae is not liable for any potential consequences, including providing full assistance and possible compensation for any harm to research participants.

RESULTS AND DISCUSSION

This research was mainly focused on learning through a problem-based learning model on the material of SLETV by using illustrations of buying and selling activities of traditional Malay snacks that students often buy in the market, such as kemojo, rasidah, and bangkit cakes (see Figure 1). Table 1 shows results that explain the implementation of buying and selling illustrations through learning with a problem-based learning model. The results describe what students and teachers did during the learning process with illustrations of the selling and buying through the syntax of the problem-based learning model.

Figure 1

Traditional Malay snacks (Asri, 2020; Rasyid, 2022; Prasetya, 2019)

(a) (b) (c)

(a) Kemojo, (b) Rasidah, and (c) Bangkit Cakes

Table 1

Learning Syntax

Syntax	Teacher's Activities	Students' Activities
Orienting Students to Problems	a. Reminding about previous lessons related to lesson in progress b. Motivating students, for instance, if they mastered the material, would help them calculate story problems related to SLETV in daily life.	a. Paying attention to the teacher's explanation **b.** Asking and responding to the teacher's explanation
Organizing Students to Learn	a. Before forming a study group, the teacher chose three students as models for buying and selling illustrations in class. The teacher prepared tools and materials to be used as media in the activities. Because it relates to Malay culture, the teacher must prepare two types of traditional snacks, *rasidah* and *kemojo* cakes. b. The teacher organized students to form heterogeneous study	a. Three chosen students as an illustration model for buying and selling came forward to the class and followed the teacher's instructions. b. The students grouped according to the teacher's instructions. c. Before completing the worksheets, students paid attention to the illustration of buying and selling traditional snacks that their

Syntax	Teacher's Activities	Students' Activities
	groups. Each group consisted of 3-4 students. c. The teacher instructed students to illustrate buying and selling, precisely one student as a seller and two as buyers. d. The teacher distributed students' worksheets to each group and asked the group leader to lead the discussion in his/her group.	friends did in front of the class. d. Students discussed worksheets in groups: students planned the steps for completion by collaborating, communicating, and asking other members of other groups.
Guiding Individual and Group Investigations	a. Guiding and assisting students in planning solutions to problems SLETV and monitoring students while working on the distributed worksheets.	a. At this step, it was related to the process of working on worksheets with illustration activities of buying and selling traditional Malay snacks, which were shown below
Developing and Presenting Works	a. Asked each group to hand in the results of the worksheets b. Directed each group to prepare presentation materials on problems solving that had been made. c. Managed the process of presenting the work and encouraged students to be actively involved d. Asked the representative of one group to present the results of solving the problem, and other group members were asked to provide feedback/input.	a. Collected the work of student worksheets. b. Prepared materials to be presented c. Listened to the teacher's directions to make a presentation d. Presented the work in front of the class (one student is a group representative), and other groups paid attention and asked questions and answers.

Syntax	Teacher's Activities	Students' Activities
Analyzing and Evaluating the Problem-Solving Process	a. Directed each group to re-check the problem-solving process that had been made. b. Helped students to evaluate and reflect (communicate collaboration or ask questions) on their problem-solving skills.	a. Checked the problem-solving process that has been done. b. Evaluated and reflected on the results of problem-solving skills.

Learning Questions

1st Question

On Sunday, Ani and Sinta visited a stall selling traditional Malay snacks. Ani bought four rasidah cakes and two kemojo cakes for Rp16,000, while Sinta bought three rasidah cakes and two kemojo cakes for Rp13,000.

a. Make a mathematical equation from the problem above, for example, the price of *rasidah* cake (x) and the price of *kemojo* cake (y)!

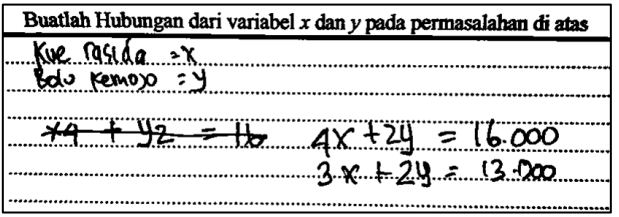
b. Find out how much one piece of *rasidah* cake and one piece of *kemojo* cake costs!

