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Challenges of Indigenous Students in Overcoming Difficulties in Learning Algebra: A Problematic Perspective of Ethnomathematical

Rani Darmayanti[1], Kamilia Rahmah[2], Dwi Priyo Utomo[3*], M. Ruskhan Fauza[4], Alfi Rachma Nisfi Laila[5], Choirudin[6]

[1, 2, 3, 4, 5] Universitas Muhammadiyah Malang, Indonesia; ranidarmayanti90@webmail.umm.ac.id
[6] Institut Agama Islam Ma'arif NU Metro Lampung, Indonesia; choirudiniaimnumetro@gmail.com

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ABSTRACT

This study aims to explain the position of ethnomathematical learning in a space that involves the challenges and problems of indigenous students in overcoming difficulties in learning algebraic material with qualitative descriptive research. Information was collected by finding out the sample from this study, which was conducted using a multi-stage sampling technique. The theme chosen was one grade VII student and one grade VIII student at the Pasuruan ALC Foundation, where both students were indigenous students with problems with algebra material. Ethnomathematics learning with a cultural context at the historical site of Candi Jawi is expected to overcome the difficulties of learning pure mathematics for indigenous students at the Assyfa Learning Center Foundation in Pasuruan.

Corresponding Author:
Dwi Priyo Utomo
Universitas Muhammadiyah Malang; dwi_priyo@umm.ac.id

1. INTRODUCTION

Algebra has been subconsciously or explicitly applied to everyday situations by some (Noeruddin & Piyanto, 2021; Sukmawati, 2015). Teaching algebraic perspectives to middle school (SMP) students who place a premium on the principles of logical, systematic, and rational thinking has been shown to be effective (Fitri, 2018; Malihatuddarojah & Prahmana, 2019; Zahid & Sujadi, 2017). A number of studies (Astuti & Sari, 2018; Dewi et al., 2020; Sari et al., 2020) have shown, however, that pupils continue to struggle while attempting to master algebraic concepts. There are some students who struggle to keep up with the rest of the class when it comes to mathematics (Lailiyah et al., 2020; Rosmaiyadi, 2018). When students struggle with mathematics, it often signifies that they are having trouble with a certain topic or concept (Liu et al., 2013, 2015). Challenge may play a role. More than one area of mathematics can be involved as well (Arjudin, 2020). Assessing the diversity of mathematics subjects, whether a discussion involves one or more topics, how difficult a student's difficulty in a debate will affect the difficulty of one or more other

issues (Neic et al., 2012; Saaroh et al., 2021; Turidho et al., 2021). So one of the difficulties students face when studying one part of mathematics can affect the difficulties experienced by students when looking at other aspects of mathematics. The research results from various international studies describe the conditions of mathematics learning in Indonesia that do not guide students in the process of reasoning, communication, problem-solving and mathematical literacy (OECD, 2019). This condition is in line with the results of daily tests for students of class VII and VIII semester one at the Assyifa Learning Center Foundation (ALC) Pasuruan, which shows a low average score. This value is obtained from the test results for each student who attends a different school, be it State, Private, or Tsanawiyah. This problem is undoubtedly a blow to classroom learning and requires constructive evaluation. Furthermore, in the attachment of the Minister of Education and Culture (2016), regarding the standards of learning mathematics, it is possible to recognize individual differences and students' cultural backgrounds.

Students still rarely have an experiential understanding of mathematics' significance, leading many to see the subject as merely a collection of useless numbers. This is due to the fact that many mathematics lessons fail to make connections between abstract concepts and students' everyday experiences in ways that are meaningful to them culturally. Ethnomathematics (Ardhi et al., 2021; Hardiarti, 2017; Yudianto et al., 2021) (Utami et al., 2020) is a branch of mathematics that focuses on the study of cultural relevance. It's fascinating to think about the ways in which cultural norms affect how and what students learn. The local knowledge of the Pasuruan region, where Candi Jawi is located, should be incorporated into educational resources. In other words, the next generation is introduced to and made familiar with the knowledge and the application of local wisdom itself by including the values of local wisdom in mathematical education.

