UJMER 11 (1) (2022) 1-7
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Unnes Journal of Mathematics Education Research

http://journal.unnes.ac.id/sju/index.php/ujmer

Mathematics Problem Solving Skill Reviewed from Cognitive Style on Problem Based Learning with Aceh Custom Nuances with Descriptive Feedback

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Article Info

Article History:
Received 15 October 2020
Accepted 24 February 202
Published 15 June 2022

Keywords:
Problem Solving Skill, PBL, Cognitive Style, Ethnomathematics, Descriptive Feedback

Abstract

Problem solving skill is the core of mathematics lesson. This research aims to describe mathematics problem solving skill reviewed from cognitive style based on independent and dependent field categories. It was done for X graders of Public SHS 1 Samudera in academic year 2018/2019. This mixed method research used sequential explanatory strategy. It is a procedure to collect quantitative and qualitative data orderly. The technique of collecting quantitative data was done by problem solving skill test while the qualitative data was done by documentation, questionnaire, and interview. The results showed that mathematics problem solving skill of the students on each cognitive category had different mastery indicators. The differences did not depend on cognitive style categories of the students but based on learning activity.

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p-ISSN 2252-6455
p-ISSN 2502-4507

INTRODUCTION

Education is a main aspect of national life. National condition in the future is influenced by society's mindset paradigm which is fostered by an educational system. Well directed educational process will bring a nation to better civilized changes. Learning is an educational process. Learning at school is expected to reach educational purpose in term of behavioral, psychomotor, and cognitive changes. According to content standard of primary and middle educational levels as stated in Regulation of Educational and Cultural Ministry Number 21 Year 2016, one of competences to achieve in mathematics learning process is problem solving skill.

Problem solving is very important in learning mathematics. It is a unison of mathematics and cannot be separated by program inside of mathematics (NCTM, 2000). It is in line with (Syaiful, 2012)whom stated that (1) problem solving skill is the common purpose of mathematics teaching even it is the core of mathematics, (2) problem solving covers methods, procedures, and strategies which are the core process in mathematics curriculum, and (3) problem solving is a basic skill in learning mathematics. One of learning mathematics purpose is to solve mathematics and common problems in daily lives. It is consisted to Harahap and Surya (2017) that problem solving is a complex cognitive activity as process to solve current faced problems which requires strategies. It shows a need of mathematics learning activity which could improve mathematics problem solving skill of students. One of learning models to use is Problem Based Learning. Barrows (Barrett & Moore, 2011) states there are several PBL characteristics, such as: 1) student-centered learning process. 2) learning process is done in smaller group, 3) teacher acts as a facilitator and supervisor, 4) the given problem is stimulus in learning process, 5) the new information is obtained independently, 6) problem is a medium to develop problem solving skill. PBL emphasizes on student as learner and on authentic - relevant problems to solve by using all prior knowledge owned by students or other sources. Students are required to work collectively to reach collective results. It is started by defining problems, discussing them to gain same perceptions, and determining the purpose and target to achieve.

The faced problems by them in daily lives could be given as problems inside of mathematics learning which should be solved. Characteristics and surrounding culture of students could be instilled into learning. Mathematics learning by using cultural conceptual theme is known as ethnomathematics. Ethnomathematics replaces instrumental concept of learning mathematics as abstract alienation technique by instilling socio-cultural context acknowledgment into mathematics concept by crossing the culture and commitment toward all involved human in society (Mesquita et al, 2011). Ethnomathematics could be used to explain relationship between environmental culture and mathematics during teaching, so it creates more relevant and meaningful mathematics learning for students.

Each region has different cultural as identity and specific characteristic. Aceh is a province in Indonesia which has various tribes and cultures. Northern Aceh is a regency in Aceh Province which is full of cultures because most of the society belongs to Aceh tribes. Several local cultures in Aceh are such as Aceh traditional house, royal relic of Pasai Kingdom, Sulaman Kasab Aceh, and Aceh songket. This research will be focused on mathematics learning based on Acel regional culture, especially Northern Aceh regency.

