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Strengthening Student Concepts: Problem Ethnomatmatics Based Learning Singosari Kingdom Historical Site Viewed from Learning Styles in the Middle School Curriculum

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ABSTRACT

Ethnographic problem-based learning motivates students to apply what they already understand and encourages them to absorb new knowledge. They introduce cultural questions to help integrate mathematics into everyday life to connect the essence and deepen understanding of mathematics. This study used a sample of eighth grade students of MTs Unggulan Singa Putih, Pasuruan, who were students from several public and private schools, and from Madrasah Tsanawiah who developed the PEBL model to strengthen the mathematical concepts of students from different learning styles. This study uses the Plomp research and development method (a. Initial evaluation, b. Design stage, c. Realization/development stage, d. Testing, evaluation, review and e. Implementation). The data technique uses literature study, observation, tests and interviews. Data is analyzed by organizing and subtracting, displaying, summarizing and verifying. This research identifies theoretical foundations and identifies models, identifies and evaluates PBL models and validates media experts, research experts and social mathematicians. The mathematical mathematical model is more effective with the combination of the PEBL model. The PEBL model was developed to improve and optimize the concepts of mathematics learning in geometry.

Keywords: Ethnomathematics, PEBL, Geometry, Learning Style

ABSTRAK

Pembelajaran berbasis masalah etnomatematika (PEBL) memotivasi siswa untuk menerapkan apa yang sudah mereka pahami dan mendorong mereka untuk menyerap pengetahuan baru. Siswa dikenalkan akan budaya pada lingkup kehidupan sehari-hari yang kemudian diintegrasikan pada pembelajaran matematika sehingga mampu menghubungkan esensi dan memperdalam pemahaman matematika. Penelitian ini menggunakan sampel siswa kelas VIII MTs Uggulan Singa Putih Pasuruan yang mengembangkan model PEBL untuk memperkuat konsep matematika siswa dari gaya belajar yang berbeda. Penelitian ini menggunakan metode penelitian dan pengembangan Plomp (a. Evaluasi awal, b. Tahap desain, c. Tahap realisasi/pengembangan, d. Pengujian, evaluasi, review dan e. Implementasi). Teknik data menggunakan studi kepustakaan, observasi, tes dan wawancara. Data dianalisis dengan cara mengorganisir dan mengurangkan, menampilkan, meringkas dan memverifikasi. Penelitian ini mengidentifikasi landasan teori dan mengidentifikasi model, mengidentifikasi dan mengevaluasi model PBL dan memvalidasi ahli media, ahli penelitian dan matematikawan sosial. Model matematika matematis lebih efektif dengan kombinasi model PEBL. Model PEBL dikembangkan untuk meningkatkan dan mengoptimalkan konsep-konsep pembelajaran matematika dalam geometri.

Kata Kunci: Ethnomathematics, PEBL, Geometri, Gaya Belajar

INTRODUCTION

In education, mathematics is one of the fields of study that has an important role (Skott, 2019). Mathematics is characterized by the use of solid, precise, abstract and meaningful spoken and icons that make it difficult for students to explore concepts, as a result they do not like to study mathematics (Astuti & Sari, 2018; Fauzi & Arisetyawan, 2020; Lestari et al., 2021). This causes mathematics learning achievement to decline (Fasni dkk., 2017; Neagoy, 2014; Tambunan, 2019). The application of interesting, meaningful, and contextual learning models improves students' mathematical abilities, especially in emphasizing student interaction to solve problems together (Ranak Lince, 2016). The application of problem-based learning (PBL) models presents contextual issues to stimulate students to improve problem-solving skills (Chamidy dkk., 2020; Eichmann dkk., 2019). Problem-based learning helps students make learning more efficient and improves students' concepts and skills (Reigeluth et al., 2016).

Based on empirical studies, the PBL model can improve creative thinking skills (Kardoyo dkk., 2020; Rudibyani, 2019); increase self-efficacy (Risnawati dkk., 2018; Syarafina dkk., 2018); increased learning achievement (Erda dkk., 2018; Kaharuddin, 2019); improved process skills (Duda & Susilo, 2019; Prasasti, 2016; Yew & Goh, 2016); strengthen concepts in learning (Juleha dkk., 2019; Silva dkk., 2018); and overcoming students' misconceptions (Karabulut & Bayraktar, 2018; Makonye & Fakude, 2016; Neidorf et al., 2020); and PBL can develop higher order thinking skills (HOTS) (Erma dkk., 2019; Kardoyo dkk., 2020; Ulger, 2018).

