



## Mathematical Problem Solving Ability Of Vocational School Students On Problem Based Learning Model Nuanced Ethnomatematics Reviewed From Adversity Quotient

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### Abstract

This study aims to analyze the students' learning quality on the application of Problem Based Learning (PBL) Model nuanced ethnomatematics to students' problem-solving abilities, and the patterns of problem-solving abilities of mathematics on the application of PBL nuanced ethnomatematics reviewed from Adversity Quotient (AQ) students. This is a mixed method research using a concurrent embedded design. Subjects in this study were determined based on AQ analysis using Adversity Response Profile (ARP) on tenth grade of pharmacy students of Vocational School of Muhammadiyah 3 Weleri, Kendal. Data collection techniques used in this research are observations, tests, and interviews. The results showed that learning with PBL model nuanced ethnomatematics gave impact on the quality to students' problem-solving ability. The problem-solving ability of quitter students in solving problems is only up to the stage of understanding the problem. The NCTM indicator that can be achieved by quitter students is only the first indicator. Meanwhile the problem-solving ability of camper and climber students in solving the problem up to the re-checking stage. Camper and climber students can reach all NCTM solving indicators.

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## INTRODUCTION

Mathematics has a very important role in the development of Science and Technology (Science and Technology), both as a means of logical, analytical, creative and systematic thinking as well as a tool in the application in other disciplines. Based on the results of Trends in International Mathematics and Science Study (TIMSS) in 2011 Indonesia ranked 38th out of 42 countries with an average score of 386 and the results of the survey for the International Student Assessment Program (PISA), in 2015 Indonesia rose six places to 64 from 72 countries. This shows that the learning of mathematics in Indonesia needs to be improved. Based on Indonesian Ministerial of Education and Culture Decree No.21 of 2016 on primary and secondary education's standard, which state that one of the competencies to be achieved by students in the process of learning mathematics is the problem-solving ability.

Conceptual understanding of mathematics can be built through problem solving, reasoning and argumentation (Junaedi & Asikin: 2012). Problem-solving plays an important role in mathematics and should play an important role in mathematics education (NCTM, 2010). Problem-solving is the focus of school mathematics (Takahashi, 2008; Ali, 2010; Caballero, 2011; Karatas & Baki, 2013). Problem-solving is part of a very important mathematical curriculum because, in the learning and completion process, students use the knowledge and skills they have to apply to problem-solving (Misu, 2014). Ulya (2014) states that mathematics cannot be separated from problem-solving. In the process of thinking to solve problems, students need the attention and assistance of teachers both in the context of mathematics as well as in the real-life context. Torio (2015) also stated that one of the goals in learning mathematics is to make students become an effective problem solver. Problem-solving is an integral part of mathematics learning (Bicer, et al., 2013).

Based on the results of preliminary observations at Vocational School of Muhammadiyah 3 Weleri, Kendal found the fact that the problem-solving ability of students has not met expectations. Students often have difficulty in understanding the problem, so the level of problem-solving ability needs to be improved. Based on the

results of interviews on mathematics teachers at Vocational School of Muhammadiyah 3 Weleri stated that students' morale on mathematical problem solving has not received attention by teachers because of the lack of teachers' understanding of students' fighting power. Teachers emphasize more on the delivery of the subject matter as a whole to the students. The development of problem-based learning model to optimize problem-solving ability as part of student's high order thinking skill, so that one of the alternatives problem-based learning model is Problem Based Learning itself. Problem-based Learning will become more meaningful when developed using cultural nuances close to the student's daily world such as ethnomathematics.

Zaenuri, et.al., (2017) posited that the application etnomatematika on the coastal environment is able to be a cornerstone of mathematical competency pattern improvement of children in schools in order to improve the quality of life in the future. Through the application of ethnomathematics in learning, students are expected to have a better understanding in mathematics, as well as understanding about their culture, which will be easier to embed these cultural values in their daily life. So with the learning-based ethnomathematics students can learn math as well as get to know the culture.

