The Implementation and Problem Solving of Mathematics Students Learning Outcomes: Syntax of Polya as the Solution of the Mathematics Problem Solving

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Abstract: The purpose of this study is to obtain a description of the effectiveness of problem-solving learning using Polya step can improve student's ability to solve the story of surface area and volume of cube and beam in grade 5 of elementary school. The type of research is classroom action research. The design of this study refers to the Kemmis and Mc Taggart model. Based on the results of the research, that learning problem solving using Polya step can improve student's ability to solve the problem of surface area and volume. The result of the research shows that the application of problem solving learning on surface material and cube and block volume can improve student's ability in solving story problem. The increase is due to good teacher and student activity. The teacher has guided the students in understanding the problem, planning, carry out the planning and looking back at the results of the answers, so that, they can be known. Student learning outcomes have reached a classical completeness of 75.58% of student's ability in solving the story problem in cycle 1 of 73.68% and cycle 2 of 81.57%. It was concluded that the application of problem-solving learning with Polya step can improve the student's ability in solving the story problem.

INTRODUCTION

Student-centered learning is expected to encourage students to be actively involved in building knowledge, attitudes and behaviors. Students have the opportunity and facilities to build their own knowledge, so that, they will gain a deep understanding and ultimately improve the quality of their learning outcomes.

Student-centered learning process requires appropriate methods and strategies. The way used should be able to develop student's cognitive, affective and psychomotor aspects. In improving the quality of education required a change of mindset that will be the foundation of the implementation of education in the future. In order for the learning process that occurs can be effective then a teacher should be able to carry out their duties well as educators.

Many strategies or ways teachers can use in learning, including direct learning, discussion, cooperative learning, problem solving and others. Strategies or ways that are varied and in accordance with the material as well as learning objectives will be able to improve students'

understanding of the material provided by the teacher. If the way the teacher used less precise, then the quality obtained is also less than the maximum.

Teaching and learning process conducted by teachers in learning mathematics should be able to develop thinking creativity that can improve student's thinking ability. Learning should also improve student's ability to construct new knowledge to improve good mastery of math materials. One of the ways that teachers can do and apply is with problem-solving learning.

In problem-solving learning, student's thinking skills must be highly optimized through a systematic group or team work process, so that, students can empower, hone, test and develop their thinking skills on an ongoing basis. Problem solving is part of a very important mathematical curriculum because in the learning and completion process, students are enabled to gain experience using existing knowledge and skills to apply to non-routine problem solving[1].

One of the problem-solving steps is Polya's step. In Polya[2], four steps are defined, namely understanding the problem, devising plan, carrying out the plan and looking back which means understanding the problem, planning, executing the plan and looking back at the results. Through Polya's steps, students will get used to doing mathematical problems by linking them to the real situations they've experienced or have ever thought about. Students can also have properties that can appreciate the usefulness of mathematics in life, that is to have curiosity, attention and interest learn and resilient attitude and confidence in problem solving.

In the implementation, until now the process of learning problem-solving student-centered in solving the story problem experienced many obstacles. One of the obstacles is the low ability of students in solving the problems that are marked by; the low ability of students in analyzing the problem, the low ability of students in designing the problem solving plan and the low ability of students in carrying out the calculation, especially, related to the material apperception that supports the troubleshooting process.

These problems need to be handled and the right solution. With reference to the above theories and remembering the ability of grade 5 elementary school students in solving the problem of low stories, then solving the problem using Polya step is very appropriate to be applied as a solution to improve students' skills in solving math story problems.

Based on the background of the above problem, the problem of this research is whether the application of problem-solving learning using Polya step can improve the ability of grade 5 elementary school students in solving math story problem?. The specific purpose of the study is that the educational paradigm is now shifting towards student centered meaning that the learning process is more emphasized on student activities and consequently the students are required to have the ability to solve the problem.

Conceptual framework

Problem-solving learning: Learning can be interpreted as a process of cooperation between teachers and students in utilizing all the good potential that comes from students themselves such as interests, talents, basic skills possessed including learning styles and potentials from outside students such as environment, facilities and learning resources as an effort to achieving learning goals[3].

Problem solving is a learning method that requires students to find the answer (discovery) without special help[4]. By solving the problem students can find new rules that are higher level even though he may not be able to formulate verbally.

According Polya[5] problem solving is an attempt to find a way out of a difficulty, achieve a goal that is not immediately achievable. Therefore, problem solving is a high level of intellectual activity. Troubleshooting means engaging in a task whose method of settlement is not known before. In order to find solutions, students must draw their knowledge and through this process, they will often develop new knowledge of mathematics. Solving the problem is not only the purpose of mathematics learning but also the main means to do so[6].