Wilson (2016) categorizes HOTS-type questions into higher order thinking skills with indicators including; 1) analyzing (analysis); 2) evaluate (evaluate); and 3) creating. Agustiari et al., (2016) showed that students' thinking skills in solving HOTS type questions got different scores. Kristanti (2006) argues that the variation in these results can be affected due to many factors, for example, learning styles. Zulfiani & Suwarna (2019), states that learning style is a method/approach that is able to describe in what way the individual learns through differences in perception on the method taken for the process of mastering new and relatively difficult information. The differences in the learning styles chosen by each individual show the best and fastest way for each individual to absorb information from outside himself. Therefore, DePorter & Hernacki (1992), mention that there are several types of Kolb's learning style, namely: (a) diverger; (b) assimilator; (c) convergers; and (d) accomodators. This is in accordance with the research of Darmayanti et al., (2022); Daimaturrohmatin & Rufiana, (2019); Fatkhiyyah et al., (2019); Fuad, (2015); Hafid & Sutria, (2019); Melinda, (2018); Setyawan, (2017); Suwi et al., (2018); Zulfiani & Suwarna, (2019) which proves that subjects with diverger, converger, and accomodator styles, as well as assimilators have different skills in interpreting mathematics.

The meaning of mathematics is rarely found by students directly, as a result mathematics appears abstraction also tends to be filled with insignificant numbers (Nurrahmah et al., 2021; Utami et al., 2020). In facilitating meaning, mathematics is a subject that can be used as a bridge/tool for other sciences (Widodo & Wahyudin, 2018; Wijaya et al., 2020). D'Ambrosio (1991), has initiated an approach to learning Mathematics that integrates a learning culture. Mathematics learning can be difficult to introduce the relationship of Mathematics with local wisdom to create contextual concepts

that are understandable, meaningful, and fun in learning Mathematics (Rosa et al., 2016). The cultural aspect develops important connection skills, participates in publishing mathematics in everyday life, and deepens students' understanding of Mathematics Halai & Barwell, (2015). Rosa et al., (2017) state culture can be historically and socially constructed that is transmitted and understood as patterns of meaning.

As an education practitioner, you are responsible for finding solutions to educational problems. Incorporating culture into mathematics learning activities is an alternative that can be developed to introduce culture and instill a love for Indonesian ancestral heritage. Cultural integration in learning can facilitate the understanding of mathematical material presented in a more realistic manner. Therefore, the purpose of this study is to reveal the value of mathematical concepts in the Singosari Kingdom Historical Site. The difference between this research and previous research is by developing PBL and ethnomathematics learning where ethnomathematical elements are included in PBL learning so that it becomes PEBL learning in terms of learning style.

METHOD

This study uses descriptive qualitative research that aims to reveal the value of mathematical concepts in the Singosari Kingdom Historical Site. The population of this study was taken by junior high school students and used a sample of class VIII students of MTs Unggulan Singa Putih, Prigen, East Java. In the experimental stage, the researcher used the experimental method by taking a pure experimental research design with the type of pretest-posttest control group design (pretest-posttest control group design). Analysis of test data processed using SPSS 16.0 For Windows.

RESULT AND DISCUSSION

Result

The implementation of the learning tools made about the historical site of the Singosari kingdom with ethnomathematical examples are; (1) Jawi Temple, on the roof from the interpretation of the pyramid and cube properties, (2) Yoni, with beam properties, (3) Patra Punggel, with rectangular properties, (4) Land around the temple, using the rectangular formula, (5) The fence around the temple, also has beam properties, all objects can be observed directly to find out the mathematical value contained in it (see Table 1).

The implementation of ethnomathematical tools is conceptualized as mathematics that is implemented, used, or incorporated into community cultural actions (Pratiwi & Pujiastuti, 2020; Sahilda, 2020; Uskono et al., 2020). In addition, the idea of ethnomathematics was born as a broad vision of the bond between mathematics and the real worl (Nurjannah et al., 2020; Selviani et al., 2021) d. In teaching activities, it has integration with ethno and mathematical concepts (Fairuz et al., 2020; Waryanto, 2020). Therefore, it can be understood that ethnomathematics is the integration of the mind of learning mathematics with cultural elements (Laurens et al., 2021; Muwahiddah et al., 2019; Nugroho et al., 2019). Ethnomathematics has the ability to increase students' contribution and interest in learning mathematics (Chahine, 2015) .

