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Problem Solving Ability Based Curiousity Through Assistance and CPS Learning Assisted with Ethnomathematics Nuanced Modules

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Abstract

This study aims to (1) determine the effectiveness of creative problem solving (CPS) learning assisted with Ethnomathematics nuanced modules on problem solving abilities (2) find out the differences in problem solving abilities of students with CPS learning assisted with Ethnomathematics nuanced modules (experiment 1), CPS module assistance classes Ethnomathematics nuance and control class (experiment 2), (3) describe problem solving ability based on curiosity of students in CPS learning class assisted with Ethnomathematics nuanced modules. This study applied a mixed method with concurrent embedded design. Quantitative data was obtained through questionnaires and tests that were analyzed by using the t-test and regression. Qualitative data was obtained through documentation and interviews of subjects selected based on the level of curiosity. Based on the results of the study obtained (1) CPS learning assisted with Ethnomathematics nuanced modules effectively improve the problem solving abilities. (2) there are differences in problem solving abilities in experimental class 1, experiment 2 and control class (3) Qualitative analysis of this study explained that students with high curiousity were able to complete 4 stages of problem solving, meanwhile, students with low and moderate curiosity have varying abilities but less good in completing the implementation phase of the completion plan. Students with low curiosity are not good at planning completion plans.

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INTRODUCTION

In the current era of contemporary learning, the focus of mathematics learning not only teaches how to count but teaches students to think mathematically (Zavenbergen, 2004). According to Zavenbergen (2004) explained that one of the way to teach mathematical thinking ability is to improve problem solving abilities. According to Polya (1973) there are four stages of problem solving, namely: (1) understanding the problem (understand the problem), (2) making plans (devise a plan), (3) implementing plans (carry out the plan), and (4) check back.

Indonesia is one of the countries that make problem solving abilities (KPM) as one of the competencies that must be achieved in learning mathematics (Permendiknas, 2016). In fact these efforts have not shown satisfactory results. The PISA survey (2015) shows that Indonesia is only able to reach 386 points in mathematical abilities. These results indicate that Indonesian students' mathematical problem solving abilities are still below the average score of the OECD problem solving ability (2016) of 490 points. The facts found in SMP N 4 Pemalang indicated that most of students have not been able to understand the problem properly which results in students making errors in calculations. In addition, the results of the problem solving ability test showed that students' problem solving abilities were low even though the problem solving ability has been integrated into the learning process.

This fact indicates that not only is the learning process the main factor determining the success of developing students' problem solving abilities. The low ability of problem solving can be caused by the low curiosity of students. Curiosity is internal motivation which is the key to encouraging active learning and spontaneous exploration (Oudeyer, 2016). Without curiosity students will not be able to absorb the learning properly.

Each individual has a different uniqueness in terms of motivation to learn which is derived from different curiosity. Berlyne (1954) distinguishes curiosity into two dimensions, namely: perceptual curiosity (curiosity as sensory experience) and epistemic curiosity (curiosity about knowledge). While Litman (2008) explains that epistemic curiosity (EC) can be divided into 2 types, namely EC interest (EC type I) and Deprivation (EC type D). The difference in these characteristics requires that the learning process is not only designed to improve problem solving abilities but can also grow curiosity with different student characteristics. In addition, the learning process must also be supported by learning resources that support the development of curiosity on the characteristics of different types of curiosity students.

The selection of the right learning resources can help the development of curiosity in the learning process. Modules are learning resources that can be easily learned by students. Tjiptiani (2016) explains that the module can be studied by students independently so that it can support the role of the teacher in learning. Modules and learning processes can be combined in the learning process to develop students' curiosity. By paying attention to the different types of curiosity of each student, the learning process and modules must be designed with topics that are able to support the development of curiosity students with EC type I and EC type D.

