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The Effect of Problem-Based Learning Assisted Concept Map to Problem-Solving Ability and Critical Thinking Ability

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Abstract
This research aims to: determine the effect of model problem based learning model concept map on the ability to solve problems and critical thinking physics students of SMA Negeri 3 Padangsidimpuan. This research is a quasi experimental research with two group pretest posttest design. The population of this research is all students of class X SMA Negeri 3 Padangsidimpuan. Samples were taken 2 classes are determined by random cluster sampling technique, that is experiment class applied problem based learning model with concept map and control class applied conventional learning. The instrument that used in this research is the problem-solving ability instrument in essay form as much as 5 questions and critical thinking ability instrument in essay form 5 questions which has been declared valid by expert team. From the result of the research, it can be concluded that the problem solving ability of physics of students that is taught by the problem based learning model assisted concept map is better than the students who are taught by conventional learning and the critical thinking ability of physics students who are taught by the problem based learning model assisted concept map is better than the students with conventional learning. There is a positive influence of problem based learning model assisted concept map to the ability of problem solving and ability of critical thinking of physics students.
Keywords: Problem Based Learning Model, Concept Map, Problem Solving Ability, Critical Thinking

1. Introduction

Education is one of the basic needs of human being and cannot be separated in daily life. Education is one of the things that have a very important role in order to improve and produce quality of human resources. Sanjaya (2011) said that education is a conscious and planned effort to create an atmosphere of learning and learning process so that learners actively develop their potential to have spiritual power of religion, self-control, personality, intelligence, noble character, and skill that needed him, Society, nation and state. Efforts to improve the quality of education in schools should be through a planned and well-planned learning process will facilitate and help students to develop the potential that is in students themselves, so that learning objectives can be achieved. One form of business to improve the quality of education is to carry out teaching and learning activities in schools, because the school as a formal educational institution in a systematic way to plan the educational environment to perform various learning activities.

Physics learning should emphasis on process, which is learning that emphasis the way of thinking science to observe the surroundings, then think about the causal relationship, then do the modeling and finally can do engineering in the work. If simplified, Research physics, the point is to recognize the natural surroundings and then create a formulation such as formulas and good attitudes toward those phenomena (Sadia, I.W, 2013). The fact is, physics learning only encourages students to memorize the concept and less able to use the concept if they encounter real life problems related to the concept (Trianto, 2009).

Based on the results of interviews of a physics teacher, physics learning in the classroom still faces several problems. The learning model is still teacher-centered. Physics teachers have not been effective in practicing thinking skills and problem-solving skills so that the students do not even have high-order thinking skills. When we looked from the minimum competency mastery (KKM) in the school for student repeat value is still under KKM. Another problem in the process of physics learning is the lack of thinking development efforts that guide students to solve a problem while learning takes place. This process more encouraging student to master the subject matter in order to answer all the exam questions. The fact shows that the students are less active in learning activities and students are prefer to hear and write what teachers describe or write on the board.

Responding to the problems above, we should overcome the problem with efforts in improving students 'thinking skills in solving problems, by changing the old learning model with new learning model that empower the students to be more active in learning (Suardani, 2014), so we can develop students' thinking ability To solve the problem faced, then the main problem faced is the use of teacher-centered learning model that causes the ability to think to solve low student problems. According to Dwi (2013); Tasoglu, (2014) stated that the problem solving ability of physics student is better with problem based learning model than conventional because learning process is more effective with problem based learning (Ismet, 2015). According to Sentyorini (2011); Temel (2014) also explains students' critical thinking skills better through problem based learning model than conventional because in the learning process, students are faced first on the problem (Ladestam: 2016).

Selecting the right learning model can improve students' thinking and problem solving skills to be better,

Problem-based learning model is one of the learning models that involve students to solve a problem through scientific method so that students gain knowledge and have ability in solving problems. In addition, to help students understand the concepts of physics, as well as facilitate students in understanding the lesson, it needs to be supported by the use of assistance such as concept maps, so that student activity is expected more active than before, student learning outcomes increase and learning process more optimal Dewi (2014).

According to Arends (2008), the problem-based learning model is a model of learning that develops thinking skills and problem-solving skills, and the intellectual skills, studies the roles of adults by experiencing them through simulated real situations or situations and becoming self-reliant and autonomous learners. Characteristics of problem-based learning are 1) asking questions or problems, making questions related to the problem and enabling the emergence of various solutions to solve the problem. 2) focus on interdisciplinary linkages, students review the issues from different subjects. 3) Authentic inquiry students must analyze, establish problems, develop hypotheses and make predictions, collect and analyze information, carry out experiments and draw conclusions. 4) produce products and publish, demanding learners to produce certain products in the form of real work or demonstrations that can represent the solution of problems they find. 5) Collaboration, students work together, most commonly forming pairs in small groups. Work together to motivate sustainably in more complex assignments. Problem based learning have five phases: phase 1) Provide orientation about the problem to the students, phase 2) Organize students to research, phase 3) Assist independent and group investigation, phase 4) Develop and present artifacts and an exhibit and phase 5) Analyze And evaluate the problem-solving process.

