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INDEPENDENT CHARACTER AND REASONING ABILITY IN MATHEMATICS LEARNING BY USING PROBLEM SOLVING POLYA MODEL

Retno Marsitin

Lecturer at Mathematics Education Department, Kanjuruhan University of Malang

Email: mars.ayuu@gmail.com & marsmelia@yahoo.com

ABSTRACT

Improving the quality of learning in higher education is very depended on the lecturers' quality and suitability of teaching strategies in learning, especially learning of mathematics, so the students will have independence and reasoning ability in solving mathematical problems. This study used a qualitative approach with the design of classroom action research, which was conducted in two cycles. The purpose of this research was to describe the independent character and reasoning ability in mathematics learning with problem solving approach Polya model. Subject of this study is mathematics education student at Kanjuruhan University of Malang who took complex function, the number is 30 students. The data collection in this research includes testing, student worksheets, observation, field notes and documentation. The validity of the data used triangulation and the data analysis was through reducing the data, presenting data and drawing conclusions. The results showed the achievement of an independent character and reasoning abilities in mathematics learning with problem solving approach Polya model. This was shown by the data obtained in the cycle two that had met the criteria of success for the reasoning ability, independent character, success in learning outcomes and success in the learning process, namely the achievement of learning outcomes obtained by the students during the learning process of mathematical problem solving approach Polya model with very good score (86%), the achievement of reasoning ability with very high score (80%) and the achievement of an independent character into a routine with a very good score (73%).

Keywords: Independent Character, Reasoning Ability, Problem Solving

INTRODUCTION

The development of globalization and the increasingly fierce competitive atmosphere affect the erosion of the noble values of the Indonesian people, especially in education. The development of globalization must be harmonized with the development of academic skills and character values in learning. Today, character education is very dominant in the various problems of the nation, particularly the problems of education. Character education has a meaning as the education of value, manners, morals, with the goal to develop the ability of students to realize the positive character in everyday life (Puskur, 2010; Berkowitz, 2005).

Character education is very necessary to be invested in education, especially in higher education through the learning process. Students studying at the college are required not only to have the technical skills (hard skills) but also has the power of reason (reasoning), able to communicate, as well as mental attitude, personality, and a certain wisdom (soft skills) so that they have extensive knowledge and different from individuals who do not have higher education in facing the problems in the real world (society). Character education focused on attitudes, behavior, emotions, and cognitions, which is applied systematically and sustainable,

thus having a positive character (Berkowitz, 2005; Dewiyani 2010). The implementation of character education in learning can be integrated into learning, especially learning of mathematics. Thomaskutty, et al. (Utubaku, 2011) states that education in mathematics has values those are: Practical or Utilitarian values, Disciplinary values, Cultural values, Social values, Moral values, Aesthetic values and Recreational value. Learning mathematics appropriately in accordance with the character of mathematical form the student as person who has the ability to clarify, draw logical conclusions, systematic, analytical, honest, and confident. Learning mathematics in university tries to make the student to become an independent person, superior, and intact both in competence and conscience. Development of mathematical skills and character values are implied in the mathematics learning objectives. NCTM (2000) stated that in mathematics there is the ability to be achieved, namely the understanding of mathematics, mathematical reasoning, mathematics connections, mathematical problem solving and mathematical communication. Mathematics learning requires students to have an independent character and high reasoning ability to be able to resolve all the problems of mathematics.

Learning mathematics, as the real experience of researchers as a lecturer seen that there are many students who lack the independent character and reasoning abilities so that students' academic ability is very less and the character value within the student has been eroded by the development of the modern era. This is showed in the academic ability of students obtained when completing math problems either at the time of the quiz, midterm and final exams. The mastery of the material in the mathematical problem needs student's independence ability to reason. The phenomenon above shows that teachers or lecturers are required to innovate in improving the quality of the learning of mathematics. One effort to innovate learning of mathematics is implementing the learning of mathematics with a learning approach. This is in accordance with the opinion of Slameto (2010) who states that learning mathematics is largely determined by the strategies and approaches used in teaching mathematics itself.