Crafts, arts, fairy tales, values, ethics, morality, and theories deeply rooted in belief systems are all examples of cultural materials and equipment used in the classroom to implement the results of various ethnomathematical studies. Math is used in everyday life in Sundanese culture in the forms of a number system, a measurement system, geometry, and organised patterns. (Abdullah, 2017). Meanwhile, to explore the mathematical concepts contained in Mlaten ceramics can be applied through the concept of circles, geometric transformations, flat shapes, curved side spaces, and the concept of functions, as well as the concept of rotating object's volume (Pertiwi & Budiarto, 2020). Tulungagung people practice mathematics by conducting explorations and interviews in exploring the elements of flat shapes in the Ratu Boko temple to get an overview of its objective forms (Jayanti & Puspasari, 2020). Furthermore, the Dayak people practice mathematics by carving, making patterns, determining dates, and numbering systems (Hartoyo, 2012). In the context of Bugis Makassar culture, learning mathematics can improve attitudes following the ways and habits of a universal society (Akib, 2016). Mathematics is practiced by Balinese people in traditional rituals and tower construction (Darmayasa, 2016). Papuans also have mathematical concepts such as honai, centipedes, para-para beads, and batik patterns of various geometric shapes (Mumu, 2018). Meanwhile, the people of Maluku apply mathematics to buying and selling, weaving patterns, textile patterns, and geometric shapes on local food products (Laurens, Ngilawayan, & Pattiasina, 2019).

Research related to ethnomathematics applied in helping to overcome algebra learning difficulties has been carried out by Jabali et al., (2020); Oktafiani (2020); Richardo (2020); Yulianto & Arumsari (2016). The concept of studying algebra in the Bulus area, Central Java, is to understand the definitions of variables, constants, and coefficients and to distinguish similar and dissimilar tribes which are narrated through storylines with Mahabharata wayang characters in the form of visual novel games (Jabali et al., 2020). Ethnomathematics studies were developed in LKS teaching materials with Tegal, Central Java cultural characteristics in improving students' mathematical connections to algebraic material (Oktafiani, 2020). Furthermore, in understanding algebraic ideas that are difficult for students to understand, reminding the operation of

subtraction and addition of algebra by presenting algebraic material designed with learning outside the classroom to produce real experiences that are of value to the cultural character of Dayeuhluhur. the "Connection" community in Cilacap, Central Java (Yulianto & Arumsari, 2016). In overcoming learning difficulties in algebraic material, it can be overcome through character building for students internalizing Islamic culture and religion in the mathematics learning process (Richardo, 2020). Many results in ethnomathematics studies require more profound insight into its application and classroom problems.

Prior research supports incorporating ethnomathematics into lesson plans (Ambarwati et al., 2020; Patri & Heswari, 2021). Especially at the Pasuruan ALC Foundation, including ethnic themes in the classroom will provide richness to the study of mathematics. This can be achieved by focusing on national integration in Indonesia, a country made up of numerous cultural subgroups, each with its own set of challenges and solutions (as seen in East Java). In addition, students have a hard time making sense of algebraic concepts because the mathematics they learn in school is not based on the local community's way of life.

Ethnomathematics research in the classroom by paying attention to the challenges and problems of indigenous students in overcoming learning difficulties in algebraic material has not been studied. This study aims to describe the position of ethnomathematics in classroom learning related to the challenges and problems of indigenous students in overcoming learning difficulties in algebraic material. The discussion in this study is related to (a) algebraic learning and its difficulties in learning, (b) ethnomathematical concepts for indigenous students, (c) ethnomathematical characteristics in learning, (d) ethnomathematical challenges in learning, (e) ethnomathematical challenges for indigenous students, and (f) Ethnomathematics as hope for indigenous students in overcoming difficulties in learning algebra.

2. METHODS

This research is descriptive and qualitative in revealing the role of ethnomathematics in the perspective of learning mathematics and its challenges to indigenous students in overcoming difficulties in learning algebra. Data collection was carried out by studying the sample from this research, which was carried out using a multi-stage sampling technique. Identification of research topics in qualitative research using a snowball sampling model. Subjects that researchers do are people who can provide the information needed for research.