Suyanto (2009) who proposed the conventional method is a teaching and learning activity that focuses students' attention centered to the teacher, so that the only active is teachers. Since the first method has been widely used as a means of oral communication between teachers and students in learning. In line with Hasan's (2004) opinion, conventional learning is an emerging learning approach where teachers actively provide teaching while the students are only passive, ie only receive lessons

Jonassen (2004) defines the problem as the difference between the outcome to be achieved and the existing reality. Problem solving uses thought processes to solve known difficulties, collects facts about the difficulty and determines additional information as needed. Then Anderson (2001) states if the problem is known then problem solving is a number of sequences of cognitive processes that are directed to finding the right solution. According Polya (1973) defines problem solving as an attempt to find a way out of a difficulty in order to achieve a goal that is not so soon achieved, Physical problem solving indicator consists of 1) identifying problems, 2) interpreting problems, 3) implementing strategies , 4) plan the strategy and 5) evaluate the solution (Heller, 1992).

Liliasari (2013) Critical thinking is an intellectually active and skillful process of discipline conceptualizing, applying, analyzing, and evaluating information gathered or generated by, experience observation, reflection, reasoning or communication, as a guide to trust and action. According to Ennis (in Costa, 1988) the ability to think critically is an intellectually active and skillful discipline process. Critical thinking skills indicators are: 1) provide a simple explanation, 2) build basic skills, 3) Conclude, 4) Further explanation 5) strategy and tactics.

In addition to problem-solving and critical thinking skills that support the problem-based learning model, the use of concept maps can also support the problem-based learning model in the learning process that allows students to memorize learning, overcome misconceptions and simplify students and to connect learning that will come and Learning that has passed. According to Hariyanto (2015) states that learning is more optimal with the help of mind map.

The purpose of this research are: (1) To analyze the problem solving ability of physics of student which is taught by problem based learning assisted concept map with student which is taught by conventional learning. (2) To analyze the critical thinking skills of physics students who are taught by the problem-based learning model assisted concept maps with students who are taught by conventional learning.

2. Method

This research is a quasi experimental research with two group pretest-posttest design. The independent variable of this research is problem based learning model assisted concept map while the dependent variable is problem solving ability and critical thinking. Sugiyono (2009) defines the population is "Region generalization consisting of objects or subjects that have certain qualities and characteristics applied by researchers to be studied and then in the conclusion. The population of this research is all students of SMA Negeri 3 Padangsidimpuan. According to Margono (2010) said, "The sample is part of the population then the sample of this research was taken by cluster random sampling. Instrument used for data collection is Tests Instrument of this research using essay test of problem solving ability consist of 5 problem and Tests instrument critical thinking ability as much as 5 problem.

3. Results and Discussion

The data were collected and analyzed in accordance with the research formulas and hypotheses presented below.
Is the problem solving ability of physics students who are taught by problem based learning model assisted with concept map better than students who are taught by conventional learning?

Table 1. Average Results of Pretest and Posttest Problem Solving Ability Control and experiment class

Class	Pretes Average	Std. Dev.	Postest Average	Std. Dev.
Control	28.06	5.03	64.09	9.14
experiment	28.12	5.83	70.24	8.19

Based on table 1 above, proven that the problem solving ability of physics students who are taught by the problem based learning model assisted concept maps better than students who were taught by conventional learning.

Based on pretest and posttest data of experimental and control class students can be calculated test of experimental class similarity and control. Hypothesis testing is done after the data feasibility test requirements are completed and fulfilled, then hypothesis testing is done by using Independent Sample T-Test with the help of SPSS 20. Data t test of problem solving t ability can be seen in table 2 and table 10.

Table 2. Pretest and Postest Test Results for Problem-Solving Capabilities

Problem Solving Skill	T-Test			Information
	T_{count}	T_{table}	Sig.	
Pretest	0.110	1.988	0.618	Ha accepted
Posttest	3.036		0.467	

Based on Table 2 above shows that Tcount < Ttable on pretest while posttest Tcount > Ttable and significance value greater than 0.05 significance (sig) > 0.05 ie 0.618 for pretest data and 0.467 for postes data so that H0 is rejected, It was concluded that the problem solving skills of students taught with problem-based learning model with concept map is better than students who are taught by conventional learning on physics learning.

Further data analysis indicator ability problem solving physics student of each indicator can be seen in Table 3 as follows:

Table 3. Analysis of indicators of problem-solving ability of control and experiment class

Model	Indicator				
	1	2	3	4	5
	Maximum Score				
	20	20	20	20	20
Problem Based Learning Assisted Concept Maps	68.24%	72.65%	76.47%	62.94%	70.88%
Conventional Learning	61.03%	59.41%	62.06%	68.64%	71.32%

In summary, the analysis of problem solving capability indicators of students of conventional learning class and class of problem based learning model with concept map can be seen in Figure 1.