Learning approach that allows students to be more active in learning to acquire knowledge and develop the thinking is through the presentation of a problem with the relevant context (Barrows & Kelson, 2003; Stephen & Gallagher, 2003). Problem solving is one of the capabilities that should be owned by every student. NCTM (2000) stated that problem solving is one of the goals in learning mathematics. As'ari (2007) states that the study of mathematics should have the ability of analytical thinkers, problem solvers, innovative and creative, effective communicators, effective collaborators, participate actively in the development of information and media, has a global consciousness. Grouws (Nuralam, 2009); Hudoyo (2001), states that the mathematical problem is everything that is wanted to be done. Krulik & Jesse Rudnick (Carson, 2007) states that "the problem is a situation, quantitative or otherwise, that confronts an individual or group of individuals, that requires resolution, and for which the individual sees no apparent or obvious means or path to Obtaining a solution ". The ability of students in solving problem can be trained and developed through an innovative learning process by using reasoning skills and mathematical connections abilities that exist within the student, thus the students need to be actively involved in the learning process to construct their own knowledge. The research problem in this study is do the independent character and reasoning abilities in mathematics learning with problem solving approach Polya model can improve students' academic ability? The purpose of research is to describe the independent character and reasoning abilities in mathematics learning with problem solving approach Polya model.

LEARNING MATHEMATICS

Slameto (2010); Dimyati & MUdjiono (2009) explain that the notion of psychological learning is a process of change that is a change in behavior as a result of interaction with the environment in meeting their needs. Soedjadi & Moesono (Sutiarso, 2000: 630) says that learning mathematics is to cultivate the ability to reason, to form attitudes, and foster math skills. Mastery of mathematics is not just have ability to compute in answering questions, but have the ability to reason and independence attitude in solving mathematical problems. Peter Alfeld (2000) states that mathematical ability is the ability to articulate ideas of mathematics which include: (1) explain mathematical concepts and facts in terms of simpler concepts and facts, (2) easily the make logical connections between different facts and concepts, (3) recognize the connection when you encounter something new (inside or outside of mathematics) that is close to the mathematics you understand, and (4) identify the principles in the given piece of mathematics that the make everything work. NCTM (2000) asserts that the communication is an essential, part of mathematics and mathematics education.

Haggarty & Keynes (Unal 2006: 510) explains that learning of mathematics need improvement as an attempt to improve understanding between teachers, students in order to make an interaction in the learning process, so that the learning objectives achieve the target well. Learning with character education can be done by giving a true understanding of character education, habituation, example or role model, and integral learning (Ghozi 2010, Sauri, 2010). For this reason, teachers must understand and be able to apply innovative and varied approaches, methods, and learning techniques to support the achievement of learning objectives maximum, as well as understand and be able to apply the theory of multiple intelligences in learning (Putrayasa, 2007).

PROBLEM SOLVING POLYA MODEL

Cankoy & Darbas (2010); Zakaria & Yusoff (2009), state that a preliminary understanding of a problem is very important in solving the problem. Malik and Iqbal (2011) states that solving the problem is a process of finding the relationship between prior experience of the problems faced and then find a solution. Cote (2011: 265) states that teachers should teach problem-solving skills that can deliver students to experience success in the future to be an effective problem solver. Lee (2010: 12), in his study concluded that students' ability to solve problems increased after given problem solving. Learning through problem solving is a way to solve problem that applied through reasoning ability. Krulik & Rudnik (2003) states that the reasoning and problem solving learning has five steps: (1) reading and thinking (identify the facts and problems, visualize the situation, describing the setting solution), (2) exploring and planning (organizing information, drawing solving diagrams, creating tables, graphs, or pictures), (3) selecting the strategy (set pattern, test pattern, simulations or experiments, reduction or expansion, logical deduction, write the equation), (4) finding the answer (estimating, using computational skills, algebra, and geometry), (5) reflection and extension (corrects answers, find alternative solutions, expand concepts and generalizations, discuss solutions, and formulate various and original problems varied. In mathematics there is well known problem solving figure named George Polya. Polya (Siswono 2008) states that solves the problem with the four steps of settlement they are understanding the problem, divining a plan, carrying out the plan, looking back. James M. Cooper (Sanjaya, 2006) states that "A teacher is the person charged with the reasonability of helping other to learn and to behave in new different ways. That is why teachers are professional jobs that require special skills that are the result of the educational process carried out by the teacher education institutions. Greta G. Morine-Dershimer (Sanjaya, 2006) explains that "A professional is a person who possesses some specialized knowledge and