Polya syntax: According Polya[2] in solving the problem there are four main steps, namely:

Understanding the problem: Without an understanding of the given problem, students may not be able to solve the problem correctly. This step begins with an introduction to what is unknown or what you want to get. Further understanding what is known and what data is available, then see if the data and conditions available are sufficient to determine what you want to get.

Devising a plan: In preparing a problem-solving plan it is necessary to look at the relationship between the data and what conditions are available with what data is not known/searched. Next develop a problem-solving plan by taking into account or recall previous experiences on related issues. In this step students are expected to create a mathematical model to further be solved by using existing mathematical rules.

Carrying out the plan: Prepared settlement plans are then carefully implemented at each step. In executing the plan or completing the mathematical model that has been made in the previous step, the student is expected to pay attention to the principles/rules of the existing work to get

the result of the correct model settlement. Error model answers can lead to errors in answering problem questions. For that reason, checking every step of the settlement should always be done to ensure the correctness of the model's answer.

Looking back: The result of the settlement must be checked again to ascertain whether the settlement is in accordance with the desired in the problem (problem) or not. If the results are not in accordance with the requested, it is necessary to re-examine each step that has been done to get results in accordance with the problem and see other possibilities that can be done to solve the problem (problem). From the examination then the various unnecessary mistakes can be corrected back, so that, students can arrive at the correct answer in accordance with the problem (problem) given.

Ability to solve problem stories: According to Big Indonesian Dictionary in 2002 the ability comes from the word "capable" which means power (capable, capable, able, rich, possessed, excessive possessions). Ability can be interpreted as ability, skill, strength or potential self.

Abilities can also be called competence[7]. The word competence comes from English "competence" which means ability, power, authority, skill, knowledge and skill, ability and authority. So, the word competence of the word competent which means having the ability and skills in the field, so that, he has the authority or the majority to do something within the limits of his knowledge.

According to Mardjuki[8], some of the abilities needed to solve the story problem are as follows:

- Ability to perform calculations such as addition, subtraction, multiplication and division

- Language skills, namely the ability to change the everyday language according to the story into the language of mathematics or mathematical sentences
- The ability of reasoning is the ability to answer questions according to the context of the problem on the story

MATERIALS AND METHODS

Research design: The type of research used is classroom action research. This study uses a model developed by Kemmis and Mc Taggart[9]. In each cycle includes the stages; planning, action and observation, reflection. Cycle will be repeated if the results obtained did not reach the research objectives.

Data collection techniques: The researchers conducted data collection with tests and observations that will be described as follows Table 1.

Test: The test uses a written test that comes with an answer key and a scoring guide.

Observation: In this research, observation is done to observe the students 'ability during the learning process from the beginning to the final stage. In addition, the observation in this study aims to find out the student's responses during the learning of problem solving using Polya step.

From the results of the test and initial observation is done a reflection of the results used to determine the actions to be taken to improve the ability of students in solving the story problem using Polya step.

The research instrument for data collection used in this research is observation sheet. This sheet is used to observe the process of improving student's ability to solve

Table 1: Rubric of the solving problem test scoring

Aspects	Scores	Information
Problem understanding	0	Not writing down what is known and what is asked of the matter
	1	Just write down what is known
	2	Just write down what's being asked
	3	Write down or mention what is known and what is asked from the problem with less precise
	4	Write down or mention what is known and what is asked from the question exactly
Planning of solving	0	Does not present the order of completion steps
	1	Presents halfway order of completion steps
	2	Presents the sequence of completion steps but the order of completion sequences presented is less precise
	3	Presents the correct sequence of steps of completion but leads to the wrong answer
	4	Presents the correct sequence of steps of completion and leads to the correct answer
Realization of solving	0	There is no solution at all.
	1	There is a settlement but the procedure is not clear
	2	Using certain correct procedures but wrong answers
	3	Using certain correct procedures but the answers are less precise
	4	Use certain correct procedures and correct results
Re-observing of the solving result	0	Do not check the process, answer and do not give a conclusion
	1	Do not check the process and answer and give wrong conclusions
	2	Checking the process and the answers with less precise and provide inaccurate conclusions
	3	Checking the process and the answers inappropriately and giving the correct conclusions
	4	Checking the process and answers correctly and making correct conclusions

story problems using the polya step. As for the measure of problem solving problems based on Polya step with reference as follows.

Success criteria:
- The ability of students to solve the story is said to increase if the results of student's ability test in solving the story problem is equal to or more than KKM, that is ≥70 with classical completeness ≥75% and the value in cycle II is higher than cycle I
- Student responses to learning tools and ≥80% positive
- Activity of teachers in implementing learning according to RPP with a minimum value of 3 on the observed aspects

RESULTS

Research result in cycle 1: Activities in the stages of action and observation carried out simultaneously. Actions taken in the form of application of learning problem solving coupled with observations made during the learning process.

