

Analysis Characteristics of Junior High School Students Grade VIII 12 Padang with Ethnomatematics Nuances through Problem Solving Models

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Abstract – Based on a literature study and preliminary analysis conducted at the Junior High School 12 in Padang state, the ability of mathematical problem solving and student involvement were still low. The low ability to solve mathematical problems of students were caused by (1) Lack of learning resources, (2) Activities in teacher's lesson plan do not lead students to be active and can find their own mathematical concepts learned. Based on this problem, the researcher developed a mathematical learning tool based on Ethnomatematics Mathematical Problem Based Learning (PBL) to improve students' mathematical problem solving abilities.

This research was a development research conducted with the Plomp development model. The Plomp development model consists of three stages, namely preliminary investigation, prototyping and assessment phase. In the preliminary investigation phase, it needs analysis, curriculum analysis, concept analysis and student characteristics analysis to be carried out. At the prototyping phase, a formative evaluation is carried out consisting of self-evaluation, expert review, one-to-one evaluation, small group, and field tests. The tools developed are lesson plan and worksheet based on Problem Based Learning (PBL) with Ethnomatematics nuances. The subjects of this study were students of class VIII SMPN 12 Padang. Data were collected by documentation, observation, interviews, questionnaires, and tests. Data from the results of observations, questionnaires and tests were analyzed quantitatively reinforced by the results of documentation analyzed descriptively qualitatively.

The results of the study indicated that the mathematics learning tools in the form of lesson plan and worksheet based on Problem Based Learning (PBL) Nuanced Ethnomatematics for class VIII of the second semester of junior high school are produced fulfilling valid, practical and effective categories. Validat in terms of content, presentation, linguistic, and graphic. Practical in terms of implementation, time, ease of use and effective in terms of its potential impact on the mathematical problem solving ability and the involvement of students. The conclusion is mathematics learning device is worthy to be used as a reference material in mathematics learning, especially the material for building the flat side of class VIII of Junior High School number 12.

Keywords – Problem-Based Learning (PBL) with Ethnomatematics nuance, Problem Solving Ability.

I. INTRODUCTION

The community's need for understanding mathematics in this globalization era will continue to increase, thus demanding mastery of knowledge and ability to solve

problems. In solving these problems, students must follow the process to solve the problem Karatas & Tray (2013) states that "Problem solving is recognized as an important life skill involving a range of processes including analyzing, interpreting, reasoning, predicting, evaluating and

reflecting". National Council of Mathematics Teacher 2 (NCTM, 2000) states that "Problem solving is an integral part of all mathematics learning". Problem solving is an important thing in learning mathematics.

The United States in 2017 strives for students to be proficient in the 21st century and be able to participate in Science, Technology, E²ngineering and Mathematics (STEM). The ability that must be possessed is problem solving, lack of problem solving ability WAS caused by teachers do not involve students in problems that challenge the thinking process 3. (Rachel & Trisha, 2017).

Several studies from other countries such as: Pakistan, the Caribbean, Turkey and London srated that the importance of problem solving skills is so that students in everyday life and in the future are able to apply mathematical concepts. Problem solving skills encourage students to think for themselves and remember topics that have been learned to be applied in everyday life (Nasrin et al, 2015; Debora & Michael, 2014; Ufuk & Ahmet, 2019; Jill & Tony, 2015).

The low ability to solve mathematical problems of students is also seen in one of the schools in Padang, namely Junior High School numer 12. Results of problem solving ability tests conducted in class VIII 3 on October 31, 2019.

Table 1. Results of Students' Problem Solving Ability Tests on SPLDV Material

Indikator pemecahan masalah	Soal 1	Soal 2	Soal 3	Soal 4	Rata-Rata
Memahami masalah	70	44	81	54	62,25
Merencanakan pemecahan masalah	79	21	36	36	43,00
Menyelesaikan sesuai rencana	42	16	20	21	24,75
Memeriksa kembali prosedur dan hasil penyelesaian	40	11	22	16	22,25
Rata-Rata	57,75	23,00	39,75	31,75	

Based on Table 1, it can be described as follows: (1) The average student's ability to understand the problem is 62.25 (2) The average student's ability to plan solutions is 43.00 (3) The average student's ability to solve according the plan is 24.75 and (4) The average student's ability to re-examine the procedure and the results of its completion is 22.25. In question number 1 the average ability of students to solve problem skills is 57.75. Problem number 2 the average ability of students to solve problems ability is 23.00. Problem number 3 the average ability of students to solve problems ability is 39.75. Problem number 4 the average ability of students to solve problem abilities is 31.75. The conclusion of the 4 indicators that have the lowest average is

to re-examine the procedure and the results of completion. And the problem that has the lowest average is question number 2.