Students with EC type I characteristics require new topics to stimulate the formation of curiosity in a learning setting. Learning in schools is thought to be based on different contexts with the surrounding environment (Pehkonen, 2013). M. Rosa (2017) explains that culture develops different mathematical concepts and is rooted in curiosity, different

abilities and trends. Based on this, mathematics learning should not only display contextual topics but also involve the surrounding cultural elements. Ethnomathematics which is a culture-based learning can give students new learning topics that have never been met before (Shirley and Palhares, 2016). Thus, the cultural narrative on ethnomatematics learning can be used as an option to develop the curiosity of students with EC type I characteristics.

The development of curiosity of students with EC type D characteristics requires different stimulants in learning. Curiosity of EC type D students will appear in problem-based learning settings. One example of the right learning model to use in supporting the development of EC type D is creative problem solving (CPS) learning. Trefinger (2005) introduces the CPS structure with six main steps, namely Mess Finding, Fact Finding, Idea Finding, Solution Finding, and Acceptance Finding. With these six steps the CPS is expected to provide opportunities for students to solve problems creatively. Research by Saironi, Zaenuri and Sukestyarno (2017) shows that there is a correlation between creativity and curiosity. Thus, in addition to being based on creative problems presented in CPS learning, it is expected to develop curiosity students with EC type D characteristics.

As explained earlier, module assisted learning needs to be implemented in a mathematics learning and also implemented into the learning scheme with a module mentoring model with a limited number of meetings. Seeing the lack of learning resources that support the formation of students' curiosity, the CPS learning module will be integrated with the topic of ethnatics to develop curiosity of students with EC type I and EC type D in learning. The study has purpose to (1) determine the effectiveness of CPS learning assisted by Ethnomathematics nuanced modules (CBME) to improve problem the solving ability, (2) find out the difference in the average of problem solving ability of students who received CPS learning assisted with Ethnomathematics nuanced modules, students who received assistance of CPS modules with Ethnomathematics nuanced and control class, (3) describes problem solving abilities based on student's curiosity.

METHODS

This study applied mixed methods with concurrent embedded designs. Quantitative research was carried out to analyze the effectiveness of CPS learning assisted with Ethnomathematics nuanced modules (CBME) to improve the problem solving ability and differences in problem solving abilities in each research class, meanwhile, qualitative research was carried out to describe the problem solving abilities based on student curiosity. The research was carried out in SMP N 4 Pemalang by choosing grade VIII D as the experimental class 1, grade VIII B as the experimental class 2, grade VIII E as the control class and grade VIII A as the class testing research instrument. In the research implementation of experimental class 1 obtained CPS learning assisted with Ethnomathematics nuanced modules, the control class received scientific learning and experimental class 2 received assistance from the CPS module with Ethnomathematics nuances.

Data collection techniques used in this study consisted of questionnaires, documentation, tests and interviews. The process of collecting quantitative learning data is obtained through problem solving ability tests, epistemic curiosity scale (ECS) (Litman; 2005) and a love questionnaire for local culture. While qualitative data will be analyzed through documentation of student work and interview results. Quantitative and qualitative data in this study were obtained with data collection instruments and learning

tools that have been declared valid by expert validators with good criteria.

In the quantitative research, the effectiveness of learning was tested through 7 hypotheses, namely: (1) the completeness of the experimental class students is more than 75%, (2) the average problem solving ability of students in experiment class 1 is more than 70, (3) the completeness of the experimental class students 1 is better than the control class, (4) the average student of experiment class 1 is more than the control class students, (5) the increase in curiosity of the experimental class 1 students is better than the control class, (6) curiosity of the experimental class 1 students has a positive effect on the ability problem solving, (7) there is an increase in the attitude of love of local culture students of the experimental class 1. In addition, quantitative research also released differences in problem solving abilities in experimental class 1, experiment class 2 and control class.

The qualitative research subjects in this study were chosen randomly based on the acquisition of ECS scores. Based on the value obtained by the curiosity subject, the categorization becomes the subject of low, moderate and high curiosity.