skills, can weigh Alternatives and select from among a number of potentially productive actions one that is particularly appropriate in a given situation ".

INDEPENDENT CHARACTER

Zubaedi (2011) explains that character education is a conscious effort to realize the behavior in virtue through understanding, shaping, fostering ethical values, both individuals and society as a whole. Darmiyati (2010) says that the goal of character education includes thinking / reasoning, feelings and behaviors. Character education goals are embodies good behavior thus can result learners who have the ability to think and reason in moral or value issues and able to make independent decisions in determining what actions should be take. Supinah & Parmi (2011) the study of mathematics can shape students' cultural values and character of the nation. Independence is one of the main characters that are formed and can be developed through the study of mathematics. Independence is the attitude or behavior in the act that is not easy to depend on others in solving problems or tasks. Nowless (Rusman, 2012) independent learners should have their own creativity and initiative, and able to work alone with reference to the guidance obtained. Independence is the character that must exist in students. Several indicators of independent characters in learning includes (a) carry out the instructions properly during the learning activity; (b) focus, serious, and consistent in learning; (c) have confidence in completing a worksheet; (d) have the ability to learn independently according to the potential owned; (e) complete the worksheet independently and do not imitate the work of other

REASONING ABILITY

Reasoning in mathematics is difficult to separate from the rules of logic. Such reasonings in mathematics are known as deductive reasoning. Shurter and Pierce (Dahlan, 2004) explains that reasoning is the process of reaching a logical conclusion based on the facts and the relevant sources. Suprijono (2010); Sudjadi (2011), states that learning to solve problems in an effort to develop the ability to think. Thinking is a high level of cognitive activity. Mathematical problem solving ability is the ability to solve a math problem in a structure through several steps or stages. Sumarmo (2010) revealed that the reasoning is classified into two types, namely inductive reasoning and deductive reasoning. Inductive reasoning is general or special conclusion based on the observed data and the truth value of an inductive argument that can be either true or false. Deductive reasoning is conclusion by considering the agreed rules and the truth value in deductive reasoning is absolutely right or wrong and not both.

Ball, Lewis & Thamel (Widjaja, 2010), states that " Mathematical reasoning is the foundation for the construction of mathematical knowledge" which means that mathematical reasoning is the foundation to acquire or construct mathematical knowledge. Mathematical reasoning abilities have indicators which include: make analogies and generalizations, provide explanations by using the model, use patterns and relationships to analyze mathematical situations, formulate and test conjectures, check the validity of the argument, arrange direct evidence, preparing evidence indirectly, give an example of denial, and follow the rules of inference (Sumarmo, 2002; Jihad, 2008). Reasoning abilities in mathematics learning has an important role in a person's thinking process and a foundation to solve mathematical problems. Thus, several indicators of reasoning ability in learning include: make analogies and generalizations, provide explanations by using the model, use patterns and relationships to analyze mathematical situations, examine the results of the analysis, draw conclusions. Bjuland & Kristiansand (2007), explained that the mathematical reasoning with regard to making conjectures and prove it can be assisted with problem solving learning strategies.

METHODS

This study used a qualitative approach that is naturalistic. Naturalistic studies show that implementation occurs as a natural, normal situation that no manipulation of the circumstances and conditions in natural descriptive (Arikunto, 2009). A qualitative approach is the approach that is expressed in the form of verbal and analyzed without the use of statistics. This type of research is the Classroom Action Research (CAR) conducted in collaboration between the principal, math teacher and researcher (Sutama, 2011), action research (PTK) is a reflective study. Research activities starting from the real problems faced by educational practitioners in the duties and functions, and then reflected the alternative solutions to the problem and followed up with concrete, planned and measured actions.