Table. 1 Ethnomatemic-Based Learning Syntax Problem

Problem Based Learning Model	Steps of Teacher's Role	Student Role
Presenting or identifying a problem	 The teacher presents problems for students to explore or asks students to identify problems. Case 1: Look at the example of the image of the Jawi Temple below, determine the shape of the structure of the building!	The students check the problem the teacher presents. In some cases, students may identify problems.
Develop a plan to solve the problem	Teachers want students to be able to develop plans to solve problems. The teacher assigns or requires students to form groups to solve the problem. Teachers need to scaffold students' learning and structure how students develop their plans. Case 2: On a land measuring 40x60 meters, a Jawi temple was built with a length of about 14 m, a width of 10 m and a height of 26 m. Determine the remaining width of the land around the temple! 	Students develop reasoned plans to solve problems. Ideally, this happens in groups, so students are deliberate and define strategies for dealing with problems.
Executing the plan	The teacher asks students to implement their plans. Teachers may need to provide additional scaffolding, such as helping students document or record their project implementation to evaluate them in the next Phase.	Students test or implement their plan. They must document what happened (the results) with their project.
Evaluation application	The teacher asks students to evaluate and reflect on their implementation plans and results.	Students evaluate and reflect on their implementation of plans and their results.

Mathematics is significant in the Indonesian education system, and is practiced at all levels of education (Tanujaya et al., 2017). In addition, mathematics is one of the branches of science that students need to have (Ruswanto et al., 2018). Furthermore, each individual is required to carry out daily activities in order to develop their skills for logical, coherent, and critical thinking of students and to support their academic success in the future (Arisoy & Aybek, 2021; Purwanto et al., 2020; Runisah, 2017). On the other hand, mathematics is a close knowledge of life activities (Güner & Gökçe, 2021; Siburian et al., 2019). Mathematics is also very close to culture in terms of behavior or habits that have existed since ancient times and passed down from generation to generation (Pratiwi & Pujiastuti, 2020; Muhtadi et al., 2017). Therefore, mathematics can be considered as one of the most critical and needed subjects in everyday life because it can improve students' thinking skills (Darmayanti et al., 2022).

To find out students' understanding of concepts based on indicators of student abilities, the following is a comparison of the percentage scores of students' concept understanding for each

indicator. In general, students do not have significant initial abilities. The students' concept ions are higher than the pretest average, which means that the Ethnomatemic Problem-Based Learning (PEBL) Singosari Kingdom Historical Site can strengthen students' conceptions (see Table 2).

Table. 2 Average Percentage Value of Students' Mathematical Concepts

Indicator	Pra	Post	Obtain
Restate a concept	57	81	0,81
Classify objects according to certain properties according to the concept	43	89	0.73
Give an example of a concept	52	91	0,89
Applying the concept of problem solving	49	80	0,75
Connecting new concepts with previous concepts	60	78	0,79
Average	52.2	83.8	0,79

Discussion

The problem solving process involves students thinking, creating, and finding mathematical understanding. However, students have difficulty in solving problems, cultural-based problems that will help students because they are related to student knowledge. Perdana & Isrokatun (2019) tated that a problem-based learning approach with ethnomathematical strategies can improve students' mathematical understanding. Problem-based learning with a cultural approach strategy to improve students' mathematical abilities.

Strengthening concepts in learning mathematics will make it easier for students to solve mathematical problems. They can overcome various difficulties in doing math problems, including careless errors, computational errors, and conceptual errors (Agustyaningrum et al., 2018; Lokanath Mishra, 2020; Veloo et al., 2015). The teacher chooses a learning model that can stimulate the enthusiasm of each student to be actively involved in their learning experience. One alternative learning model that allows learning to solve real-world problems in an interesting way is problem-based learning. Problem-based learning motivates students to apply what they already know and inspires them to acquire new knowledge (Clare R. Kilbane & Natalie B. Milman, 2014). PBL is a learning model that challenges students to learn how to learn, work in groups to find solutions to real-world problems that stimulate students' curiosity. Problems are given to students before students understand the concept or material for questions to be solved.