Students' Answers for the 1st Question

The illustration of buying and selling in the classroom was done by making two students as buyers, Ani and Sinta, and one as a seller. Seeing the students directly makes it easier to make mathematical equations/models. Figure 2 shows the answer from one group of students.

Figure 2

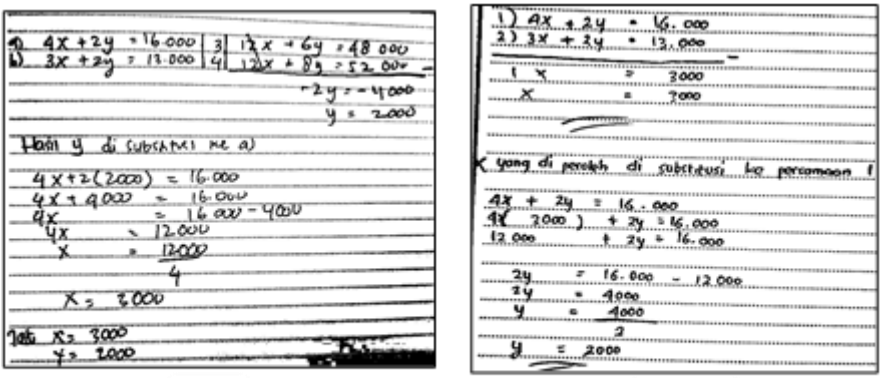
Student's Answer for Question 1(a)



Based on the group's answers in Figure 2, it can be concluded that students can understand the concept of developing mathematical models/equations. Students can directly see the concrete objects used as material in learning mathematics in class. Afterward, to answer point b in this question, students were directed by the teacher to do or choose an appropriate settlement strategy. Students can choose from 4 methods of completion, including the graph method, substitution, elimination, and mixed method. Figure 3 shows student answers.

Figure 3

Students' Answers to Question 1(b)



(i) (ii)

Based on the student's answers to point b (Figure 3), students have solved the problem correctly. In Figure 3(i), in the first step, students eliminated the x variable to obtain the value of the y variable. Thus, they performed a multiplication operation on each part of the existing equation with certain constants. Then, from the results of the obtained y variable, substitution was carried out in the initial equation to obtain the value of the x variable. Meanwhile, in Figure 2(ii), students directly perform subtraction operations on the two existing equations. They did this because the two equations have the same coefficient and variable values, namely the y variable, so a subtraction operation can be carried out directly to get the value of the x variable first. The next step is to substitute the value of x into the initial equation to get the value of the y variable.

Overall, in answering question number 1, it can be concluded that students can understand the concept of developing mathematical models/equations by illustrating buying and selling. In addition, students can choose the correct strategy/method to answer the given problem.

2nd Question

Naya and Rina bought traditional Malay cakes for themselves and their friends. They bought at the same stall. The problem was that they forgot to ask how much each cake cost.

a. Naya paid Rp39,000 to buy seven small packages of *bangkit* cakes and twelve *kemojo* cakes.

b. Rina paid Rp42,000 to buy ten small packages of *bangkit* cakes and eight *kemojo* cakes.

How can we help Naya and Rina to find the price of one pack of bangkit cakes and one piece of kemojo cake?

Students' Answers for the 2nd Question

In the 2nd question, the students were also instructed to illustrate buying and selling in front of the class. Based on the illustration of selling and buying, students could see directly, and it was easier to develop mathematical equations/models. Figure 4 presents the answers written by students.

Figure 4

Student's Answers to the 2nd Question in Making a Mathematical Model

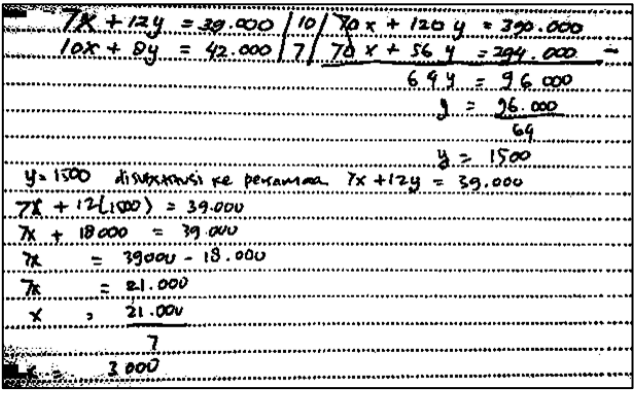
(i) (ii)

Based on the answers in Figure 4(i), it could be said that students could make mathematical models correctly and adequately as expected. However, some students could not make models correctly because they were wrong in combining the variables and coefficients, as shown in Figure 4(ii). Nevertheless, after getting the teacher's scaffolding, they knew their mistakes and could immediately correct them.