The study started with conducting pretest in all three classes to obtain data on students' problem solving abilities before the research. The results of the analysis of student pretest scores are presented in table 1.

Table 1. The Analysis of Pretest Score

Test	Score	Sig
Normality	0.074	0.05
Homogeneity	0.820	0.05
Average similarity	0.914	0.05

Based on table 1, it can be concluded that all sig values> 0.05, therefore, it can be concluded that the pretest data of the problem solving abilities of students in the three research classes are normally distributed, homogeneous and have the same average. This showed that the three classes have met the requirements for the research class.

RESULT AND DISCUSSION

The results of this study were divided into two parts, namely the results of quantitative and qualitative research. The results of quantitative research consist of (1) analysis of the effectiveness of experimental class 1 learning, (2) differences in students' problem solving abilities in all research classes. Meanwhile, the results of qualitative research in the form of a description of students 'problem solving abilities in terms of students' curiosity.

Based on the results of the analysis of the effectiveness of learning obtained information (1) experimental class 1 achieved classical learning completeness that reached more than 75%, (2) the average of problem solving ability of experimental class 1 was 78.31 exceeding the school determined that is 70, (3) the proportion of completeness of experimental class 1 students is better than control class, (4) the average problem solving ability of experimental class 1 is 78.31 better than the control class which is 72.62, (5) the difference in posttest and the prestes of the experimental class 1 is better than the control class which means an increase in curiosity of the experimental class 1 students is better than the control class, (6) curiosity affects 79.7% of students' problem solving abilities and 20.3% is influenced by other variables, (7) there is an average of the character of students' love for local culture before and after CPS learning assisted with ethnomatemics nuanced modules, namely the average pretest of 89.9687 and the average posttest of 121.90 625 which showed an increase in the character of students' love of local culture. Therefore, it can be concluded that CPS learning assisted with Ethnomathematics nuanced modules

effectively improves the problem solving ability in the material of flat geometry.

CPS is a heuristic strategy-based learning that allows students to actively participate in learning. According to Eisenmann (2015) the heuristic approach proved to be efficient in improving problem solving abilities. In addition, Centikaya's research (2014) proves that CPS learning effectively improves learning outcomes. On the other hand, ethnomatemics nuanced modules also support the effectiveness of learning. An Ethnomathematics nuanced module based on the surrounding culture as a learning tool also supports the improvement of student's problem solving abilities. The research of Aziz, Zaenuri, and Dwijanto (2014) proved that learning tools that are compiled based on local culture students can improve students' problem solving abilities. In addition, Endra and Zaenuri (2017) problem-based learning with ethno-mathematical nuances can improve problem solving abilities. Thus, CPS Learning and Ethnomathematics nuanced modules have basically been proven to improve problem solving abilities separately without being combined. However, the combination of CPS and ethnomatemics produces different effects if put together in learning. In fact the results of the study showed that the increase in curiosity of the experimental class 1 students was better than the control class. In addition, curiosity proved to have an effect of 79.7% on problem solving ability. This is in accordance to the findings of Grossnickle (2014) which explains that curiosity is related to the ability to understand problems. In addition, the findings of Oudeyer (2016) also explained that there is a positive influence between the learning process and students' curiosity. Thus, the process of improving problem solving abilities that arise in CPS learning aided by Ethnomathematics nuanced modules is positively influenced by an increase in student curiosity. Accordingly, this study proves that the difference in score of the character of the love of the local culture of the experimental class 1 students before and after CPS learning is assisted by an Ethnomathematics nuanced module better than the control class. This is supported by the findings of Aziz, Zaenuri and Dwijanto (2014) which show that there is an increased sense of love for local culture in culture-based learning. In addition, Betha and Zaenuri (2018) found that learning with an Ethnomathematics nuance effectively increased the love of local culture.