One example of the answer to the questions about students of SMPN 12 Padang can be seen in Figure 1. While at a food stall, Ratna ordered 1 plate of Soto Padang and 2 cups of ice tea and she had to pay Rp. 19,000.00, while Fitri ordered 2 plates of Padang Soto and 3 cups of ice tea and he has to pay Rp 36,000.00. If Husnul wants to order a plate of Soto padang and 1 cup of iced tea, how much should Husnul pay?

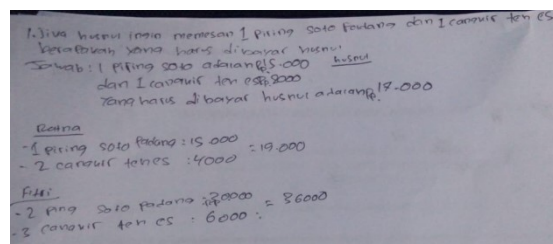


Figure 1. Examples of answers from 12 Padang students at SMPN 12

In Figure 1 shows the answer sheet of students who have not met the indicator of the ability to solve problems including students can not understand the problem, students can assume the price of one soto padang plate with x and the price of one ice test with y then the students cannot compile a plan problems. Students should be able to form a system of equations such as $x + 2y = 19,000$ equations one and $2x + 3y = 36,000$ equations two, students have not been able to carry out a problem solving plan with elimination and substitution methods and the last is students have not been able to check the results of the answers. The problem solving ability of students is still low and can be seen also from the answer sheets of students can be seen from Figure 2.

Mrs. Dayah and Mrs. Ida returned from Bukittinggi and intended to buy souvenirs for their children. Mrs. Dayah bought 3 packages of Sanjai Balado and 2 Karak Kaliang and she had to pay Rp. 54,000.00, while Mrs. Ida bought 6 packages of Sanjai Balado and 3 Karak Kaliang at Rp. 96,000.00. If Mrs. Ita wants to buy 1 packet of Sanjai Balado and 1 Karak Kaliang, how much does Ms. Ita has to pay?

Handwritten student work showing calculations for the price of packages. The work is organized into columns for items and their prices. The items listed are 'bungkus sanjai', 'bungkus Karak', and 'Kaliang Karak'. The prices are given in thousands of Rupiah (Rp. 10.000, Rp. 12.000, etc.). The calculations are as follows:

Item	Quantity	Price (Rp.)	Total (Rp.)
bungkus sanjai	3	10.000	30.000
bungkus Karak	2	12.000	24.000
Kaliang Karak	6	10.000	60.000
Kaliang Karak	3	12.000	36.000
Kaliang Karak	1	10.000	10.000
Kaliang Karak	1	12.000	12.000

Figure 2. Examples of answers from students of Padang 12 Junior High School

Students' answers from Figure 2 shows that students can get the correct results from the problem by trial and error so that students can get the price of 10,000 sanjai packages and 12,000 packs of Kaliang karak. But students have not been able to carry out a problem-solving plan using the method of elimination or substitution, and have not been able to re-check whether the answer is right or wrong.

Based on sample answers from students, it can be seen that students' mathematical problem solving ability is low, Lack of students' understanding of concepts in mathematics and students' difficulties in working on problem solving problems, because when teaching the teacher has not been maximized in planning the implementation of the learning process that can encourage students think and involve students actively.

The success of students in learning is largely determined by the learning tools designed by the teacher. The device commonly used to facilitate students is worksheet. But in reality the teacher does not make worksheet Teachers only use worksheet that is provided or circulated in the market, worksheet which is still general in nature meaning worksheet sold in the market is feared to be incompatible with the concepts being taught, rather emphasizes on cognitive learning very little that emphasizes into daily life days or contextual as well as those that involve the emotions and attitudes of students. Suryadi (2010) things like that make student creativity becomes limited.

Worksheet makes students look unenthusiastic and less cheerful in participating in mathematics learning. Some students even looked sleepy whenthey were given worksheet by the teacher. worksheet is usually used to facilitate students because worksheet is in the form of a summary that has been detailed, such as beginning with the material, sample questions and then practice. The Worksheet used has not seen any process of activity that guides students to find the concept of learning mathematics,

worksheet should be specifically designed according to the needs of students to develop their own knowledge by being actively involved in the material being discussed. Students are expected to practice their independence in learning so that it will improve their understanding because they find their own concepts and conclusions in learning.