Cycle 1 held two meetings. The teaching and learning process refers to the prepared learning plan. Evaluation cycle 1 known that the average class of 70.19. From 38 students, there are 24 students get the score above the minimum completeness criteria, 4 students reach the minimum completeness criteria and 10 students have not reached the minimum completeness criterion that has been determined that is 70. Student learning completeness in class or class completeness in cycle 1 reach 73,68%. Comparison of percentage between complete and unfinished students in cycle 1 can be seen in Fig. 1.

Based on the picture above, it can be seen that the number of students who complete learning more than the unfinished. But the percentage of completeness that reached 73.68% is still not achieved indicators of success in the study which amounted to ≥75%. Thus, the achievement of learning completeness in cycle 1 cannot be fulfilled. So, to achieve the completeness indicator of 75% of this study should be continued in cycle 2.

The success of the mathematics problem solving Through the syntax of Polya in cycle 2: In cycle 2 the researcher wanted to minimize the deficiencies in cycle 1 and fix them to achieve the result of the research as determined. Here, are the improvements that will be implemented in cycle 2 cycle. In the core activities the teacher presents the information by asking students to pay attention to the slides on the board and provide an example of how to solve problems consisting of understanding problems, planning problem solving, running problem-solving plans and looking back and concluding. Then proceed by organizing the students in
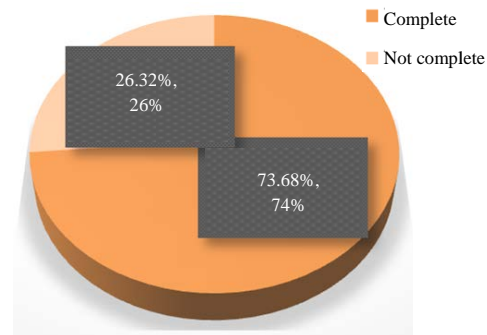

Fig. 1: Percentage of students learning mastery in cycle 1

groups consisting of 6 students. At this first meeting of cycle 2 each completion step is solved together. The activities carried out consist of initial activities, core activities, and end activities. Overall, the process or steps of learning at the second meeting is the same as the steps undertaken in cycle 1. Learning begins with preliminary activities that teachers say welcome greetings, check the readiness of students and then presenting the presence of students who continued by praying. Furthermore, the teacher explains the learning objectives and conveys the benefits of studying the volume of the beam.

The next learning activity is the core activity. In the core activities of the teacher asks the students to read the book and give the opportunity to the students to ask things that are not understood from reading activities that have been done. Students in groups and teachers distributed group worksheets.

Then followed by guiding the students in the discussion to complete the worksheet. In this discussion activity it seems that each group has understood the problem solving step, so, they directly finish the worksheet. No one just playing the unit cubes. In cycle 2, each settlement step is solved together -same. Teachers go around each group to see the results of completion while reminding students to check the outcome.

Subsequently, communicating activities, representatives from the group presented the results of their discussion in front of the class. Another friend commented on results from other groups. Teachers strengthen the conclusions obtained according to the work of groups and individuals.

The final activity at this second meeting is the same as the final activity at the first meeting. In this final activity, students are given the question of evaluation as many as 4 problems to be done. After the whole series of activities was held, the teacher closed the meeting on that day with a greeting.

The result of evaluation of cycle II is known that the average of the value obtained by the students is 75.58. From 38 students there are 29 students get the score above

the minimum completeness criterion, 2 students reach the minimum mastery criteria and 7 students have not reached the minimum criterion that has been determined that is 70. The number of students who complete the study is much more than the unfinished. In accordance with the indicator of successful completeness of classroom learning success, which is equal to 75%, it can be said that the achievement of learning class has been fulfilled. Thus, the study was declared successful and stopped at cycle 2. It can be concluded that learning math problems can be solved by applying the Polya syntax.

DISCUSSION

The ability of students in solving the story problem seen from the evaluation results at the end of the second meeting each cycle. To know the level of mastery of students on the material taught researchers using mastery learning. Individual success using the reference criteria minimum ability set in primary school I/261, that is ≥ 70. While classical success accounted for 75% of VA students.

The results of the evaluation conducted on cycle 1 showed 28 students (73.68%) reached completeness and there are still 10 students with a percentage of 26.32% has not reached the minimum defined criteria defined. The classical completeness reached 73.68% also did not meet the criteria of completeness because the success indicator in this research classical completeness of 75%. In the second cycle of classical completeness increased by 7.89% to become 81.57%. It can be said that this research has fulfilled the indicator of classical completeness success and the research was stopped in cycle II. This shows that learning problem solving with Polya step has good effect on student learning outcomes. The improvement of student ability can be described in Fig. 2.

