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Wayang: Alternative Media for Teaching Ethnomathematics to Explore Students' Creativity and Problem Solving

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Abstract: Indonesia has a quite diverse local culture, one of which is wayang. Culture-based learning is very important to be implemented in Indonesia because of cultural diversity that can be used as learning media as well as cultural introduction to the nation's next generation. Can use ethnomathematics as a learning medium. Writing in this scientific article uses a qualitative descriptive methodology. The subjects of this study were fourth grade students. Where grade IV students were given a questionnaire about their knowledge related to wayang culture and were given math questions about flat shapes before and after treatment with ethnomathematics. Then the data is processed together with data during the action process and after the action with data analysis techniques to draw conclusions. The results show that from the previous 55% did not complete math problems, after the class action 85% of students experienced complete math problems on flat material. So that ethnomathematics can be used as a learning medium in elementary schools or MI (Madrasah Ibtidaiyah) and can also be used at the same time to introduce culture to the next generation of the nation.

Keywords: Wayang Culture; Ethnomatematics; Mathematics

Abstrak: Indonesia memiliki budaya lokal yang cukup beragam, salah satunya adalah wayang. Pembelajaran berbasis budaya sangat penting diterapkan di Indonesia karena keragaman budaya dapat dijadikan sebagai media pembelajaran sekaligus pengenalan budaya kepada generasi penerus bangsa. Dapat menggunakan etnomatematika sebagai media pembelajaran. Penulisan dalam artikel ilmiah ini menggunakan metodologi deskriptif kualitatif. Subyek penelitian ini adalah siswa kelas IV. Dimana siswa kelas IV diberikan angket tentang pengetahuannya terkait budaya wayang dan diberikan soal matematika tentang bangun datar sebelum dan sesudah diberikan perlakuan etnomatematika. Kemudian data tersebut diolah bersama dengan data pada saat proses tindakan dan sesudah tindakan dengan teknik analisis data untuk menarik kesimpulan. Hasil penelitian menunjukkan bahwa dari sebelumnya 55% tidak menuntaskan soal matematika, setelah dilakukan tindakan kelas 85% siswa mengalami tuntas soal matematika pada materi datar. Sehingga etnomatematika dapat digunakan sebagai media pembelajaran di sekolah dasar atau MI (Madrasah Ibtidaiyah) dan juga dapat digunakan sekaligus untuk mengenalkan budaya kepada generasi penerus bangsa.

Kata kunci: Budaya Wayang, Etnomatematika, Matematika

INTRODUCTION

Indonesia is an archipelagic country which is also known as Nusantara. A country rich in culture, language, tradition, ethnicity, race and religion (Sormin et al., 2021). Regional culture is the legacy of our ancestors. There are many Indonesian cultures that should be preserved, including batik, wayang, bamboo angklung, gamelan and others. Nusantara culture has become a magnet for foreign tourists because of its uniqueness. There are so many things that make Nusantara Culture worth preserving. And there are so many ways to maintain the Archipelago's Culture so that it remains sustainable and known by the next generation. However, the most important thing is that the younger generation must have a sense of love for Nusantara Culture.

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With a sense of love, there will be an attitude to maintain the culture. Globalization is the biggest challenge faced by the nation's next generation today in preserving the Archipelago's Culture.

Education and culture are two inseparable components like two sides of a coin. Between Education and Culture both are very closely related because they complement and support one another. For this reason, education has a very large role in the process of cultural inheritance so that cultural values really need to be applied in the learning process. Education as a pillar of culture and culture will develop education. According to Rulyansah et al. (2022) the education that will be developed in this culture is mathematics. Culture is something that we cannot avoid in everyday life, because culture is a complete and comprehensive unit of the various manifestations that are produced and or apply in a community. So that cultural literacy needs to be developed in the world of education.