The subjects the researchers chose were 1 grade VII junior high school student and 1 grade VIII student at the Pasuruan ALC Foundation. The two students are expected to be able to obtain information about the difficulties they encounter in solving algebraic material questions. The method of data collection was carried out with algebraic material test questions. These questions are given to discover indigenous students' difficulties in solving mathematics. The data analysis used is descriptive qualitative, which describes the problems of indigenous students' learning difficulties in solving algebra material, describes challenges, and provides linking efforts to the ethnomathematics site of Candi Jawi through animated videos for indigenous students in overcoming algebra learning difficulties.

3. FINDINGS AND DISCUSSION

3.1. Learning Algebra and Its Difficulties in Learning

Based on the algebra test results given to indigenous students, many students have difficulty learning algebra, so their unique knowledge of algebra is not high. Therefore, to improve students' algebra skills, teachers must first overcome students' learning difficulties. Students learning difficulties in algebra can be used as a starting point for developing appropriate learning

methods or teaching materials (Malihatuddarojah & Prahmana, 2019). Some types of difficulties that students face when learning algebra:

1) *Understanding the Concept of the Symbol "equal to ('=')"*

The same symbol looks simple, but many students misunderstand the symbol. It can be seen when the teacher gives a problem related to algebra in class VII in the learning process at the ALC Foundation. Students cannot give the correct answer. For example, when indigenous students are given a question to determine the value of m on the question "9 + 5 = m + 2,". However, students did not have difficulty in solving the questions "9 + 5 = ..." or "8 x 6 = ...".

Several studies (Price, 2004; T. P. Carpenter, M. L. Franke, 2003) stated that students perceive the "equals" symbol ('=') as "the answer is" or "can be executed" instead of a character that describes equivalence (equivalence). Understanding the "equals" symbol is essential for students to understand and symbolize the relationship between numbers. In addition, students who do not understand "equal to" notation tend to have difficulty with algebraic forms (Baker et al., 2011; Godsil C., 2001; Saaroh et al., 2021).

2) Tendency to Use Arithmetic Procedures and Neglect Variables

When students are given the same problem as mentioned above, namely "9 + *m* = 4" or "11 – *n* = 5", students still have difficulties. Students are still confused with the letter "*m*" or "*n*". Students think that these questions cannot be done because numbers (numbers) cannot be added or subtracted by letters. It often happens to students who are new to learning algebra. Interestingly, when the presentation in these questions is presented in different forms such as "9 + m = 4" or "11 – n = 5" it is changed to "9 + ... = 4" or "11 - = 5". It seems that students have no difficulty when completing subtraction or addition operations that contain "□" or "...", but students are confused when the symbol "□" or "..." is replaced with the letter "m" or "n". This shows that the variable as a letter is not an easy thing for students. To overcome these difficulties, we can use arithmetic operations as a starting point for studying algebra. The transition from arithmetic operations to algebraic operations becomes easier. An example is asking students to understand that the letter "m" or "n" has the same place as the symbol "□" or "...".

Learning difficulties on the algebra test results given to indigenous students in performing algebraic operations are not only experienced by students who are just learning algebra but also occur in class VII students at the Pasuruan ALC Foundation, showing that many students cannot perform addition and subtraction operations in algebraic form. These students often omit (release) variables or symbols when performing algebraic operations. Students ignore variables and only focus on addition or subtraction operations. An example is the question "(3m + 2) + (4m + 2)". Some possible incorrect answers due to variable neglect are "(6m) + (2m) = 8m", '8', or "8mm". In line with several studies (Drijvers et al., 2010; Maclachlan & Oosterlee, 2007; Saundarajan et al., 2020; Shitrit et al., 2011), which state this kind of thing can show how important it is to understand the concept of variables.