Each individual has different characteristics which influence to an individual's characteristics in understanding the received materials. It will influence on problem solving analysis process. Each student has different style to process information. Therefore, cognitive style roles in learning process cannot be ignored. Cognitive syle is consistent in nature and could influence all students' activities dealing with cognitive and affective aspects (Syaban, 2012). Cognitive style is divided into field independent and field dependent cognitions (Witkin et al, 1977). Characteristics of FI and FD cognitive styles are to carry out or complete a task or question, FI tends to cooperate better if FI is given freedoms. Meanwhile, FD individual will cooperate better if FD is given direction or extra guidance.

Each student has different understanding and impression on all learning process which could be delivered by them in the form of feedback. It is in line

with (Irons, 2008) that formative feedback is every information, process, or action which provides or accelerates learning based on concerning comments with formative assessment of summative assessment activities. However, the implementation shows rarely frequency of a teacher shares feedback in learning process because it is considered taking lots of time. Descriptive feedback is a formative feedback. Rodgers (2018) It defines descriptive feedback as reflective conversation between teacher and students in which student describes his experience as a learner by having purpose to improve learning, to deepen trust between teacher and student, and to develop creative dynamic community. Every day, descriptive feedback should focus on gaps in understanding and specifically inform students how to improve their learning rather than listing their mistakes. Thus, it could facilitate feedback learning process between teacher and student (Cranmore & Wilhelm, 2017).

The problem formulations in this research are (1) Is PBL with Aceh cultural nuances and descriptive feedback effective to improve mathematics problem solving skill, and (2) how is the description of mathematics problem solving skill reviewed from cognitive styles based on field independent and field dependent categories.

METHOD

This is a mixed method research. The research strategy is sequential explanatory (Cresswell, 2016). Creswell & Clark (in Creswell (2016) states that sequential explanatory is a procedural strategy to collect quantitative and qualitative data orderly. Sequential explanatory is a procedure prioritizing quantitative data rather than qualitative data.

This research was conducted at Public JHS 1 Samudera, in academic year 2018/2019. The population consisted of five X grades. The taken samples were based on random sampling technique with X Science 1 as experimental group intervened by PBL with Aceh cultural nuances and descriptive feedback while X Science 2 as control group intervened by discovery learning. The subjects consisted of three persons from each cognitive style categories to investigate their mathematics problem solving skills.

The techniques of collecting data were test, questionnaire, and interview. Test was used to obtain data about problem solving skill and students' cognitive styles. Meanwhile interview was used to obtain credibility of the data. The problem solving skill test was adjusted to NCTM problem solving indicators. Group Embedded Figure Test (GEFT) was used to find out cognitive style data of the students. The quantitative data analysis was done through normality and homogeneity tests to determine the hypothesis test. The hypothesis test consisted of individual and classical accomplishment test, variance average test, and proportional test. Meanwhile, the qualitative data analysis was done by documenting, interviewing, and observing on the selected subjects. The qualitative data analysis used Miles and Huberman (Sugiyono, 2016:338) as the references by following these (1) data reduction, (2) data display, and (3) data conclusion.

FINDINGS AND DISCUSSION

The results of initial mathematics problem solving skill of the students resulted to Actual Accomplishment Standard as calculated by $BTA = \bar{X} + \frac{1}{4}\,SD$ with $\bar{X}$ has class average score and SD is the standard deviation (Sudjana, 2009). The result of Actual Accomplishment Standard of mathematics literacy is 71 with $\bar{X} = 68{,}75$ and $SD = 8{,}87$.

The effectiveness of mathematics problem solving skill in PBL with Aceh cultural nuances and descriptive feedback were seen from: (1) average test score of mathematics problems solving skill of students taught by PBL with Aceh cultural nuances and descriptive feedback was accomplished both individually and classically; (2) proportion of classical accomplishment on PBL model based on Aceh local culture and descriptive feedback was higher than proportion of discovery learning model classical accomplishment, (3) mathematics problem solving skill of students taught by PBL with Aceh local cultural nuances and descriptive feedback was better than discovery learning.