Apart from cultural literacy, there is also numeracy literacy that needs to be a concern in the world of education (Widiantari et al., 2022). Because of the complexity of math concepts, many people lack a basic understanding of counting, a skill that is essential for numeracy literacy. In this way, interest in students decreases. The Program findings for the Program for International Student Assessment (PISA), held every three years by the Organization for Economic Co-operation and Development (OECD), show that these improvements are not deep enough. Indonesian students' PISA scores have declined since 2015 (Fajriyah, 2018). The numeracy proficiency score fell from 397 to 371, a decrease of 26 points. Comparison with the average of 458.1 shows that this figure is much lower than usual. This score places Indonesian students at the first level of education (Fenanlampir et al., 2019). Jean Piaget said that elementary school students (children aged 7-11) are in the developmental stage of concrete operational thinking (Pratiwi, 2019). Students need concrete examples to help them understand abstract concepts. Instilling the idea that learning mathematics, and especially learning about algebraic forms, is simple and fun is a process that may start with elementary schools or MI (Madrasah Ibtidaiyah) students.

Students at elementary schools or Madrasah Ibtidaiyah should be taught mathematics with an emphasis on cultural relevance (Rulyansah, Asmarani, Mariati, et al., 2022). Culture-based learning is very important in Indonesia because of the country's cultural diversity and the fact that primary school students sometimes struggle to make connections between what they learn in the classroom and the real world. It requires methods to bridge the gap between classroom mathematics and real-world applications (Wardana & Rulyansah, 2019). The use of *wayang art* learning media strategies is one such method. The introduction of the local culture of *dongkrek art* can improve literacy, especially cultural literacy and numeracy literacy. It allows that there are mathematical concepts embedded in cultural practices and recognizes that all cultures and all people develop unique methods for understanding and changing their own reality, which is then called ethnomathematics.

Ethnomathematics is a study of the different ways in which people solve mathematical problems and practical algorithms based on their own mathematical perspectives which refer to various forms of mathematics as a consequence embedded in cultural activities (Budiarto et al., 2019). Learning mathematics based on culture is one of the perceived ways to make learning mathematics meaningful and contextual which is closely related to cultural communities, where mathematics is studied and will be determined later. Development of learning tools needs to be done in order to produce math learning tools that are valid, practical, attractive and effective (Rulyansah & Wardana, 2020). Ethnomathematics is a tool that can be applied to learning in elementary school students. Ethnomathematics combines two literacy namely mathematical literacy and cultural literacy. The culture used in this research is wayang, wayang media is used to deepen the mathematical material of flat shapes. By connecting the wayang images and flat shapes, flat shapes are obtained in the form of triangles, squares, rectangles, trapezoids, and rhombuses. This puppet is used as a concrete medium to implement a flat shape.

Previous research conducted by Fauzi & Setiawan (2020) demonstrated that his findings took the form of mathematical concepts, particularly the concept of geometry; specifically, that the traditional motifs of the *Sesekan Sasak* weaving craft contain flat geometric elements in the form of squares, rectangles, kites, parallelograms, triangles, rhombuses, angle concepts, and congruence concept. Another study conducted by Febriyanti & Ain (2021) did further research which confirmed the high validity of the modules, this demonstrated the modules' usefulness in the classroom. Nooryanti et al. (2020) also did a research showing that teaching mathematics using an ethnomathematics-based Realistic Mathematics Education method improved students' mathematical communication skills. Many people, according to the literature are curious in ethnomathematics studies at the primary school level. Yet, these studies have not shown a thorough discussion of applied mathematical calculations.

This research was conducted with the aim of exploring students' creativity and problem solving in mathematical literacy in grade IV students by applying ethnomathematics through wayang media as a concrete learning medium. Besides that, the purpose of this research is to introduce and also preserve wayang culture to the next generation of the nation. The formulation of the problem that the author proposes is how is the effect of applying ethnomathematics through wayang media to explore students' creativity and problem solving in mathematical literacy in flat shape materials in grade IV students? This study provides insight to develop students' competence in numeracy literacy in flat shapes by applying ethnomathematics to wayang. This research can be used as a reference for further research on similar topics.