The results of interviews with teachers in SMPN 12 and SMPN 13, researcher can conclude that the lesson plans used by teachers are not made by themselves but downloaded from the internet and the lesson plans used by mathematics teachers in schools have not directed students to be actively involved in the learning process and have not led students to constructing his knowledge in improving mathematical problem solving abilities. The teacher only explains the material then gives examples of questions from the book and sometimes only a few students understand the material explained by the teacher. The teacher assumes if there are already several students who understand the material explained by the teacher, then that is enough to represent the other students. This is because the teacher wants to finish the material on time so that no material is left behind.

As a result of learning implemented by the teacher, students who were initially still enthusiastic about attending mathematics, their enthusiasm became decreased, less active, and less creative. Students assume mathematics is not important and not useful in everyday life. Problem-based learning method or known as Problem Based Learning (PBL) is one way to overcome the difficulties of students working on story problems. Story questions are usually used to find out students' abilities in learning mathematical problem solving.

What is meant by mathematical story problems are mathematical problems stated in sentences in the form of stories that need to be translated into mathematical sentences or mathematical equations. PBL helps students to develop thinking skills and problem solving skills in Arifin, (2018). PBL learning model can help students work on story problems in a coherent and correct way. PBL learning is done by presenting a problem which then requires students to actively carry out investigations in solving problems and the teacher acts as Sani's guide, (2015).

In this PBL learning, story problems will be linked to real problems that exist in everyday life to improve problem solving abilities. As a group students can build and solve problem problems with the help of worksheet through activities to analyze problems, develop problem solving

strategies, design problem solving strategies and check back. In addition, PBL is also one of the recommended learning models in the implementation of the 2013 curriculum. Meanwhile, according to Muhammad (2017) PBL can use knowledge in the form of real problems and train students to think critically.

Along with the development of the times, mathematics grew and developed rapidly in various regions. However, the growth and development of the world of mathematics that occurred in Indonesia in general can not be equated. This is because of the life challenges facing the people of Indonesia in various regions with different cultural backgrounds. Fitriati, (2017). One that can bridge the gap between culture and education is ethnomatematics.

Ethnomatematics is a science that is used to understand how mathematics is adapted from a culture. Mathematics is expected later students can better understand mathematics. Ethnomatematics is the learning of mathematics that links into local cultural wisdom. This is in accordance with the opinion expressed by Sirate (2012) stating that the teaching of mathematics for everyone should be adapted to their culture, further disclosed by Sembiring in Rachmawati (2010) that mathematics is a construction of human culture.

Ethnomatematic learning will make it possible for material learned from their culture to arouse learning motivation and understanding of material by students more easily because the material is directly related to their culture which is their daily activities in Mahendra socialization, (2017). In order for the PBL learning model to be interesting and can improve student learning outcomes, this PBL model is integrated with minangkabau ethnomatematics. According to Mahendra (2017), ethnomatematics is a science that is used to understand how mathematics is adapted from a culture.

II. RESEARCH METHODS

This research was conducted at Junior High School number 12 in Padang state. The research subjects were one Math teacher and 33 students of VIII 2 grade. Data collection used a list of questions for interviews, a closed questionnaire for problems, and a closed questionnaire for needs. Data analysis was performed descriptively qualitative which included data collection, data analysis, data presentation and drawing conclusions.

III. RESULTS AND DISCUSSION

A. Research result

The activity of analyzing students' behavior and initial characteristics in learning development is an approach that accepts students as they are and sets up a learning system on the basis of the learner's circumstances. Therefore, the activity of analyzing students' behavior and initial characteristics is a process to find out the behavior controlled by students before participating in the learning process, not to determine prerequisite behavior in order to select students before attending the training. The consequences of using this method are: the starting point of a learning activity depends on the student's initial behavior. So, identifying students' behaviors and initial characteristics is aimed at determining the boundary line between behavior that does not need to be taught and behavior that must be taught to students.

Characteristics of students is one of the variables of the teaching conditions. This variable is defined as aspects or quality of individual students. These aspects can be in the form of talents, interests, attitudes, students' motivation, learning styles, thinking abilities and initial abilities (learning outcomes) they have. Characteristics of students will be very influential in the selection of management strategies, which are related to how to organize teaching, especially the components of teaching strategies, to fit the individual characteristics of students.