The effectiveness of mathematics problem solving skill of experimental group students had met criteria determined by tested data processed results :(1) The accomplishment average of experimental

group showed $z_{count} \geq z_{table}$. It is $3{,}002 > 1{,}65$ then H_0 is accepted, meaning that the significant level is 95%. The hypothesis states that average of matheamtics problem solving skill was higher and equal to 71, it could be accepted and the mathematics problem solving skill test obtained 29 students passing the grade from 32 students. It shows that $z_{count} \geq z_{table}$, it is $2{,}041 > 1{,}65$ thus H_0 is accepted that 75% of the experimental group accomplished classically, (2) the result of mathematics problem solving skill of the students showed $z_{count} \geq z_{table}$, it is $2{,}58 > 1{,}65$ then H_0 is accepted, meaning that on significant level 95%, the classical proportion of mathematics problem solving skill on experimental group was higher than the control group, , and (3) the result of mathematics literacy skill average score differences showed $t_{count} \geq t_{table}$, it is $3{,}03 \geq 1{,}99$ then H_0 accepted, meaning that on significant level 95%, the hpothesis stated that the average score of experimental group was better than control group. It is in line with argument stating that problem based learning with ethnomathematics nuance could improve mathematics problem solving skill (Geni & Hidayah, 2017; Prisha Bahri et al, 2018; Parwati et al, 2018; Setiyadi & Mulyono, 2018).

The qualitative analysis of mathematics problem solving test results in the forms of answer sheets of the students and GEFT were categorized in field dependent if the obtained scores were 0 until 11 and field Independent if the scores were 12 until 18. Based on GEFT of experimental group, it was obtained percentage of each category as seen on Table 1.

Table 1. Classification of the Students based on Cognitive Styles

Categories	Students' Numbers	Percentage
Field Independent	8	25
Field Dependent	24	75
Total	32	100

The table shows that from 32 participants of experimental group based on GEFT 8 or 25% of them were categorized as field Independent. Meanwhile, 24 or 75% of them were categorized as field dependent. There were three subjects selected from each category. GEFT instrument had purpose to find out cognitive style classification owned by each student and was used to select subjects offered by interview comprehensively about the students' problem solving skills.

The indicators of mathematics problem solving skills were based on NCTM. They are (1) constructing new knowledge through problem solving, (2) solving problems on mathematics or other field, (3) implementing and adjusting various appropriate strategies to solve problems, and (4) observing and reflecting mathematics problem solving process. Here is the score percentage of each problem solving indicators seen from the students' cognitive styles as seen on Figure 1.

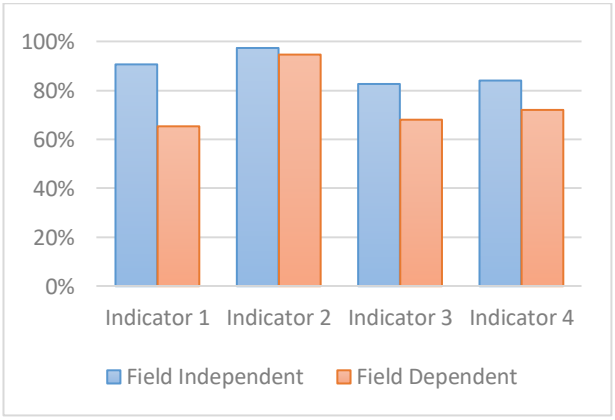

Figure 1. Problem Solving Skill of Experimental Group Diagram Reviewed based on Student Cognitive Style

Figure 1 shows that students with field independent style could reach better problem solving rather than those field independent cognitive style typed students. The third indicator was the lowest one. The indicator was implementing and adjusting various problem solving strategies. Both cognitive type students were less capable to determine different steps to solve problems. Meanwhile, dealing with first indicator, constructing new knowledge through problem solving, the field dependent typed students were found low. The field independent typed students could construct new mathematics knowledge through problem solving.

During the PBL process with Aceh local cultural nuances and descriptive feedback, the field independent students could reach problem

orientation and could understand the problems properly. They could also conduct individual investigation. On discussing stage, field independent typed students could explain to their members. On each final learning stage, the students were given formative test in the form of problem solving quiz. It was started from rules of sinus and co-sinus and triangular area. The given quiz result was announced directly. Then, it was continued by giving descriptive feedback by asking how the students felt during working on the quiz; which part was difficult; how to solve the quiz and the questions orally. After being given descriptive feedback, the teacher obtained various responses from the students such as questions or concerning questions to quiz which had been worked. Next, when the students' answers were incorrect, they would be given three more similar typed questions.