METHOD

Approach and Type of research

Writing in this scientific article uses a qualitative descriptive methodology. This article provides a response to the problem statement by providing a thorough overview of the problem encountered from the perspective of the theoretical framework investigated. In order to find solutions to the problems presented in this article, the authors reviewed the relevant literature to study the topic in depth. This approach takes into account literary studies, which are then matched with the notion of harmony with actual concerns (Subiyakto & Hidayat Putra, 2021). An in-depth description of the theory that has been reviewed in the literature review, together with evidence relevant to the problem at hand, is an appropriate discussion. This scholarly article describes the author's process for conceptualizing, designing, and implementing his own ideas, and making predictions about how those ideas might be used in the future.

Sample, Participant and place of research

The subjects of this study were students of class IV MI in Madiun Regency. Grade IV students were given a questionnaire about students' knowledge regarding flat shapes and wayang culture on Saturday, January 14, 2023. The results of the questionnaire showed that students had minimal knowledge about wayang culture. So the writer does the treatment by providing ethnomathematics material on wayang culture which is connected with flat shape mathematics material. Students are explained how to learn mathematics by using wayang ethnomathematics as a concrete medium and students are given wayang pictures and shown various related videos. Students are asked to analyze what flat shape I found in the wayang picture. The flat shapes found become the topic of discussion in class. After being given the treatment students were asked to fill out the same questionnaire regarding student knowledge regarding flat shapes and wayang culture on Saturday, January 21 2023. Then the data was processed using data analysis techniques to draw conclusions.

Data collection

This study uses data sources obtained directly through the results of grade 4 student questionnaires regarding students' knowledge of flat shapes and wayang culture. In addition, the data also comes from observations when the writer gives treatment in class. Literature study using study objects from books, scientific articles, journals and literature from the internet that are relevant to the discussion of flat shapes and wayang culture is also a source of reference for this research.

Validity and Reliability of the Study

To ensure quality control, the authors used the same procedures for all questionnaires and classroom action observations (López et al., 2021). A teacher who has the skills of a school psychologist ensures the questions are relevant and valid. The aim of qualitative research is not to draw broad conclusions, but rather to adapt specific results from one context to another with similar characteristics (Lemon & Hayes, 2020). To ensure the validity of our results, the authors opted for detailed descriptions and a selective sample in the study. The results of qualitative research can only be trusted if they have been independently confirmed by researchers (Nassaji, 2020). In this study, the confirmation method with students and teachers was quickly used to build credibility with outside sources.

Data analysis

This analysis is based on information obtained from the findings of the literature study mentioned above and subsequent trials. Both descriptive and qualitative analysis methods are used so that conclusions can be obtained from discussing individual problems (Rijali, 2019). This research uses data analysis methods as follows:

a. Data collection, in which the author collects important information and extracts key points for inclusion in the article. Data collection was carried out using questionnaire techniques and semi-structured interviews, observation and document review.
b. Data reduction is an analysis that helps focus, categorize, direct, and structure information so that the desired conclusions can be drawn from it.
c. Drawing conclusions is to provide answers to the problem statement. This article provides a comprehensive introduction to the working idea of the tool, including its design, assembly, and practical use.

Ethical Considerations

Grade IV students will have access to their data at any time during the trial. The honesty of research subjects is very decisive. Therefore, support from school principals, teachers, students, and families of grade IV students is very important. MI teachers are allowed to give directions to students who are given class action during research at any time. Principals and teachers support research so that it can be achieved by ensuring their confidentiality during and after their involvement in research.