Afterward, the teacher directed students to choose the appropriate settlement strategy to determine the price of one package of bangkit cake and one piece of kemojo cake. Figure 5 shows the results of the student's answers.

Figure 5

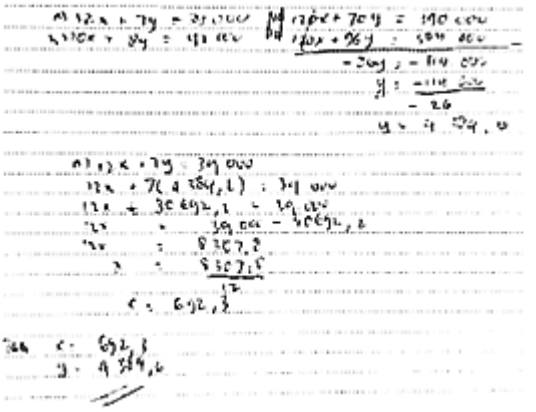
Student's Answer to the 2nd Question



Based on the answers in Figure 5, it could be seen that students could work step by step to solve problems and obtain the correct results. However, two of the six groups still wrongly answer the question due to the wrong mathematical model/equation formulation. For an example of one wrong answer, see Figure 6.

Figure 6

Student's Answer to the 2nd Question (Wrong Answer)



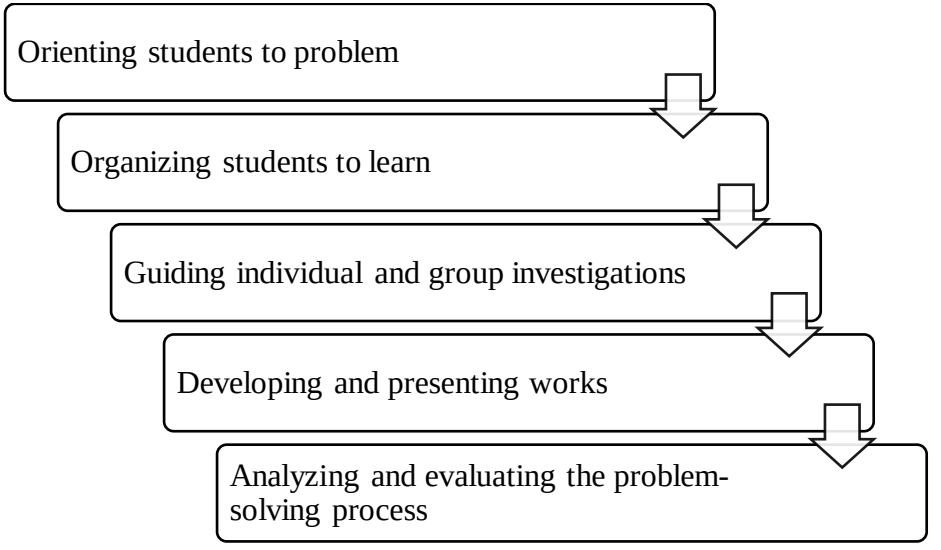
Overall, based on the student's answers, it could be seen that the process of finding the results done by most students was excellent and correct. In addition, the observation concluded that an error in the initial step when making a mathematical model might cause a fatal error when pursuing the final answer.

From the series of the teacher's and students' activities, it could be concluded that by applying the illustration of buying and selling in the classroom, students would find it easier to solve material problems of SLETV, especially when developing mathematical models/equations. This could be seen from the answers to the first question which all groups answered correctly. However, there were two groups of the six groups with wrong answers in determining the strategy/method of solving the problem on the second question. Based on the observation of these groups, the determination of the method and the solving process were correct. An error occurred because the beginning of the formation of the model/equation was wrong.

The stages of implementing the activities in this study can be summarized in Figure 7.