The analysis of differences in problem solving ability in control class, CPS learning class assisted with ethnomatemics nuanced modules (E1) and ethnomatematics nuanced CPS module assistance class (E2) was carried out by examining the differences in average problem solving ability test scores in the three research classes. The data testing results are shown in table 2 and table 3.

Table 2. The Result Output Anova of Problem Solving Ability Differences

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	590.083	2	295.042	3.528	.033
Within Groups	7777.250	93	83.626		
Total	8367.333	95			

Table 3. The Result of Output Post Hoc of Problem Solving Ability

(I) Kelas	(J) Kelas	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
kontrol	e1	-5.68750*	2.28619	.015	-10.2274	-1.1476
	e2	-4.68750*	2.28619	.043	-9.2274	-.1476
e1	kontrol	5.68750*	2.28619	.015	1.1476	10.2274
	e2	1.00000	2.28619	.663	-3.5399	5.5399
e2	kontrol	4.68750*	2.28619	.043	.1476	9.2274
	e1	-1.00000	2.28619	.663	-5.5399	3.5399

Based on table 2, obtained the value of $sig = 0{,}033 < 0{,}05$ that showed difference in problem solving abilities class E1, class E2 and control class. The results of the research in table 3 show that the problem-solving ability of the control class differs significantly from the experimental class 1 and 2 problem solving

abilities. In addition, the results of the research in table 3 also show that the experimental class 1 and 2 students have problem solving abilities that are not significantly different. These results indicate that the problem solving abilities of the two experimental classes are the same. The similarity of problem solving abilities in experimental classes 1 and 2 can be caused by various factors. Research Caliskan (2017) shows that most students feel satisfied with distance learning methods. These findings can answer the success of mentoring models adapted from distance learning in improving problem-solving skills. Research by Silvi, Zaenuri and Sukestyarno (2018) proved that students with mentoring of ethnomatematics modules have the same problem solving abilities as students who get learning with face-to-face models . Thus, this assistance method can be used as an alternative learning at the secondary school level although further research is needed to develop a learning system with a module mentoring model with limited meetings in the future.

Qualitative research was carried out to find out how the problem solving ability can be viewed from the students' curiosity. The qualitative research subjects were divided into 3 categories, namely low, moderate and high curiosity. A summary of the results of the analysis of the problem solving ability of the low, medium, and high curiosity category based on the problem solving phases can be seen in Table 2.

Table 2. The Problem Solving Ability of the Research Subject

Subyek Penelitian	No Soal	Tahapan Pemecahan Masalah			
		Memahami masalah	Merencanakan Masalah	Melaksanakan Rencana	Memeriksa Kembali
Curiosity rendah	1	Mampu	Kurang Mampu	Kurang Mampu	Tidak Mampu
	5	Mampu	Kurang Mampu	Tidak Mampu	Tidak Mampu
Curiosity Sedang	1	Mampu	Mampu	Kurang Mampu	Tidak Mampu
	5	Mampu	Kurang Mampu	Kurang Mampu	Tidak Mampu
Curiosity Tinggi	1	Mampu	Mampu	Mampu	Mampu
	5	Mampu	Mampu	Mampu	Mampu

Based on the data in table2 the ability of subject curiosity students in all categories of morality tend to be classified as good at the stage of understanding the problem. This is consistent with the findings of Grossnickle (2014) which revealed that curiosity can be used to predict problem-solving ability even though for complex problems it takes a higher curiosity. The findings also explain the varying abilities at the stage of planning problems and implementing plans. Students with low and moderate curiosity tend to be less able to plan and implement plans. Students with high curiosity have been able to plan well the completion and implement the completion plan. The results of the student test work in the category of medium and low curiosity can be seen in Figures 1

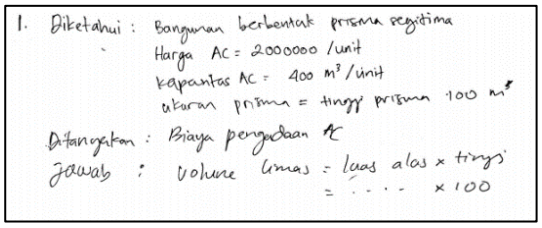

Figure 1. The test work of Students with Low Curiosity.