PBL allows students to engage in learning: real world problems, higher order thinking skills; problem solving skills; interdisciplinary studies; learn to be independent; learn to dig up information; learn to work together; learn communication skills (Bruce Joyce et al., 2015). Therefore, PBL is an active learning application. The learning approach is student-centred and focuses on skills, lifelong learning, applying knowledge, and problem-solving skills. PBL is designed to stimulate higher order thinking in problem-oriented situations by encouraging students to learn to complete tasks. Maxwell (2020) statement PBL method tries to be specific in design to incorporate several other active learning methods through the process and the achievement of the end result.

Good learning will affect the success of teachers in achieving learning objectives. But sometimes teachers don't realize it, as evidenced by SMP teachers using old learning methods, explaining formulas, and giving examples of questions instead of giving exercises. The process of learning mathematics in Indonesia is still mechanistic, namely the teacher explains formulas,

algorithms, illustrations, then students carry out activities according to the teacher's example (Rimbatmojo et al., 2017). This is the cause of the low mathematical ability of students, especially in problem solving skills. Moreover, the abstract character of mathematics is inversely proportional to the development of junior high school students who are still in the concrete operational stage.

Ethnomathematics is used to express the relationship between culture and mathematics. This term requires dynamic interpretation because it describes the not rigid or extraordinary concepts, ethnicity, and mathematics, which were first coined (D'Ambrosio, 1985). Adopting ethnomathematics into mathematics learning activities is possible (Zhang & Zhang, 2010). Even ethnomathematics can be used as an alternative to learning mathematics (Owen, 2012). These two opinions have inspired mathematics education practitioners to apply ethnomathematics in mathematics learning activities.

The study of ethnomathematics is so broad that it is considered as one of the two thinking centers for understanding mathematics. Barton (2016) states that ethnomathematics studies examine the culture of understanding, practicing, using concepts, and articulating people from other people. This gave rise to the idea that the role of ethnomathematics should have a wider influence on education and society, especially on mathematics education (Begg dan Hamilton , 2016). This role is authentic, but the most important thing is to try and work hard to present mathematical concepts in ethnomathematical learning activities to directly relate students' culture and daily experiences (Rosa et al., 2016). If the teacher can do this, it will create an ethnomatic approach in learning Mathematics. It is hoped that mathematics in schools will be more relevant and meaningful for students and the quality of their education.

Students assume that mathematics is irrelevant and meaningless for themselves because students have difficulty learning mathematics that is not easy to understand. This is in line with the opinion of Warren & Miller (2016), which states that the challenges in learning a second language cause mathematical ideas conveyed in a second language to cause problems.

Problem Based Learning (PBL), developed by Howard S. Barrows & Robyn M. Tamblyn (1980), is a popular learning model in the medical world. PBL is similar to case - based learning, a learning model in the fields of medicine and law (McLean, 2016); goal-based scenario model (Taman, 2017); and a just-in-time training model in management and business learning (Al Haraisa, 2017); project-based learning model in science learning in primary and secondary schools (Almulla, 2020). All of them focus on presenting problems to students. Then students are asked to find solutions through a series of research and investigations based on the theories, concepts, principles they have learned from various fields of science (multiple perspectives).

PBL is a teaching model that uses real-world problems as a context for students to learn to think critically and creatively about problem-solving skills and acquire important knowledge and concepts from the subject matter (Clare R. Kilbane & Natalie B. Milman, 2014). PBL gives freedom to students in the learning process, giving control to individuals to learn according to their interests, abilities, and knowledge (Phungsuk et al., 2017). Students can identify problems, collect data, and use them to solve teacher problems. Finally, the teacher plays a role in presenting problem issues and more as a resource than as a provider of information, the teacher straightens the flow of thoughts and principles that students have used in learning (Maxwell, 2020).