Figure 7

Steps of Implementing Activities



The observation results indicate that students are enthusiastic about learning, particularly while watching the buying and selling illustrations enacted by some classmates. In addition, students feel more confident in their ability to comprehend learning material when they immediately observe what is at stake in math problems. In addition, the usage of traditional Malay snacks in math problems piqued their interest because they frequently see these things. In this instance, ethnomathematics plays a role in using traditional Malay snacks. Indonesia has people with different characteristics, backgrounds, and mindsets (Passakonjaras & Hartijasti, 2019). One of the results of the culture of the Indonesian people is traditional snacks. Many traditional snacks in each province of Indonesia describe different identities and cultures. The Malay culture was chosen in this current study because students' daily lives as research subjects are in the Malay Deli environment, North Sumatra (Tanjung et al., 2022).

According to Albanese and Palacios (2015), ethnomathematics is a research program focusing on the relationship between mathematics and culture. The primary foundation of ethnomathematics is the awareness of the many ways to know and do mathematics related to ideas, values, and techniques in cultural diversity (Rosa et al., 2016; Rosa & Orey, 2015). In other words, ethnomathematics is a way of using mathematics by specific cultural groups. Because ethnomathematics emerges from culture, people are always unaware that they use mathematics. So, in the daily life of the community, especially Middle School students, it is necessary to show that mathematics is around them and is helpful in everyday life. This can be accomplished using applicable, real-world examples containing mathematical elements such as measurement, calculation, and problem-solving. In this way, students can see and experience the significance of mathematics in their daily lives, which can increase their interest in mathematics and their comprehension of mathematical concepts.

The success of this research is also attributable to the PBL learning model's superiority in training students to learn independently, enhancing students' self-learning. In addition, PBL can train students to communicate previously studied material to others. PBL can also develop students' problem-solving skills. The PBL learning approach promotes students' abilities to address contextual problems; the components offered are consistent with the student's experiences, so the problems that develop are contextual. In addition, students are expected to develop critical thinking skills, problem-solving abilities, and mastery of the subject matter (Lehmann et al., 2008). PBL requires students to actively solve problems and engage in a collaborative learning process with their instructors and peers. This can stimulate students' curiosity and enhance their ability to recognize, analyze, and solve commonplace problems.

According to Arends (2012), the instructional goals of problem-based learning are to help develop investigative and problem-solving skills, provide authentic adult role experiences, and lead students to gain confidence in their abilities to think and become independent learners. Problem-based learning is not designed to help teachers provide students with as much information as possible (Moust et al., 2021; Tan, 2021). However, problem-based learning is developed to help students develop thinking, problem-solving, and intellectual skills and learn various adult roles through their involvement in real experiences or simulations (Anazifa & Djukri, 2017; Khoiriyah & Husamah, 2018). Eventually, according to Sari (2020), applying problem-based learning can increase students' learning independence. Students are given the opportunity to develop critical thinking, creativity, and problem-solving

independence through problem-based learning. In addition, PBL allows students to acquire a deeper understanding of the material and apply it to real-world scenarios.

In order to use PBL-based ethnomathematics, one must consider the student's background. Owing to the diversity of cultures, only truly relevant cultures may be used to pique students' interest in learning and facilitate their comprehension. Much research on ethnomathematics has been conducted with students from various cultures. For instance, Zayyadi (2017) investigated Madura batik as a material for teaching the concept of lines and planes in mathematics. In addition, Nursyeli and Puspitasari (2021) explained geometry using the Cangkuang Leles Garut Temple in West Java. In addition, Putri (2017) investigated the art of the Rebana as geometry material for elementary students.

The teacher must support the application of ethnomathematics in mathematics education to foster national character. In this situation, the role of the teacher is highly anticipated. As one of the components of education that carry out the teaching and learning process in the classroom and interact directly with students, the teacher is obligated to develop character education in students (Wahyuni et al., 2013). Teachers must be able to research cultural values so that their students can comprehend the values that exist within their culture. This process will have direct and indirect effects on student character development. Therefore, the noble characteristics of cultural values will be incorporated into the national character if practiced from a young age. By incorporating cultural values into the educational process, teachers can assist students in understanding and appreciating their own culture and promote the development of a strong and moral national character. This procedure will contribute to the development of a generation that adores its culture and is proud of its national identity.