The problem-solving skills are highly correlated with intelligence, creativity, reasoning ability, numerical ability, and mathematical skills (Pimta, 2009). Student's mathematical problem solving ability is very important to develop. In line with NCTM (2000) which states that problem solving is an integral part of mathematics learning, so it should not be released from the learning of mathematics. Furthermore, according to Armiami & Febrianti (2013: 583), students are said to be able to solve mathematical problems if they can understand, choose the right strategy, then apply it in problem-solving. Polya's (1973) troubleshooting steps include: (1) understanding the problem, (2) devising a plan, (3) carrying out the plan, (4) looking back

Paul Stoltz (2000) has introduced an interesting new concept of Adversity Quotient (AQ), which describes how well one's ability can overcome difficulties. In addition, Stolz (in Sudarman, 2012) states that not only IQ or EQ that determines a person's success but AQ also have a tremendous influence in actualizing a person's success. AQ is a

person's intelligence in overcoming difficulties. AQ help increases the student's potential. AQ can be used as a mental coaching for students to avoid psychological problems. Students are able to see the positive side, more willing to take risks so that the demands and expectations serve as support. The presence of AQ in learning process helps students to improve their learning abilities and achievements. Stoltz (Sudarman, 2012) states that not only Intelligence Quotient or Emotional Quotient that determines the success of students but AQ also has a tremendous influence in actualizing a student's success. AQ has three categories: Low-score AQ called quitter, medium-score AQ called a camper, and high-score AQ called climber (Stoltz, 2000).

This research focuses on students' problem-solving abilities according to their AQ classification. The purpose of this study is to analyze the student's learning quality on the application of Problem-based Learning model nuanced ethnomathematics to the student's problem-solving ability and to analyze the patterns of mathematics problem-solving abilities on the application of Problem-Based Learning nuanced ethnomathematics reviewed from AQ students.

## METHODS

This research is a combination of qualitative and quantitative research method also known as mixed methods. The design used in this research is concurrent embedded design. This strategy can be characterized as a mixed-method strategy that applies a single stage of quantitative and qualitative data collection at one time (Creswell, 2013: 321). The selection of this strategy is due to the collection of quantitative and qualitative data in this research conducted simultaneously.

The population in this study were second semester students of grade tenth (10<sup>th</sup>) in Vocational School of Muhammadiyah 3 Weleri, Kendal in academic year of 2016/2017. Through a random sampling system, students in grade tenth of Pharmacy 2 are selected as an experimental class and students in

grade tenth of Pharmacy 1 as a control class. The experimental class is taught using the learning model with Problem Based learning ethnomathematics nuance and control class is taught using Discovery Learning model. The initial skill test and the problem solving ability test is conducted in the experimental class and control class. The determination of research sample is based on random sampling. To analyze the same preliminary condition of those class, it is necessary to hold some prerequisite tests including normality test, homogeneity test, and average equality test. The data used as a prerequisite test in the sample selection is the data of the middle exam result of the even semester. AQ questionnaire was given prior to the research. Research subjects were taken from the experimental class students based on the AQ questionnaire. The subjects selection were selected from the experimental class based on the AQ category of students i.e. climber, camper, and quitter category by random sampling. From each category were selected 2 students to be analyzed their problem-solving ability.

Sources of data in this research are answered sheet of problem-solving test, AQ questionnaire, student interview result sheet, and observation. Problem solving ability test is done twice, both pre test dan post test. Problem solving ability test carried out in experimental class and control class. The students' answers on problem solving ability test were analyzed and the research subjects were interviewed. Quantitative data were tested using normality test, homogeneity test, equality test average, completeness test, and mean difference test. While the qualitative data analysis is done by reducing the data, presenting data, and draw conclusions from the data collected and verified the conclusion.

## RESULT AND DISCUSSION

Based on the results of AQ questionnaires on students who were taught using Problem-Based Learning nuances of ethnomathematics obtained the results as in Table 1.