Problem solving skill of field independent subjects, on constructing new knowledge through problem solving, solving problems in mathematics and other fields, implementing and adjusting various strategies to solve problems, and reflecting problem solving process were categorized excellent. It could be seen from written test and interview excerpt of the students. Field independent typed students understood the questions well and drew correctly by correctly sketching to solve the question. Several students could solve problems with various ways. However, there were some of them had not been able to solve with different ways. Field independent students could recheck their written solutions to check the answers. The field dependent students, dealing with constructing new mathematics knowledge through problem solving, were found low. Dealing with problems appearing in mathematics and other fields, the FD students were found sufficiently excellent. In implementing and adjusting various strategies to solve problems, the FD students were not excellent. Dealing with reflecting mathematics problem solving process, they were also found not excellent. It could be seen from written test and interview excerpt of the students. Field dependent typed students could not understand the questions well and their drawn sketch were inappropriate. The students could solve problems with various ways. Field dependent students could recheck the written solution to check the answers but they did not aware of their incorrect answers. It is in line with Kafiar et al (2015) stating that FI was better in understanding the concept, solving problem, and rechecking the obtained results than FD subjects. Alifah & Aripin (2018) stated that F1 had better understanding and performed the solution orderly, clearly, and in detail. The problem solving process was done perfectly based on the asked questions. Siahaan et al (2018) Stated that FI solved problems correctly and rechecked the solution so that the answers were accurate.

PBL learning with Aceh cultural nuances and descriptive feedback could make students more active in learning process. They worked in groups with more active situation and could connect the lesson to surrounding Aceh cultures. It is in line with (Pranoto et al, 2017)that PBL provides chance for students to be active and to have independent initiation in solving tasks during learning. It is supported by (Jana & Supiati, 2019) that PBL could lead students to understand problems and involve them actively in solving mathematics problems. There were also active asking students to obtain understanding about concerning problem solving process. It made the learning more interesting because students were not passive and did not only listen to the teacher but also actively used their knowledge in solving given problems. It is in line with Vendiagry & Junaedi (2015) whom explained that in solving problem, students have profile to understand verbal questions from the problems and change it into mathematics sentences, to be more analytic in receiving information, and could broaden the result of problem solving by having mathematics reasoning, giving correction based on result, and solving problems based on real life context and obtaining correct answers. This statement is supported by Fyfe et al (2015) that problem solving could be optimized by considering characteristics of students and their environments.

PBL with Aceh cultural nuances and descriptive feedback could also improve problem solving skill of the students and to improve local cultural compassion. It was shown by the existence of local cultural compassion questionnaire result before and after PBL implementation with Aceh cultural nuances and descriptive feedback which covered

Aceh culture in the learning. Aceh cultural example covered in the learning is presented in Figure 2.

Figure 2. Kasab Mereuce and Kasab Kipas

After being intervened by PBL with Aceh cultural nuances and descriptive feedback, students would know better their cultural terms, understand the surrounding cultures, and recognize the local culture especially Aceh. The improvement of local culture compassion questionnaire average result showed that there was interest of students toward the ethnomathematics objects. It is in line with Sunandar et al (2018) that students had high interest on ethnomathematics object but not all of such objects could be observed directly. This statement is supported by Zaenuri et al (2019) and Suryapuspitarini & Dewi (2018) whom stated that the questionnaire result of students' interests toward local culture showed improvement after being intervened by ethnomathematics nuances. Besides that, Richardo (2016) stated that ethnomathematics provides effective competence in the form of acknowledgment, nationalism, and pride of tradition, art, and national cultures. Ethnomathematics facilitates students to construct mathematics concept by having their prior knowledge through their own environments. Wahyuti et al (2013) explained that through ethnomathematics concepts, mathematics could be reviewed in cultural practices.

CONCLUSION

The conclusion of this research is PBL with Aceh cultural nuances and descriptive feedbacks was effective toward mathematics problem solving skill of the students. The results showed that mathematics problem solving skill of the students on each cognitive category had different mastery indicators. The results showed that mathematics problem solving skill of the students on each cognitive category had different mastery indicators. The differences did not depend on cognitive style categories of the students but based on learning activity. Therefore, to promote the learning should be based on understanding which could be understood by students.

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