This research was conducted in Mathematics Education Study Program Kanjuruhan University of Malang. The subjects were students of Mathematics Education that take complex function subject, the number was 30 students. Data collection was done with a test, student worksheets, observation, field notes and documentation. Observation is collecting data through observations during the learning process and observation with other forms that is interviews. Tests and students' worksheets is a series of questions used to measure the skills, knowledge, intelligence, ability in accordance with the rules that have been determined. Documentation is collecting data through the document. Field notes to record important events during the learning process. The research instrument was developed by the researcher and lecturer of mathematics in maintaining the validity of the instrument. Data analysis was performed at the beginning of learning to reflection and preparation of reports by using descriptive qualitative data analysis that includes data reduction, data presentation, data analysis and drawing conclusions. The validity of the data with triangulation is checking data for comparison to the data (Sukmadinata, 2011; Sugiyono, 2011; Mahmud, 2011; Arikunto 2009; Moleong (2008).

RESULTS & DISCUSSION

The results of the study during the learning process took place in 2 cycles that appear on the results of research on cycle I included: (a) the activities of researchers as a lecturer on the learning of both observers obtained the total scores from the observer 1: 55 of the maximum score of 80, the percentage of the average score was 68.75% it mean in the good category, while the total score obtained from the observer II was 54 out of a maximum score of 80, the percentage of the average score was 67.5% with good category; (b) total score of students' activity in the learning process of both observers was obtained for observer I was 47 of the maximum score of 70 with a percentage of the average score 67.15% was good, while the total score obtained from the observer II was 46 of the maximum score of 70 with percentage of the average score was 65.71%, included into good category; (c) 52% of students achieved good category for independent character, (d) 53% of students achieved high category for reasoning ability, (e) the results of the student presentation showed that students who got score ≥ 75 was 63% of the 30 students with good category; (e) the data of students' learning outcomes (test) showed that students who got score ≥ 75 reaches 61% of the 30 students with good category. The findings of cycle II included: (a) the activities of researchers as a lecturer on the learning of both observers obtained the total scores from the observer 1 was 69 out of a maximum score of 80 with a percentage of the average score was 86.25% which means in very good category, while the total score obtained from the observer II was 70 out of a maximum score of 80 with a percentage of the average score was 87.5% with a very good category; (b) total score of students' activity in the learning process of both observers was obtained for observer I was 59 out of a maximum score of 70 with the percentage of the average score was 84.29% was very good, while the total score obtained from the observer II, 60 of the maximum score of 70 with the percentage of the average score

was 85.71% was very good; (c) 73% of students achieved good category for independent character, (d) 80% of students achieved very good category for reasoning ability, (e) the results of the student presentation showed that students who got score ≥ 75 was 87% of the 30 students with very high category; (e) the data of students' learning outcomes (test) showed that students who got score ≥ 75 reaches 86% of the number of students.

The results of achievement and observational studies on the independent character and reasoning ability in mathematics learning with problem solving Polya model shown in the following table:

Table 1. Recapitulation Result of Independent Character Achievement Qualifications

№	Descriptions	Cycle I	Cycle II
1	Carry out instructions during learning activities well	63.33%	73.33%
2	Focus, serious, and consistent when learning	56.67%	66.67%
3	Having confidence in completing worksheets	56.67%	63.33%
4	Having independent learning ability corresponding the student's potential	46.67%	76.67%
5	Completing the worksheet independently, without imitate friend's work	36.67%	86.67%
	Average	(52%)	73.33 (73%)

Source: Recapitulation of research's results

Table 2. Recapitulation Result Reasoning Ability Achievement Qualifications

№	Descriptions	Cycle I	Cycle II
1	Making analogy and generalization	76.67%	90%
2	Giving explanation by using model	70%	76.67%
3	Using the patterns and relationships to analyze mathematical situations	56.67%	83.33%
4	Checking the results of analysis	30%	63.33%
5	Drawing conclusions	30%	86.67%
	Average	52.67% (53%)	80%