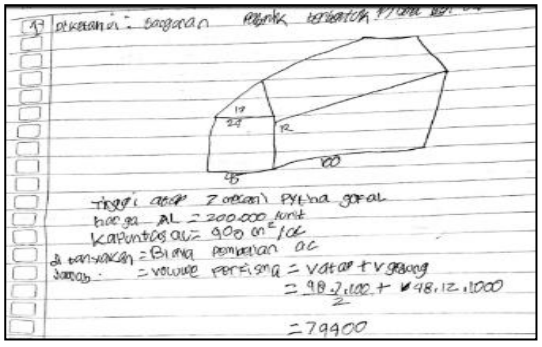

Figure 2. The Test Work of Students with Moderate *Curiosity*.

Based on Figure 1 and Figure 2, it can be concluded that students in the low category and moderate category are already good at understanding the problem but not well in the planning and implementing the completion plan. In the stage of implementating plan, students with a low curiosity category could not carry out the problem solving plan written plan, meanwhile, the students with moderate curiosity category students were likely to write answers in their own language in a simple sentence and seem hesitant. This is consistent with the findings of Kang et al., (2009) who explained that low curiosity is associated with low self-confidence. In contrast to this, students with high curiosity have been able to properly write answers in the stage of planning the completion and implementing the plan. The subject of high curiosity is able to explain the answer well during the test and interview. The difference in the high curiosity category indicates that the learning process is successfully absorbed well by the subject of high curiosity. The process of good cognition on the subject of high curiosity makes the ability to solve the subject matter of high curiosity subjects better than the subjects of the low and medium curiosity categories. The subject of the findings was supported by Von Stumm et al (2011) who explained that curiosity causes a sense of need for knowledge which is the main determinant of differences in academic achievement of each individual. Thus, the high and low curiosity can be used as a predictor of academic achievement. This is consistent with the findings of Grossnickle (2014) which revealed that curiosity can be used to predict problem-solving ability even though for complex problems it requires high curiosity.

In the re-checking stage, the subjects in the category of low curiosity and moderate curiousity were not able to re-examine the answers properly while the subjects of high curiosity, were able to properly check the answers written. The results of high curiosity category student work can be seen in Figure 3.

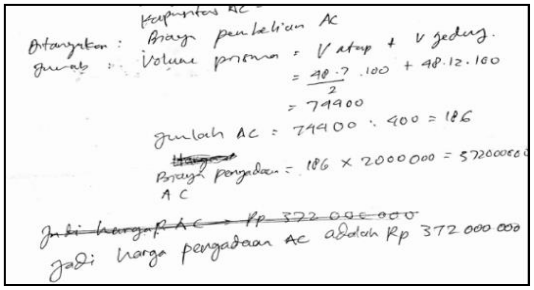

Figure 3. The Result of Work of Students with High *curiosity*

Figure 3 shows that the subject of high curiosity has been able to write conclusions from the results of the work. This fact shows that the subject has been able to understand the problem deeply.

CONCLUSIONS

Based on the results of quantitative analysis, it can be concluded that CPS learning assisted with modules is effective in improving students' mathematical problem-solving ability in the material of flat geometry.

The average of problem solving ability of the class students who received CPS learning assisted with Ethnomathematics nuanced modules and classes that received assistance of CPS modules with Ethnomathematics nuances were better than control classes.

Qualitative analysis showed that generally, students with high curiosity have better problem solving ability than students with moderate or low curiosity. Students with moderate and low category have varied problem solving abilities. The results of the study showed that the average of student in the category of low curiosity and moderate curiousity was unable to complete the implementation of the plan well, meanwhile, the students in the high curiosity category were able to complete all stages of solving the problem.

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