RESULT AND DISCUSSION

The following is a chart of the integration results between the material content in wayang and SBdP material and mathematics in elementary schools that have been adapted to the Basic Needs learning, namely as follows:

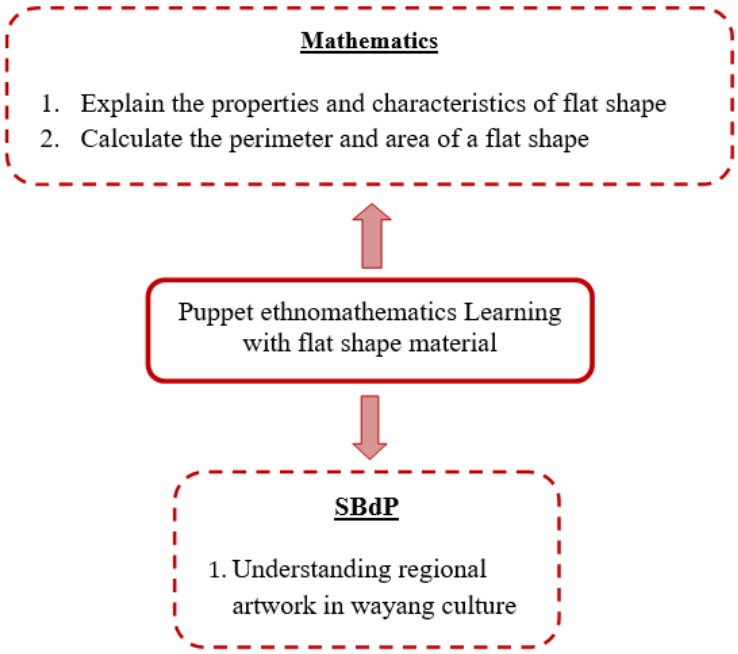


Chart 1. Integration of Basic Needs with webbed model class IV

In the webbed model, often known as the spider's web, the central topic serves as the stem from which several competencies within the discipline can grow. The theme of each unit is decided through brainstorming to find learning media solutions. An example can be seen in the webbed model shown above, where the ethnomathematics topic of wayang with flat shape material is chosen and its relationship to the various field of study competencies described, namely SBdP (Cultural Arts and Crafts) and mathematics.

The results obtained based on the questionnaire show that grade IV students have minimal knowledge about wayang culture. The results showed that 4 students knew the history of wayang culture and flat numeracy literacy of 20 students, and the other 16 students did not know. Research data can be seen in the following table:

Table 1. Questionnaire Results About Knowledge of Wayang Culture and Numerical Literacy

No	Initial Name	Do you know what wayang is and its history	Are you interested in learning about wayang which will be related to the ethnomathematics of cultural literacy and numeracy in flat shape material
1.	AT	Don't know	Yes interested
2.	AP	Don't know	Yes interested
3.	AA	Don't know	Yes interested
4.	EA	Yes i know	Yes interested
5.	FZ	Don't know	Yes interested
6.	FF	Don't know	Not interested
7.	HB	Don't know	Yes interested
8.	ML	Don't know	Yes interested
9.	NL	Don't know	Yes interested
10.	NP	Yes i know	Yes interested
11.	NO	Don't know	Yes interested
12.	PF	Yes i know	Yes interested
13.	RA	Don't know	Yes interested

No	Initial Name	Do you know what wayang is and its history	Are you interested in learning about wayang which will be related to the ethnomathematics of cultural literacy and numeracy in flat shape material
14.	RB	Don't know	Yes interested
15.	RF	Don't know	Yes interested
16.	RA	Don't know	Not interested
17.	SN	Don't know	Yes interested
18.	SR	Yes i know	Yes interested
19.	TU	Don't know	Yes interested
20.	UY	Don't know	Yes interested

In this study, samples were taken from class IV, which consisted of 20 students. The results showed that students were interested in learning the art of wayang and then carried out class actions for 1 week. This learning media is related to literacy and numeracy culture which will be developed by applying ethnomathematics. The author provides material which is carried out from Monday to Thursday during Mathematics and SDdP lessons. Before starting class action, students were asked to work on math problems about flat shapes. This aims to determine the results before and after the action. Students are said to be complete if the score is above 70 and if it is below 70 it has not been completed. The results show the following, can be seen in table 2:

Table 2. Learning Outcomes Before Treatment

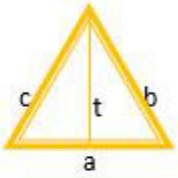
No	Value	Before Treatment	
		Number of students	Percentage %
1.	55 – 59	2	10%
2.	60 – 64	4	20%
3.	65 – 69	5	25%
4.	70 – 74	3	15%
5.	75 – 79	3	15%
6.	80 – 84	2	10%
7.	85 – 89	1	5%
Amount		20	100%
Complete			45%
Not Completed			55%