Source: Recapitulation of research's results

Table 3. Recapitulation Result of Problem Solving Polya Model Success

№	Description	Cycle I			Category	Cycle II			Category
		Observer I	Observer II	Average		Observer I	Observer II	Average	
1	Lecturer's activity	68.75%	67.5%	68.13% (68%)	Good	86.25%	87.5%	86.88% (87%)	Very good
2	Students' activity	67.15%	65.71%	66.43% (66%)	Good	84.29%	85.71%	85%	Very good

Source: Recapitulation of observation result in problem solving Polya model

Table 4. Recapitulation of Research Result

№	Descriptions	Cycle I	Category	Cycle II	Category
1	Independent Character	52%	Good	73%	Very good
2	Reasoning Ability	53%	Good	80%	Very high
3	Student's Presentation	63%	Good	87%	Very good
4	Student's Learning Outcomes (Test)	61%	Good	86%	Very good

Source: Recapitulation of research's results

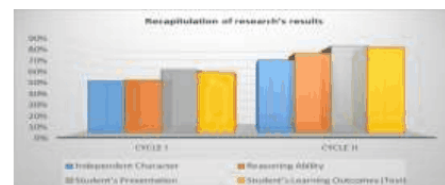Figure 1. Recapitulation Result of Problem Solving Polya Model Success

Figure 2. Recapitulation of research's results

The results of the study of problem solving Polya model learning in terms of independent character showed an increase that was independent character that appeared in the first cycle 52% (good) and the second cycle 73% (very good) thus it can be said that the independent character achieved with routines in independence. This was in accordance with Arends (2008) who found a problem-based learning helps students to develop thinking skills and troubleshooting skills, and become an independent student. Students' reasoning ability also showed that there was an increase in the ability of reasoning on the first cycle of 53% (high) and the second cycle reached 80% (very high). This was in accordance with the Sumarmo (2003) opinion that one of the basic math skills is mathematical reasoning.

In general, the results showed that there was increase in independent character and reasoning ability in mathematics with problems solving Polya model. Applied problem solving Polya model in learning has provided the motivation of students to reason in solving mathematical problems, which appear from the observation results of this research on first cycle was 68% (good) and the second cycle was 87% (very good), while observations on student learning in first cycle was 66% (good) and the second cycle 85% (very good). For students' learning outcomes (test) in the first cycle was 61% (good) and the second cycle was 86% (very good), whereas student presentations in the first cycle was 63% (good) also achieved an increase in the second cycle of 87% (very good). This was in line with the opinions of Cobb (Suherman 2003) who states that learning is an active and constructive process in which students try to solve the problem by participating in mathematics exercises during the learning process. Moreover, in accordance with the results of research conducted by Dhany (2011) stated that learning with problem solving can deliver students achieve learning mastery exceeds the standard criteria of completeness. Sanjaya (2008) who explains that problem solving can develop students' ability to think and reason and to develop the potential that exists within him. Problem solving Polya model trains students to reason in solving mathematical problems. Thought that was made independently by the student have an impact on student self that was to know the process of solving problem, therefore the student knew the weaknesses or faults that had been done during the process of solving the problem, so that students do not repeat what he had done and the students had experience in mathematics learning activities.

CONCLUSION

From the description of the results and the discussion it can be concluded that the independent characters and reasoning ability in mathematics learning with problem solving Polya model can be achieved and improved very well, therefore can guide the students to be more independent, more careful and more reasonable to think in solving the mathematics problem. The response of the students in mathematics learning with problem solving approach Polya model was very positive. The suggestions in this research was for other researchers or teachers who pleased and interested to do research by applying problem solving in learning mathematics were expected to be more innovative in the learning of mathematics in accordance with the characteristics and skills of the students in mathematics, thus the research variable would be more varied and mathematics learning would be more qualified.

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