CONCLUSIONS

The results indicate that learning mathematics, especially on SLETV material, through ethnomathematics with a problem-based learning model is very useful. Students can easily comprehend the material using everyday objects as learning tools. Teachers can take advantage of this by introducing culture-based learning so students not only learn mathematics but also become familiar with the culture of their surroundings. Cultivating cultural values is crucial to forming national character because, with an understanding and application of cultural values, individuals can filter the negative consequences

of globalization, which are seen today. Developing national character is also the responsibility of education in our country because the national character may be produced directly through education. Concerning education and mathematics, ethnomathematics can be viewed as a tool for fostering national identity. As a result of ethnomathematics, educators, particularly those in mathematics education, can include culture in mathematics, and cultural values can be studied in the classroom. By examining cultural values and applying them as much as possible to learning, it is intended that each student would develop national character.

Exploring the efficacy of incorporating ethnomathematics into the mathematics curriculum in schools could be a potential area for future research based on these findings. This could involve designing and implementing a curriculum that incorporates cultural values and practices into mathematics education, as well as assessing the impact on student engagement, comprehension, and character development. The perceptions and attitudes of teachers toward ethnomathematics and cultural integration in mathematics education, as well as any implementation challenges, could be the subject of additional research. This could inform the development of programs and resources to facilitate the incorporation of ethnomathematics into mathematics education.

AUTHORS' CONTRIBUTIONS STATEMENTS

N.S. conceptualized and developed the methodology, conducted the investigation, and wrote reviews and editing. S.S. and E.E.N. supervised the study and validated the study's results. D.N.S. and S.S. conducted the investigation and wrote the original draft. A.A. carried out project administration, conducted formal analysis, and wrote reviews and editing. All authors discussed the results and reviewed and approved the final version of the work.

DATA AVAILABILITY STATEMENT

The data presented and supporting this research results are available at a reasonable request to the corresponding author, N.S., upon reasonable request.

REFERENCES

Abi, A. M. (2017). Integrasi Etnomatematika Dalam Kurikulum Matematika Sekolah. *JPMI (Jurnal Pendidikan Matematika Indonesia), 1*(1), 1. https://doi.org/10.26737/jpmi.v1i1.75

Albanese, V., Adamuz-Povedano, N., & Bracho-López, R. (2017). The Evolution of Ethnomathematics: Two Theoretical Views and Two Approaches to Education. *Ethnomathematics and its diverse approaches for mathematics education*, 307–328. https://doi.org/10.1007/978-3-319-59220-6_13

Albanese, V., & Palacios, F. J. P. (2015). Enculturation with ethnomathematical microprojects: From culture to mathematics. *Journal of Mathematics and Culture*, *9*(1), 1–11.

Anazifa, R. D., & Djukri, D. (2017). Project- Based Learning and Problem-Based Learning: Are They Effective to Improve Student's Thinking Skills? *Jurnal Pendidikan IPA Indonesia*, *6*(2), 346. https://doi.org/10.15294/jpii.v6i2.11100

Arends, R. I. (2012). *Learning to teach (9th ed.)*. McGraw-Hill.

Ascher, M. (1994). *Ethnomathematics: A multicultural view of mathematical ideas*. CRC Press.

Asri. (2020). *Cara Membuat Kue Bolu Kemojo Khas Riau*. https://www.resepkuerenyah.com/cara-membuat-kue-bolu-kemojo/

Balamurugan, M. (2015). Ethnomathematics; an approach for learning mathematics from multicultural perspectives. *International Journal of Modern Research and Reviews, 3*(6), 716–720.

Benedict, R. (2019). *Patterns of Culture*. Routledge.

Bergmann, H., Hundt, C., & Sternberg, R. (2016). What makes student entrepreneurs? On the relevance (and irrelevance) of the university and the regional context for student start-ups. *Small Business Economics, 47*(1), 53–76. https://doi.org/10.1007/s11187-016-9700-6

Bishop, A. J. (1988). Mathematics education in its cultural context. *Educational Studies in Mathematics, 19*(2), 179–191. https://doi.org/10.1007/BF00751231

Bishop, A. J. (1991). Mathematical Values in the Teaching Process. *Mathematical knowledge: Its growth through teaching*, 193–214. https://doi.org/10.1007/978-94-017-2195-0_10

Council, N. R. (2004). *How students learn: History, mathematics, and science in the classroom.* National Academies Press.