**Table 1.** Students Category On Grade Tenth Students Of Pharmacy 2 Based On Adversity Quotient

No	Student Category	Quantity
1	<i>Quitter</i>	4
2	<i>Camper</i>	21
3	<i>Climber</i>	11
	Total	36

Based on table 1 , Two students from each AQ category were selected to be analyzed in depth problem-solving skills. The selection of quitter category was obtained from 2 students with the lowest AQ score. The selection of camper category was obtained from 2 students with middle AQ score. While the selection of climber category was obtained from 2 students with the highest AQ score. This is done in order to see a significant difference between students from all three AQ categories in solving the problem.

The quality of learning consists of three stages, namely the planning phase, implementation phase, and evaluation phase. Mathematics learning that has

been implemented in this study have met the three stages of the quality of learning, which is in the planning stage, the learning device which has been drawn was valid, at the implementation stage, the learning has been categorized well and get a positive response from the students, as well as the evaluation stage, has met the effectiveness test.

The planning stage of this research is done by preparing a learning device, the syllabus, lesson plan, student worksheets, and problem-solving ability test. Learning devices are then validated by validators. To declare the learning tools are compiled valid or not is to make interpretation criteria assessment of experts in table 2.

**Table 2.** Validity Assessment Criteria

Average value	Category
$1,00 \leq R < 2,00$	invalid
$2,00 \leq R < 3,00$	Less Valid
$3,00 \leq R < 4,00$	Valid
$4,00 \leq R \leq 5,00$	Very Valid

Source: Khabibah (2006)

The validation results indicate that the learning device meets the valid criteria, and can be used. The

results of the validation of the learning device can be seen in Table 3 below.

**Table 3.** Results of Validation Instrument Research

No	Instrument	Validator			Average	Validity
		I	II	III		
1	Syllabus	5.00	3.83	4.25	4.36	Very Valid
2	Lesson plan	4.90	4.10	4.10	4.37	Very Valid
3	Teaching materials	4.93	4.00	4.07	4.33	Very Valid
4	Student worksheets	4.90	4.10	4.10	4.37	Very Valid
5	Problem-solving ability test	4.90	3.70	4.00	4.20	Very Valid

For the implementation stage, it is obtained by instruction learning sheet and student response

questionnaire. Data from the observation of learning shows that the average percentage of learning

implementation that is 89.17% which means that the learning of mathematics with Problem-based Learning nuances of ethnomathematics that have been implemented already categorized very well. For data with many student questionnaire responses about 20 items obtained an average value of 4.43 student response data, so it can be said that the students' response was very good category. So, it can be concluded that students' responses to the mathematics learning with Problem-based Learning nuances of ethnomathematics received a positive response from students, it was concluded that the learning tools have met the practical criteria.

In the evaluation phase, to test the effectiveness of learning with Problem-based Learning nuanced ethnomathematics towards problem-solving skills of students through similarity test average; a test of completeness which includes the classical completeness test and the average mastery test; and test the average difference with prerequisite tests including normality test and homogeneity test.

Significant values of normality and homogeneity test in the initial test of problem-solving ability are  $0,200 > 0,05$  and  $0,675 > 0,05$  respectively, so it can be stated that the initial test data of problem-solving ability come from the normal and homogenous distribution population. In the mean equality test, the value of equal variances assumed is  $0,517 > 0,05$ , so it can be stated that the average of initial problem-solving ability in the experimental class is the same as the average initial problem-solving ability in the control class. The value of  $z$  in the classical exhaustiveness test obtained  $z\_count = 2.41$  while  $z\_tabel = 1.65$  so  $z\_count > z\_tabel$  so it can be stated that 75% of students in the class are taught using Problem-based Learning nuanced ethnomathematics complete classically.