PBL was developed primarily to help thinking skills, problem solving, and intellectual skills as well as learning to become independent learners. The advantage of PBL is that it encourages collaboration in completing tasks. PBL engages students in investigations of their own choice, enabling them to interpret the real world and build an understanding of the phenomenon. Understanding concepts is very important in mathematics. Students who understand many mathematical concepts will solve problems better and make it easier for students to follow mathematics lessons in the next material. This is in line with the opinion expressed by Rach & Ufer (2020) that if students have mastered the basic concepts in mathematics, then students can also master the next ideas in mathematics. Understanding simple concepts is a prerequisite for students to understand more complex concepts (Eriana et al., 2019). The preconceptions possessed by each student are different. If the teacher pays less attention to this, it will allow the emergence of misconceptions in teaching materials.

Understanding mathematical concepts is very important in schools at every level and grade because the idea of learning mathematics underlies learning and cognitive development (Björklund et al., 2020; Safaruddin et al., 2020). The concept is considered as the basis of knowledge building (Darling-Hammond dkk., 2020). To give a better picture in each Mathematics lesson, it is important to know the students' previous knowledge and develop new strategies according to their understanding.

Ausubel (in Bigozzi dkk., 2018) shows that students' conceptual knowledge in certain fields can significantly affect students' conceptual learning. Learning depends on the cognitive level of the learner and the complexity of the concepts to be learned. It is impossible to expect that every student learns ideas at the same rate or in the right way. Thus, in understanding this concept, some students may experience difficulties in learning, resulting in misunderstandings known as misconceptions (Neidorf et al., 2020).

Research related to ethnomathematics (Amit & Abu Qouder, 2017; Fouze & Amit, 2017; Rosa et al., 2017) states the need to develop innovative approaches using ethnomathematics. In this study, ethnomathematics focuses on Javanese culture, one of the Indonesian ethnic groups. Research conducted by Putri (2017) on ethnomathematics in the art of tambourines. This study aims to explore the mathematical elements in the traditional art of tambourine. Ethnomathematical research has also been carried out by Fadila Dyah Rahmawati & Marsigit (2017) in exploring the culture of Sidoarjo. The results show that without studying mathematical concepts, the people of Sidoarjo have applied these concepts in their daily lives by using ethnomathematics. It is proven that there are mathematical concepts found in temple buildings and inscriptions, the unity of the Sidoarjo community, geometric shapes of traditional pottery, batik, and embroidery motifs, as well as classical games of the Sidoarjo people.

Fadila Dyah Rahmawati & Marsigit (2017) developed ethnomathematics teaching materials in the form of worksheets. Another study conducted by Marsigit et al., (2018) The development of ethnomathematics-based learning tools includes modules and worksheets. Research on the development of ethnomathematics can take place in 3 places, namely Borobudur Temple,

Prambanan Temple, and Yogyakarta Palace. Edy Research (2013), develops ethnomathematics teaching materials based on West Kalimantan culture.

Good learning affects the success of a teacher in achieving learning objectives. However, some teachers sometimes do not realize it, as evidenced by the fact that there are still many junior high school teachers who use old methods in their learning, especially mathematics. This is the cause of the low mathematical ability of students, especially in problem solving skills. Moreover, the abstract character of mathematics is the opposite of the development of junior high school students who are still in the concrete operational stage.

CONCLUSION

Teachers can take various alternatives to solve these problems by creating effective mathematics learning. One of the meaningful and meaningful mathematics learning is to use the ethnomathematics-based learning (PEBL) dilemma approach to enrich the content of teaching materials. Another characteristic of PEBL, students learn in groups, improve student problem solving, activity, understanding, positive attitude, and independence in terms of student learning styles, namely (a) divergent; (b) assimilator; (c) convergers; and (d) accomodators. Different learning styles have different effects on PEBL learning outcomes. The convergent learning style group outperformed the learning style group in terms of PEBL learning outcomes (pattern recognition, application of procedural action sequences, and combination of pattern recognition and action sequences) in mathematics. None of the four learning style groups (divergence, assimilation, adjustment, and convergence) outperformed PEBL learning outcomes (pattern recognition, application of procedural action sequences, and combination of pattern recognition and action sequences) in mathematics. Learning mathematics will also be more meaningful if students learn from everything related to their environment. Students can learn from the various cultures that develop in the area where they live. Mathematics learning like this is known as ethnomathematics-based learning, which links mathematics material with the socio-cultural community. While learning mathematics examples is more effective with a combination of ethnomathematics in PBL examples. Examples of PEBL improve students' concepts and achievement in terms of learning styles.

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