Source: Processed Research Results, January 2023

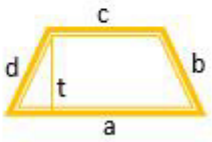
Based on table 2, the results above show that 45% of students complete and the remaining 55% do not complete. After working on the questions, the author provides material by displaying printed and electronic images as well as showing wayang art videos. Use it as a first step to introduce the art of wayang to fourth grade students. The author relates it to KD SBdP learning (Cultural Arts and Crafts), which is related to understanding regional art works. In mathematics it is also associated with KD learning, namely flat shape material. The first meeting gave an explanation about wayang culture by showing pictures of wayang and giving flat shape material. Wayang culture is explained through an educational video shown by the author and students watching the video. The educational video lasts 30 minutes and the remaining 30 minutes explains flat shape material. At the second meeting, the writer began to associate wayang images with flat material. The author provides the following images as learning media:

Flat Build Material:
Ket: W= Wide
A= Around

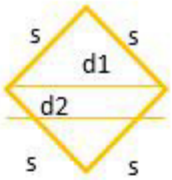
1. **Triangle**
   $W = \frac{1}{2} \times a \times t$
   $A = a + b + c$



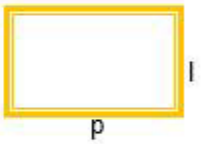
2. **Trapezoid**
   $L = \frac{1}{2} \times (a + c) \times t$
   $K = a + b + c + d$



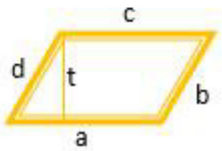
3. **Cut the rice cake**
   $L = \frac{1}{2} \times d1 \times d2$
   $K = s + s + s + s$



4. **Rectangle**
   $L = p \times l$
   $K = 2\,(p + l)$



5. **Parallelogram**
   $L = a \times t$
   $K = a + b + c + d$



At the third meeting students were asked to discuss how the relationship between flat shapes and wayang culture, students were given worksheets to work on in groups to build discussions. At the last meeting students were asked to present their results in groups and ended with individual tests. The results of the student presentations showed an understanding of the material previously explained, because according to some students learning by using the media made it easy to understand. The final test results also showed good results, 85% of students scored above the KKM, namely 70, but 15% of students scored less, as can be seen in the following table:

Table 3. Learning Outcomes After Treatment

No	Value	After Treatment	
		Number of students	Percentage %
1.	65 – 69	3	15%
2.	70 – 74	5	25%
3.	75 – 79	7	35%
4.	80 – 84	3	15%
5.	85 – 89	2	10%
Amount		20	100%
Complete			85%
Not Completed			15%

Source: Processed Research Results, January 2023

Based on the table above, it can be seen that 15% of students did not complete and 85% of students completed math practice questions on flat shape material after being given wayang cultural ethnomathematics actions. This shows that there was an increase from before treatment, before the treatment of students who completed only 45% and after treatment there was 85%. In addition, the ethnomathematics of wayang culture is also a medium for introducing Indonesian culture to the nation's next generation.

CONCLUSION AND SUGGESTIONS

Wayang culture has the potential to be adapted into a number of other integrated learning models, such as the webbed model or the spider web model, which brings together a number of core abilities specific to SBdP and Mathematics subjects. In addition, wayang learning media has the potential to develop into a related model, an integrated learning model that brings together a number of basic SBdP and Mathematics subject matter with wayang by using ethnomathematics. Based on the research above by applying ethnomathematics to puppets for learning mathematics on class IV flat shapes. The results show that from the previous 55% did not complete math problems, after the class action 85% of students experienced complete math problems on flat material. So that ethnomathematics can be used as a learning medium in elementary schools and can also be used at the same time to introduce culture to the next generation of the nation.

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