Vygotsky emphasizes how mental development processes such as memory, attention, and reasoning involve learning using community findings such as language, mathematical systems, and memory tools. He also emphasized how children are helped to develop with guidance from people who are already skilled in these fields. Vygotsky's theory assumes that learning occurs when children work or learn to handle tasks that have not been learned but the tasks are still within reach of their abilities, or those tasks are still in the zone of proximal development. (the ability he already has). Vygotsky's learning theory is one of social learning theories so that it is very compatible with the model of cooperative learning because in cooperative learning interactive social interaction occurs, namely the interaction between students and students and between students and teachers, in an effort to find concepts and problem solving.

The results of the analysis of students are done as a basic foundation for development in designing learning tools from the language level and the level of difficulty of the problem.

The observations showed 1) students have a high curiosity. 2) during learning some students do not focus on paying attention to the teacher's explanation. 3) students forget easily the concepts they have learned. 4) talk to his seatmate. 5) there are students who bow their faces on the table. 5) students like to discuss. 6) students like to be in groups. Problem-based Learning (PBL) based on ethnomatematics nuance is learning done to train students in critical thinking and to be trained in problem solving. PBL-based learning tools are expected to be able to open up the horizons of thinking, develop ideas, and increase students' thinking creativity.

PBL-based learning can accommodate students' knowledge in learning and improve their mathematical problem solving abilities from problems encountered by students in their daily lives. Problem-based learning strategy is a learning strategy by exposing students to practical problems as a foothold in learning or in other words students learn through problems. Mathematics learning with the application of problem based learning models has proven to be successful and of high quality because the results are higher when compared to conventional approaches.

PBL-based learning tools, not only help students understand concepts, but also help students understand the application of material into everyday problems. PBL-based learning can "improve student learning activities, help students how to transfer their knowledge to understand problems in the real world and encourage students to do their own evaluation of the results and the learning process". Through PBL-based learning, students think to solve problems, find ideas and make decisions. Students will understand better because students are directly involved actively in fostering new knowledge, so they will remember more about all concepts and principles. The learning model which is oriented to solving problems such as problem-based learning is an effective learning to increase the potential possessed by students".

In the learning process there is a change in the behavior of students in a positive direction. Changes in behavior include aspects of knowledge, understanding, skills and values. "The learning process is a physical or mental activity that takes place in active interaction with the environment that results in changes in knowledge, understanding, skills and attitude values. The ingredients are constant and reactive." It can be concluded to overcome these problems in the process of learning mathematics must be flexible, varied and meet standards that can apply the stages of cognitive development of students who have started to be

able to think scientifically. Based on the description of the problems that have been raised, a study was conducted to produce a PBL-based mathematics learning class VIII Semester II that meets the criteria of validity, practicality and effectiveness. The effectiveness of the learning device seen from the problem solving ability of students. Problem solving indicators used are (1) Identifying the elements that are known, asked and the adequacy of the required elements, (2) Formulating mathematical problems, (3) Implementing strategies to solve problems and (4) Re-checking the results obtained. Discussion A development learning device is said to be of quality if it meets 3 criteria, namely valid, practical, and effective. Based on the results of the study note that the mathematics learning device based on the PBL model nuanced ethnomatematics is valid, practical and effective. The following description of each aspect as follows.

1. The validity of the Mathematics Learning Tool Based on the Problem Based Learning (PBL) nuanced ethnomatematics.

Validity in development research is seen from two things, namely the content validity (relevance) and construct validity (consistency). Content validity means that the suitability of the product produced with compulsory mathematics material for class VIII of SMPN semester 2. While the construct validity means the conformity between the product produced and the PBL model developed.

a. Validity of Lesson Plan

After several corrections were made during the lesson plan validation, the lesson plan was considered valid. Based on these results, the lesson plan has been declared valid in terms of content and construct validity, so that this lesson plan can be used as a teacher's guide in carrying out PBL model based learning to facilitate students in finding concepts. With the well-designed lesson plans, it is hoped that they can be used by teachers as guidelines for implementing learning in schools so that students can learn mathematics well.

b. Validity of worksheet

The validity criteria for the product being developed are in terms of content and construct. The aspects assessed for the validity of worksheet are the educational or presentation aspects, material and content aspects, linguistic aspects and graphic or display aspects. worksheet validation was conducted by 3 mathematics lecturers, 1 Indonesian language lecturer and 1 education technology lecturer. The

mathematics lecturer validates worksheet from the aspect of education or presentation, material aspects and content. Indonesian lecturers validate worksheet from the linguistic aspect. Meanwhile educational technology lecturers validate worksheet from the aspect of graphic or appearance.