Based on the average results of tests on a problem-solving abilities experimental class was 78.28 with deviation standard  $s = 7.28$  and the number of students were 36. Value t-test average completeness obtained  $t\_count = 6.82$  while  $t\_table = 1.69$  so that  $t\_count > t\_table$  it can be stated that the average problem-solving ability of students in the experimental class exceeds the Minimum Criterion.

Significant values of normality and homogeneity test in the problem-solving ability test are  $0.200 > 0.05$  and  $0.675 > 0.05$  respectively, so it can be stated that the problem-solving ability test data comes from the normal and homogenous distributed

population. The average of problem-solving test results in the experimental and control classes was 78.28 and 68.29, respectively. The result of the mean difference test of problem-solving ability is obtained  $t\_count = 6.037$  whereas  $t\_table = 1.67$  so that  $t\_count > t\_table$  it can be stated that the average of problem-solving ability in experimental class is more than the average of problem-solving ability in control class.

At the stage after conducting research and analysis of research data, obtained information that (1) the results of the learning device assessment from the expert/ validator meet the good criteria; (2) the observation result of quality and implementation of learning meet the good criteria; (3) students' positive responses to learning go beyond 70%; (4) learning in the classroom using Problem-based Learning nuances of ethnomathematics can achieve good completeness classically the average completeness; (5) the average problem-solving skills in the classroom taught with Problem-based Learning nuanced ethnomatematics more than the Minimum Criterion, and (6) the average problem-solving ability of students in the class that is taught with Problem-Based Learning nuanced ethnomathematics more than the average of problem solving skills in classes taught using Discovery learning. So it can be concluded that learning with Problem-based Learning nuanced ethnomathematics have a certain quality.

Quality in learning is an indicator of the success of learning that is implemented. In addition to several factors above, the success of learning is also determined by the creativity of educators in developing learning. The high average problem-solving ability is a supporting fact that learning with Problem-based Learning nuanced ethnomathematics effective. Problem-based Learning is a learning that supports problem-solving based on the direct object of student activity through a problem. This is consistent with the theory of Gagne which is a combination of direct objects in the form of facts, skills, concepts, and rules that are strung in the activity with the object of indirect ability to investigate and solve problems. In addition, higher average problem-solving abilities in learning Problem-based Learning nuanced ethnomathematics prove that Problem-based Learning nuanced ethnomathematics able to train students to be actively involved in extracting information as elements of knowledge which can then be constructed into the structure of a solid knowledge in accordance with Piaget's opinion. It is

also strengthened by the enthusiasm of the students which are high on every syntax of Problem-based Learning nuanced ethnomathematics which is conducted in every learning activity.

The application of problem-based learning affects the students positively, students becoming more active in building their knowledge to gain new knowledge through problems that teachers have prepared. This is in accordance with the opinion of Hmelo-Silver (2004), problem-based learning is an instructional method that begins by creating a need to solve the problem whereby during the troubleshooting process, students build knowledge and develop learning skills towards finding a solution. Students on problem-based learning have the opportunity to practice problem-solving skills where students are required to solve problems so that they become more active in the learning process. The result of Festus (2013) study shows that learning mathematics with Problem Based Learning model is an effective strategy for classroom learning, in general, this research indicates that students become more active in learning process.

Learning the nuances of ethnomathematics will help students foster a love of local culture and help students to better understand the application of mathematics in everyday life. In accordance with Wahyuni et.al (2013) research indicates that with ethnomathematics students will better understand how their culture is related to mathematics, and educators can instill the noble values of the nation's culture that impact on character education. Kaselin's research results (2013: 146) indicate that the subject matter that links real problems in everyday life based on the culture that exists around us is very helpful to find ideas.

Qualitative research is conducted to find out the pattern of the mathematics problem-solving ability of student based on Adversity Quotient. Through the AQ test using the Adversity Response Profile (ARP) instrument. After the test randomly selected each of the 2 subjects in the category of Quitter, Camper, and Climber. Based on the AQ Test Result, there are 3 students with quitter category, students with camper category and 13 students with climber category with the total number of students in the experimental class is 36 students, each subject is analyzed qualitatively.