D'Ambrosio, U. (1985). Ethnomathematics and Its Place in the History and Pedagogy of Mathematics. *For the Learning of Mathematics, 5*(1), 44–48.

D'Ambrosio, U. (1986). Socio-Cultural Bases for Mathematical Education. In *Proceedings of the Fifth International Congress on Mathematical Education* (pp. 1–6). Birkhäuser Boston. https://doi.org/10.1007/978-1-4757-4238-1_1

D'Ambrosio, U. (1990). *Etnomatemática [ethnomathematics]*. Ática.

D'Ambrosio, U. (1994). Cultural framing of mathematics teaching and learning. *Didactics of Mathematics as a Scientific Discipline*, 443–455.

Díez-Palomar, J., Simic, K., & Varley, M. (2007). Math is everywhere": Connecting mathematics to students' lives. *Journal of Mathematics and Culture, 1*(2), 20–36.

Eglash, R., Bennett, A., O'Donnell, C., Jennings, S., & Cintorino, M. (2006). Culturally Situated Design Tools: Ethnocomputing from Field Site to Classroom. *American Anthropologist, 108*(2), 347–362. https://doi.org/10.1525/aa.2006.108.2.347

Fredricks, J. A., Hofkens, T., Wang, M.-T., Mortenson, E., & Scott, P. (2018). Supporting girls' and boys' engagement in math and science learning: A mixed methods study. *Journal of Research in Science Teaching, 55*(2), 271–298. https://doi.org/10.1002/tea.21419

Gay, G. (2002). Preparing for Culturally Responsive Teaching. *Journal of Teacher Education, 53*(2), 106–116. https://doi.org/10.1177/0022487102053002003

Gerdes, P. (1988). On culture, geometrical thinking and mathematics education. *Educational Studies in Mathematics, 19*(2), 137–162. https://doi.org/10.1007/BF00751229

Gerdes, P. (1996). Ethnomathematics and Mathematics Education. In *International Handbook of Mathematics Education* (pp. 1035–1053). Springer. https://doi.org/10.1007/978-94-009-1465-0_28

Gorman, J. C., & Balter, L. (1997). Culturally Sensitive Parent Education: A Critical Review of Quantitative Research. *Review of Educational Research*, *67*(3), 339–369. https://doi.org/10.3102/00346543067003339

Hartinah, S., Suherman, S., Syazali, M., Efendi, H., Junaidi, R., Jermsittiparsert, K., & Umam, R. (2019). Probing-Prompting Based On Ethnomathematics Learning Model: The Effect On Mathematical Communication Skill. *Journal for the Education of Gifted Young Scientists*, 799–814. https://doi.org/10.17478/jegys.574275

Haushchild, S. (2017). *Creating a knowledge culture*.

Jaworski, B. (2006). Theory and Practice in Mathematics Teaching Development: Critical Inquiry as a Mode of Learning in Teaching. *Journal of Mathematics Teacher Education*, *9*(2), 187–211. https://doi.org/10.1007/s10857-005-1223-z

Khoiriyah, A. J., & Husamah, H. (2018). Problem-based learning: Creative thinking skills, problem-solving skills, and learning outcome of seventh grade students. *Jurnal Pendidikan Biologi Indonesia, 4*(2). https://doi.org/10.22219/jpbi.v4i2.5804

Lehmann, M., Christensen, P., Du, X., & Thrane, M. (2008). Problem-oriented and project-based learning (POPBL) as an innovative learning strategy for sustainable development in engineering education. *European Journal of Engineering Education, 33*(3), 283–295. https://doi.org/10.1080/03043790802088566

Moust, J., Bouhuijs, P., & Schmidt, H. (2021). *Introduction to Problem-based Learning*. Routledge. https://doi.org/10.4324/9781003194187

Nursyeli, F., & Puspitasari, N. (2021). Studi Etnomatematika pada Candi Cangkuang Leles Garut Jawa Barat. *Plusminus: Jurnal Pendidikan Matematika, 1*(2), 327–338. https://doi.org/10.31980/plusminus.v1i2.1265

Passakonjaras, S., & Hartijasti, Y. (2019). Transactional and transformational leadership: a study of Indonesian managers. *Management Research Review, 43*(6), 645–667. https://doi.org/10.1108/MRR-07-2019-0318