After validating, the results of worksheet validation in the formulated presentation are classified as valid. From the results of the validation of aspects of worksheet presentation, it can be concluded that worksheet already contains instructions for using worksheet, actively involving students to solve the problems given. Motivate students to ask questions and motivate students to learn mathematics.

The next assessed aspect is the content aspect. Based on the validation of the content aspects that are already classified as valid and the contents contained in the worksheet are clear. It can be concluded that the worksheet used has fulfilled the principle of depth and accuracy of the material. worksheet has included material that is in accordance with KI, KD and sufficient to achieve indicators of competency achievement and has included problems related to daily life. The steps in worksheet facilitate learners constructing their knowledge and improving students' problem solving abilities.

In the linguistic aspect, results are categorized valid. This shows that the instructions for using worksheet are clear. The language used in worksheet is in accordance with Indonesian Language Rules, the information conveyed is clear, the sentence is communicative and uses language that is in accordance with the level of understanding of students

In the graphic or display aspect, results are obtained with valid categories. In the display aspect it can be concluded that the worksheet display has fulfilled the expected aspects such as fulfilling the selection of letters, colors, layout, images, correct size and worksheet has included activities that support the implementation of PBL model based learning.

2. Practicality of Mathematics Learning Tools Based on Problem-Based Learning (PBL) models using ethnomatemics.

A good learning tool should be practical. Practicality can be seen from the use, ease of teachers in using lesson plan and worksheet based on PBL models. Ease of learners in learning, and implementation in the field. In assessing the practicality of this tool, the FGDs collected data through observations of the implementation of learning and

practicality questionnaires filled out by students and teachers.

Based on the analysis of the teacher questionnaire, it was concluded that the worksheet used was easy to use, interesting and well understood so that it motivated students in the learning process. The implementation of learning using PBL model-based learning tools shows that the learning process creates a class situation that encourages students to solve the problems given, ask each other questions, answer and express opinions and interactions between students. Developing independence, creativity in understanding worksheet and solving problems.

Interviews with students showed that the worksheet used was clear and could help students to build understanding so that they could understand the lesson well. The worksheet used is easy to understand, interesting, makes the desire to read increase and the worksheet work time is sufficient, Although there are students who can think differently. This is because there are students who are difficult to put forward their ideas to draw conclusions, so many ask the teacher because students are accustomed to getting information from the teacher in full without having to think to find the information itself. These problems can be overcome, during the learning process the teacher is tasked with helping students by directing them in thinking so they can issue ideas to draw conclusions. The use of learning tools can make it easier for students to understand lessons and solve problems related to their daily lives.

3. The Effectiveness of Mathematics Learning Tools Based on the Problem Based Learning (PBL) nuanced ethnomatematics.

The effectiveness of worksheet can be seen from the extent to which worksheet an influence on students has after using worksheet in learning. Effectiveness is also carried out by seeing whether after the use of PBL-based PBL models can improve students' problem solving abilities. To determine the effectiveness of worksheet by conducting a final test on students. The final test questions given were 4 questions based on indicators of problem solving ability. Based on the final test scores obtained that there are 33 students who scored above the passing grade or about 84.84% of students thoroughly in learning. This shows that the scores obtained by students from the pilot class to see the effectiveness of the learning tools developed increases from the initial test of problem solving ability to the final test of problem solving ability. So it can be concluded that worksheet based on PBL models that have been developed

have been effective for improving students' mathematical problem solving abilities.

IV. CONCLUSION

The learning tool based on the PBL model with ethnomatematics nuances was developed in the form of lesson plan and worksheet for class VIII of Junior High School number 12 in second semester. Based on the research process and results, the following conclusions are obtained:

The results showed that the learning tools developed already met valid criteria in terms of content and construct. The learning tools developed are in accordance with the syllabus of subjects, curriculum content, student experience, and in accordance with the PBL model with nuances of ethnomatematics.

The results showed that the learning tool based on PBL models with ethnomatematics developed already fulfilled practical criteria both in terms of implementation, convenience and time required. This can be seen from the empirical data, namely the practicality questionnaire data according to students and teachers and the results of observations of learning implementation.

The results showed that the mathematics learning device based on the PBL model developed with an ethnomatematic nuance was effectively seen from empirical data. In this case, it can improve students' problem solving abilities by 84.84% reaching passing grade.

An effective PBL model based mathematics learning tool is a learning device that can direct students to construct their knowledge so as to improve students' problem solving abilities and make learner-centered learning in accordance with the curriculum.

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