3) Generalization

Algebra material is not only about variables but also about relationships and patterns. Relationships and practices cannot be removed from generalizations. So we must place generalization as one of the essential aspects of learning algebra. Students should have opportunities to learn, use, and describe patterns and abstractions. In fact, of the importance of generalization in algebra, it turns out that many students are less able to generalize. One difficulty in generalizing is that (Drijvers et al., 2010) as "overgeneration". For example, students often misinterpret or describe algebraic forms such as the following:

$$m^2 \times n^2 = 36 \text{ then } m \times n = 6$$

or

$$(m \ x \ n)^2 = m^2 \ x \ n^2$$

or

$$\sqrt{m^2 x \ n^2} = \sqrt{m^2} x \sqrt{n^2}$$

The simplification or refinement is not correct. However, do we understand why students make such mistakes? Kirschner and Awtry (2004) reported that one of the reasons for the error was that students observed that simplification or complexity was applied to multiplication ("×"). Students who make these errors have difficulty identifying generalizations and do not know the limits of abstraction. The strategy to overcome this error is to represent these algebraic problems as geometric representations as squares and rectangles (Drijvers et al., 2010).

4) Abstraction

Contextual questions are often used in algebraic learning, both as a starting point for learning and as an application of concepts learned by students. A simple example of an algebraic contextual problem we can easily find in textbooks is a two-variable linear equation system, which some students have difficulty solving (Drijvers et al., 2010). When solving equations, students start from the "left" side to the "right" side. To solve these difficulties, a strategy is needed to help students understand abstract thinking.

5) Graphic Meaning

Algebra is not only about variables and algebraic forms but often also involves graphs. Many types of algebra are presented graphically; For example, a straight line is a description of a graph of a linear equation. In general, the topic of graph creation consists of two aspects, namely, making graphs (building graphs) and interpreting graphs (interpreting graphs). Regarding students' difficulties with graphs, (Czimmermann, 2007; Godsil C., 2001; Knuth, 2020) identified several types of difficulties, namely: (a) The first difficulty is treating graphs as pictures (seeing graphs as images), which shows that students only focus on the form of image text and do not look at the mathematical nature of the graph. (b) The second type of error is point range confusion. This problematic student did not see that a line consists of many points. (c) The last type of difficulty is the error in distinguishing the slope height, which involves students who cannot determine the slope of a line or the slope of the vertical distance of a point.

The indigenous students also experience the above difficulties at the ALC Foundation. To achieve learning objectives on algebraic material, it is necessary to choose a practical and effective learning method that students can understand. One may include ethnomathematics in learning (Jabali et al., 2020; Oktafiani, 2020; Richardo, 2020; Yulianto & Arumsari, 2016).

3.2. Ethnomathematical Learning Challenges for Indigenous Students

Ethnomathematical challenges in an educational program, especially for indigenous students di Yayasan Assyifa Pasuruan, can be described in table 1 :

Table 2. Ethnomathematical Learning Challenges for Indigenous Students At Assyifa Foundation

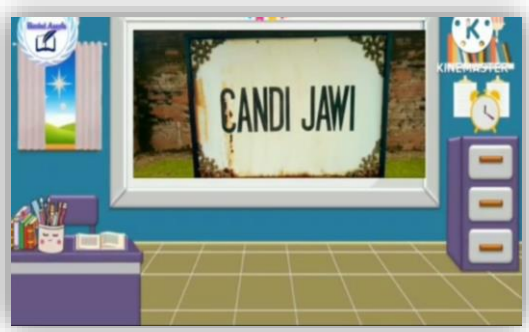
Num	Challenges	Real Condition
1	Concern for the success of ethnomathematics as a pedagogical measure.	This seems to be caused by the number of books or teaching materials that do not integrate ethnomathematics in the classroom, the lack of discussion on ethnomathematics, especially at the Assyifa Foundation, and the lack of trained teachers.
2	Many indigenous students have difficulty understanding Mathematics.	Indigenous students have difficulty understanding Mathematics which is full of symbols, abstracts, and complex problem-solving.
3	The decreasing students' knowledge about local wisdom in the Pasuruan.	Teachers have little knowledge to teach the values of wealth and local wisdom. In addition, teachers do not want to use cultural mathematics practices.