Prasetya, D. (2019). *Resep Kue Bangkit Renyah dan Lembut Didalam*. https://blog.tokowahab.com/resep-kue-bangkit-renyah-dan-lembut-didalam/

Putri, L. I. (2017). Eksplorasi Etnomatematika Kesenian Rebana Sebagai Sumber Belajar Matematika pada Jenjang MI. *Jurnal Ilmiah Pendidikan Dasar*, *4*(1). https://doi.org/http://dx.doi.org/10.30659/pendas.4.1.%25p

Rasyid, M. A. S. al. (2022). *Makanan Raja Melayu Deli Kini Tetap Lestari*. https://www.bocahudik.com/2022/02/kue-rasidah.html

Risdiyanti, I., & Prahmana, R. C. I. (2017). Ethnomathematics: Exploration in Javanese culture. *Journal of Physics: Conference Series*, *943*, 012032. https://doi.org/10.1088/1742-6596/943/1/012032

Rosa, M., D'Ambrosio, U., Orey, D. C., Shirley, L., Alangui, W. v., Palhares, P., & Gavarrete, M. E. (2016). *Current and future perspectives of ethnomathematics as a program*. Springer Nature.

Rosa, M., & Gavarrete, M. E. (2017). An Ethnomathematics Overview: An Introduction. *Ethnomathematics and its diverse approaches for Mathematics Education*, 3-19. https://doi.org/10.1007/978-3-319-59220-6_1

Rosa, M., & Orey, D. C. (2015). A trivium curriculum for mathematics based on literacy, matheracy, and technoracy: an ethnomathematics perspective. *ZDM*, *47*(4), 587–598. https://doi.org/10.1007/s11858-015-0688-1

Sari, N. (2020). Pengaruh Pembelajaran Berbasis Masalah Pada Kemandirian Belajar Matematis Siswa SMK Ar-Rahman Medan. *Jurnal Mathematic Paedagogic*, *4*(2), 175–180.

Semken, S., Freeman, C. B., Watts, N. B., Neakrase, J. J., Dial, R. E., & Baker, D. R. (2009). Factors that influence sense of place as a learning outcome and assessment measure of place-based geoscience teaching. *Electronic Journal for Research in Science & Mathematics Education*, *13*(2), 136–159.

Simamora, R. E., & Saragih, S. (2019). Improving Students' Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. *International Electronic Journal of Mathematics Education*, *14*(1), 61–72.

Stodolsky, S. S., Salk, S., & Glaessner, B. (1991). Student Views About Learning Math and Social Studies. *American Educational Research Journal, 28*(1), 89–116. https://doi.org/10.3102/00028312028001089

Suryawan, I. P. P., & Sariyasa. (2018). Integrating ethnomathematics into open-ended problem based teaching materials. *Journal of Physics: Conference Series, 1040*, 012033. https://doi.org/10.1088/1742-6596/1040/1/012033

Tan, O. S. (2021). *Problem-based learning innovation: Using problems to power learning in the 21st century*. Gale Cengage Learning.

Tanjung, Y., Hardiyansyah, M. R., & Nababan, S. A. (2022). Malay Deli in North Sumatra: History and Today's Existence. *Journal of Education, Society & Multiculturalism, 3*(1), 115–131. https://doi.org/10.2478/jesm-2022-0007

Wahyuni, A., Tias, A. A. W., & Sani, B. (2013). Peran etnomatematika dalam membangun karakter bangsa. *Prosiding, Jurusan Pendidikan Matematika FMIPA UNY, 1*(1), 114–118.

Weinstein, C. S., Tomlinson-Clarke, S., & Curran, M. (2004). Toward a Conception of Culturally Responsive Classroom Management. *Journal of Teacher Education, 55*(1), 25–38. https://doi.org/10.1177/0022487103259812

Yi, L., Ying, Z., & Wijaya, T. T. (2019). The Trend of Mathematics Teaching Method Has Change from Fragments to Systematics. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 3*(2), 471–480. https://doi.org/10.31004/cendekia.v3i2.137

Zayyadi, M. (2017). Eksplorasi Etnomatematika pada Batik Madura. *Sigma Kajian Ilmu Pendidikan Matematika, 2*(2), 35-40.