The pattern of problem-solving ability of quitter group students is (1) Quitter students group

can understand the problem. The ability of understanding the problem for students in quitter group are still lacking. Quitter students group able to mention things that are known and questioned but not quite complete; (2) Quitter students group can not plan for solving the problem. They can not mention any formula needed to resolve the matter; (3) Quitter students group inability in planning the problem solving resulted them to not be able to perform troubleshooting plan. In answering question, quitter group students still made many errors in problem-solving; (4) The quitter students group did not re-check the answer. This is consistent with the results of (Yani, et al, 2015) which states that the quitter students have difficulty in problem-solving. The NCTM problem solving indicators that can be achieved by a group of students of quitter students is just the first indicator of building a new mathematics through problem-solving.

The pattern of problem-solving ability of camper group students is (1) Camper students group can understand the problem well. Camper group students can determine the identity of their information and be asked the questions well; (2) The camper students group troubleshooting plan appropriately, they can determine what formula will be used to resolve the matter appropriately; (3) A group of camper students was no trouble at the stage of carrying out troubleshooting. This is because camper students can plan a problem solving well. However, camper students do not have a maximum effort in carrying out troubleshooting. Camper students group are satisfied with the answer and a little less conscientious; (4) The camper student groups can check back answers that have been obtained. This is consistent with the results of the study (Widyastuti, 2013) which states that the camper student group is able to identify what is known and asked, develop a problem-solving plan and implement it, and also be able to re-check the answers. Camper student groups can achieve the four NCTM problem-solving indicators.

The climber student problem-solving pattern is (1) The climber student group can understand the problem well; they can determine the information that is known and asked in the question well; (2) The climber student group is able to develop a proper problem-solving plan. The climber student group is able to determine the formula to be used to solve the problem appropriately; (3) The climber student group

carries out problem-solving in accordance with the plan. The climber student group strives to find answers; (4) The climber student group re-checks the answers obtained. This is in accordance with research conducted by (Muna,2014; Darajat,2016) which states that climber student groups can declare problem-solving steps well. Climber student groups can achieve four NCTM problem-solving indicators.

Based on the analysis of problem-solving abilities of each AQ quitters, campers, and climbers obtained the ability to solve the problem quitters less good when compared with other types. This is because quitter students are only able to implement problem-solving Polya stage understand the problem. Problem-solving abilities in campers' students are also poor because they have not been able to perform all indicators at the checking stage. While the ability of problem-solving on student climbers done well because it is able to carry out all the indicators at the stage of problem-solving skills Polya. If all indicators in problem-solving are well executed, then the impact on good student learning outcomes. Vice versa if not all indicators in solving problems can be implemented properly, then the impact on student learning outcomes are less good.

## CONCLUSION

Based on this research, it can be concluded that learning model PBL nuanced ethnomathematics have some certain quality. Therefore, this learning can be an alternative choice for teachers to develop student problem solving abilities.

Qualitative analysis revealed findings that in general, Climber student groups have problem-solving abilities that tend to be better than camper and quitter student groups. Students with different AQ will have different problem-solving abilities, therefore teachers can analyze AQ students using ARP test in advance in order to provide learning to students according to their individual needs. Based on this research, students have a high interest in the object of ethnomathematics, but not all objects of ethnomathematics can be observed directly. To build a good understanding, it is expected mathematics materials nuances of ethnomathematics there are some objects that can be observed directly by students.

Therefore, based on this research, it can be concluded that problem-solving ability will become more optimal if it is built through appropriate design and learning scenarios with respect to the adversity quotient (AQ) aspect of each student. The problem-solving ability of the quitter student group in solving the problem is only to understand the problem. The NCTM indicator that can be achieved by the quitter student group is only the first indicator. While the problem-solving ability of camper and climber student group in solving the problem of problem-solving skills until the re-checking stage. Groups of campers and climber students can reach all NCTM problem-solving indicators.

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