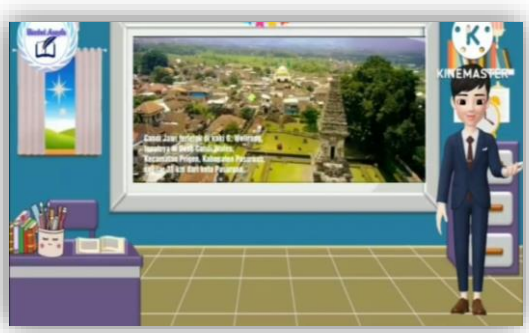
The pedagogical activities of the ethnomathematics program emphasize the importance of understanding the mathematical aspects of culture and having clear goals for educational activities. One of these ideas is that ethnomathematical work in schools is initially simple from cultural examples or simply placing mathematics in a cultural context (Rosa & Orey, 2011). Students may not detect this context as mathematics because they already have the basic idea of mathematics as pre-existing knowledge (François, 2010). The origin of this pedagogical aspect is to prepare a teacher training model that can understand ethnomathematical concepts in general. Teachers should learn about math and additional teaching skills to help students examine math content in-depth

3.3. Ethnomathematics as hope for indigenous students in overcoming algebra learning difficulties

The characteristics needed to overcome learning difficulties in indigenous algebraic material students at Assyifa Foundation At least in the learning process, they must pay attention to several things: (a) Contains implicit and explicit generalizations. (b) Facilitate investigation of patterns and relationships between numbers and formulas. (c) It contains questions that can be solved by applying general or situational-specific rules. (d) Promotes logical reasoning through the use of unknown quantities. (e) Use variables represented as letters in mathematical operations. (f) Contains tables or graphs to define and study formulas or rules. (g) Use formulas and expressions to describe situations where units and quantities are necessary.

1. Giving of learning apperceptions to students on local wealth and wisdom in the Pasuruan. This is done by delivering the site of Candi Jawi content through animated videos that attract students' attention.

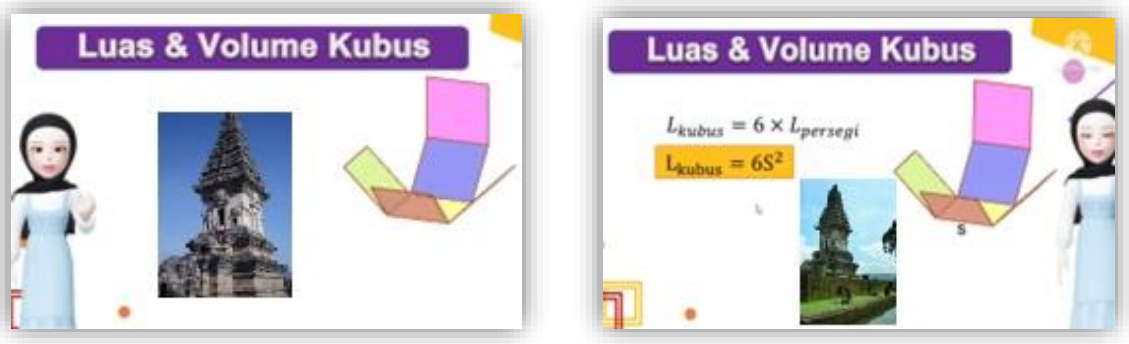




Figures 1 and 2. Animated videos of Candi Jawi

Apperceptions delivered through animated videos will motivate and attract students' interest in learning. The content of the Jawi temple adds to the love for the local culture of the Pasuruan community.

2. Linking the existing cultural content at the site of Candi Jawi into algebraic content.



Figures 3 and 4. Content Material of Ethnomatematics Candi Jawi

Incorporating the content and local wisdom of the site of Candi Jawi will undoubtedly be something new that motivates students to learn. Students get to know more about their regional wealth so that indigenous students directly feel the meaning of Mathematics in life and make mathematics lessons full of abstractions, formulas, and problem-solving will change how children think.

3. Good mathematics books and teaching materials will become more varied and provide separate learning innovations for indigenous students. The integration of mathematics and culture at the Assyifa Foundation will offer a new experience for teachers to be skilled and trained in managing mathematics learning.