From Fig. 2 it can be seen that in cycle 2 there is an increase percentage of learning mastery class 7.89%. Obtained percentage completeness class 81.57% has met and even exceeds the research indicator of 75%. The achievement of the maximum value of knowledge is an indicator that the improvement of learning done in cycle 2, especially, on the application of learning problem solving has a significant impact on the improvement of student's understanding.

Based on the results of research that has been described in the previous chapter, problem-solving learning can improve student's ability to solve story problems. This is consistent with PTAI consortium 3 team (Surabaya Sunan Ampel: 154) learning problem-solving as a series of learning activities that emphasize the scientific problem-solving process that expects students to actively think, communicate, search and manage data and ultimately conclude.
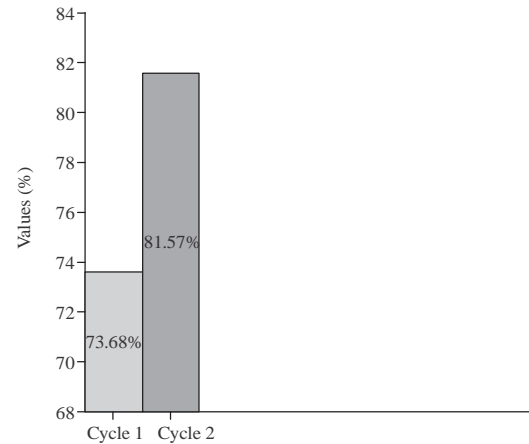

Fig. 2: Increasing of the learning mastery percentage

The results of this study are also in line with the results of research conducted by Wulan gives the conclusion of applying learning problem solving can improve student's critical thinking skills.

However, there are still some obstacles that make learning using problem-solving learning has not run optimally. The constraints encountered during cycle 1 are expected to be of particular concern to the next lesson without putting aside the other steps in learning using problem solving. In addition, the obstacles that arise in the learning cycle 1 is expected to no longer appear, so that, learning done in the classroom can get a more optimal learning outcomes.

Considering the above, the researcher decided to do the learning using problem-solving learning in cycle 2 with some improvement plan, in the hope that the learning done in the classroom gets better result than the result of learning obtained in cycle 1 which has shown improvement pretty good. Improvement plans to be implemented in cycle 2 include:

- The teacher explains the learning objectives and learning scenarios at the beginning of the lesson in the proper way
- The teacher explains the procedure in detail
- Child coaching in study groups is more frequent
- Time management is more attention, so that, all learning activities can be done optimally

CONCLUSION

Student's ability to solve story problems has increased with average grade 68.5% of 73.68% completeness in cycle 1 and average class 75.58 with percentage completeness 81.57% in cycle 2. Student's response to the device in problem-solving learning has increased, i.e., in cycle 1 of 8 aspects responded 6 aspects get response >80% and on cycle 2 all aspects (8) get

response >80% positive. Skills of teachers (researchers) in the management of mathematics learning with problem-solving learning from cycle 1 to cycle 2 good, so that, learning also goes well in accordance with the plan. Teachers are expected to teach the problem-solving steps in a coherent and complete, that is understand the problem, plan the problem solving, carry out problem-solving planning and review the completeness of problem solving.

REFERENCES

01. Suherman and Erman, 2003. [Contemporary Mathematical Learning Strategies]. Universitas Pendidikan Indonesia, Bandung, Indonesia, (In Indonesian).

02. Polya, G., 1973. How to Solve it. 2nd Edn., Princeton University Press, Princeton Municipality, New Jersey, ISBN 0-691-08097-6,.

03. Sanjaya, W., 2008. [Learning Planning and Design]. Kencana, Jakarta, Indonesia, (In Indonesian).

04. Nasution, 1982. [Approaches in the Learning and Teaching Process]. Bumi Aksasra, Jakarta, Indonesia, (In Indonesian).

05. Polya, G., 1971. How to Solve it: A New Aspect of Mathematical Method. 2nd Edn., Princeton University Press, Princeton, New Jersey, USA., ISBN:9780691023564, Pages: 253.

06. NCTM., 2000. Principles and Standards for School Mathematics. 3rd Edn., National Council of Teachers of Mathematics, Reston, VA., ISBN-13: 9780873534802, Pages: 402.

07. Suja'i, 2008. [Arabic language learning innovations]. State Islamic University of Walisongo, Semarang, Indonesia.

08. Mardjuki, 1999. [Learning story problems in mathematics]. Faculty of Mathematics and Natural Sciences UNY, Yogyakarta, Indonesia. (Indonesian)

09. Denzin, N. and Y. Lincoln, 2007. Participatory Action Research. Sage, Thousand Oaks, California, USA.,.