Therefore, one of the efforts that can be made is to bring learning with cultural elements to bring cultural aspects into the lessons and lives of students. It is based on Rosa & Orey (2021**),** which state that through ethnomathematics, students can be helped to understand more about reality, culture, society, and themselves. Algebraic material that tends to be problematic will be more accessible for students to know when it is linked to everyday life, which is then brought in mathematical sentences to provide a stimulus in understanding algebraic material—the importance of understanding ethnomathematics in studying algebraic material, especially for indigenous students.

The study of mathematics that is directly related to cultural activities is a way of connecting formal mathematics with the context of everyday life. Integrating indigenous students' knowledge into their cultural practices with mathematics materials is an effort to achieve justice and preserve culture (Barajas lópez, 2018). The mathematical approach to cultural aspects gives indigenous students more opportunities to understand the realities of their lives (Were, 2003). As observed in students from the interior of Papua, most have a lower cognitive development level than students from developed countries. Culture-based learning embedded in the mathematics curriculum can increase learning motivation by realizing unconventional mathematical ideas (Owens, 2012).

The difficulties indigenous students face in learning mathematics about language, symbols, ideas, and representations can be minimized by reflecting on the socio-cultural context students usually understand. Indigenous students cannot be forced to accept formal mathematical concepts without knowing the basis for studying them. For example, Maluku students studying geometry can take various textile patterns or other objects in the form of traditional cake shapes as abstract concepts (Laurens, Ngilawayan, & Pattiasina, 2019). Makassar students can learn mathematics by cultivating a sense of empathy, caring, cooperation, and responsibility that they already have in everyday life (Akib, 2016). Introducing abstract denominators and modules need not confuse students in Bali because they are connected to traditional contexts that develop in society (Darmayasa, 2016).

Studying mathematics rooted in a cultural context provides respect for values in society. The Maluku community with various ethnicities and cultures that can be used as learning materials is an example of inclusive education in mathematics (Laurens, Ngilawayan, & Pattiasina, 2019). Ethnomathematics is a learning approach that is by the character of indigenous students and can enrich the pedagogic repertoire. Students in Pasuruan no longer need to know mathematical terms unrelated to daily activities. Algebraic concepts and similarities can be obtained through the honai house, millipede house, or traditional symbols (Jabali et al., 2020). Mathematics is no longer considered as the knowledge that exists in a vacuum but on earth and lives with indigenous people.

Although ethnomathematics still has shortcomings as a planned and structured pedagogical concept in the curriculum, the hope for students to study mathematics from a world perspective is something that absolutely must be fought. The position of formal mathematics as a structure and ethnomathematics as a humanist approach in learning mathematics is the glue that binds to the realization of respect for indigenous cultures. Therefore, it can be done through ethnomathematical-based learning to overcome the difficulties of learning algebra for indigenous students at the ALC Foundation in Pasuruan. The concept of algebra in ethnomathematical education is presented in the cultural context of historical sites that can be obtained through historical heritage temples from the Singasari kingdom, such as Candi Jawi as abstract concepts presented in the context of storylines, statues, and reliefs as concepts in studying symbols, ideas, and language that can be delivered through a media or teaching materials. It is hoped that ethnomathematical learning with a cultural context on the historical *site of Candi Jawi* can overcome the difficulties of learning algebra for indigenous students at the Assyfa Learning Center Foundation, Pasuruan

4. CONCLUSION

Ethnomathematics, however, may be a subset of arithmetic is the relationship between formal ideas and their observations in culture. Ethnomathematics is not an inspiration that can eliminate the proper system of mathematics but a tool to change mathematics further. There are six dimensions of study in ethnomathematics, especially psychological characteristics, abstract, academic, philosophical, historical, and political dimensions. Ethnomathematical thinking is a significant and sophisticated concept that every professional should understand. Ethnomathematics is not only about images, symbols, and alternative cultural products that will only be included in learning content. However, the education system needs to be designed and tiered so that it does not overlap with the standard education system. Ethnomathematics requires specific information so that its achievements and goals can be relatively measured. Thus, there will be no concern that ethnomathematics will cause problems in traditional curricula with entirely different views and philosophical foundations. Overcoming the challenges and issues of indigenous students at the Assyfa Learning Center Foundation, Pasuruan applies ethnomathematical learning with a cultural context on the historical site of Candi Jawi to overcome the difficulties of learning algebra.

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