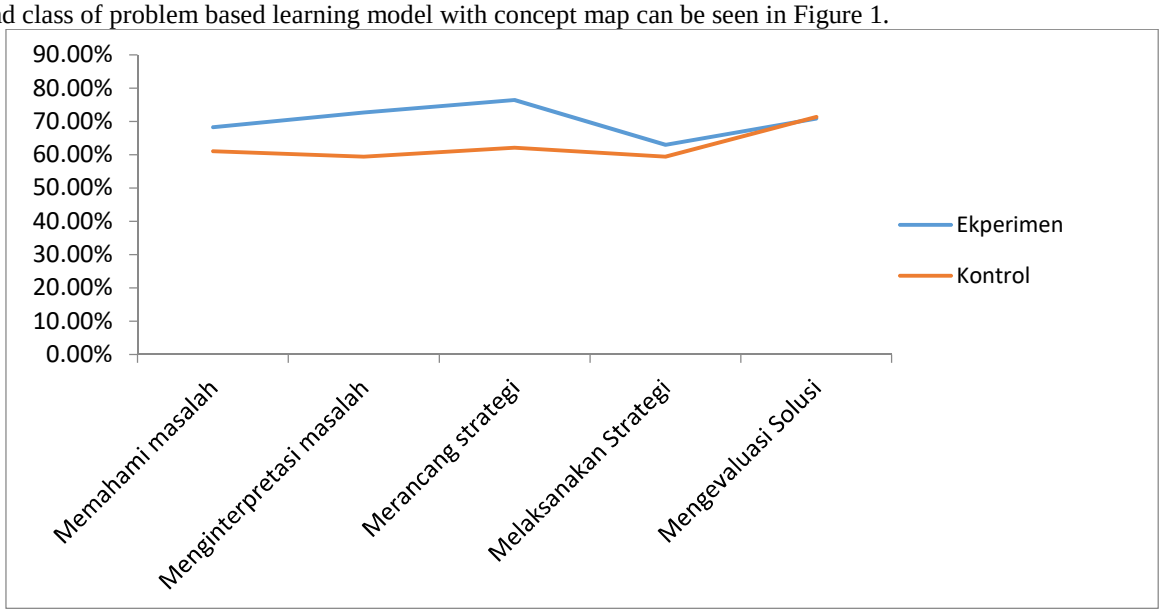

Figure 1. Graph of each student's troubleshooting ability indicator.

The highest percentage of achievement lies in the indicators of problem solving ability lies in the third indicator that is planning the strategy in the experimental class while the lowest percentage achievement in the

fourth indicator is implementing the strategy in the control class. Then it can be explained that the indicators in the experimental class are better than the control class.

Ha1 accepted that Students' problem solving abilities that are modeled with problem based learning model with concept map better than conventional learning students

Is the critical thinking ability of physics students who are taught by the problem-based learning model assisted with concept maps better than the students who were taught by conventional learning?

Table 4. Average Results Critical thinking skills and Posttest control and experiment class

Class	Pretes Average	Std. Dev.	Postes Average	Std. Dev.
Control	39.26	9.06	66.18	7.29
experiment	39.41	9.75	71.03	7.86

Based on table 4 above, it is evident that the critical thinking ability of physics students who are taught by the problem based learning model with concept map is better than students who are taught by conventional learning.

So the data can be concluded that the critical thinking skills of both classes have the same variance. Hypothesis testing is done after the requirements of data feasibility test is completed and fulfilled, then further hypothesis testing is done by using Independent Sample T-Test with the help of SPSS 20. Data t test result of critical thinking ability can be seen in Table 5.

Table 5. Pretest and Posttest Test Data for Critical Thinking Ability

Critical Thinking Skills	T-Test			Information
	T_{count}	T_{table}	Sig	
Pretest	0.066	1.988	0.353	Ha be accepted
Pottest	3.204		0.678	

Based on Table 5 above shows that Tcount < Ttabel in prettest while posttest Tcount > Ttable and significance value greater than 0.05 significance (sig) > 0.05 ie 0.353 for pretest data and 0.678 for posttest data so that H0 is rejected, It was concluded that students' critical thinking ability taught with problem-based learning model with concept map is better than students taught by conventional learning on physics learning.

Analysis of indicators of critical thinking ability of conventional learning class and class of problem based learning model assisted concept map Table 6.

Table 6. Analysis of Indicators of Critical Thinking Skill of Control and Experiment Classes

Model	Indicators				
	1	2	3	4	5
	Maximum Score				
	4	4	4	4	4
Problem Based Learning Assisted Concept Maps	69.85%	72.79%	77.21%	65.44%	69.85%
Conventional Learning	60.29%	66.18%	67.65%	68.38%	68.38%

In summary, the analysis of indicators of critical thinking ability of conventional class learning students and class of problem based learning model concept maps can be seen in Figure 2.

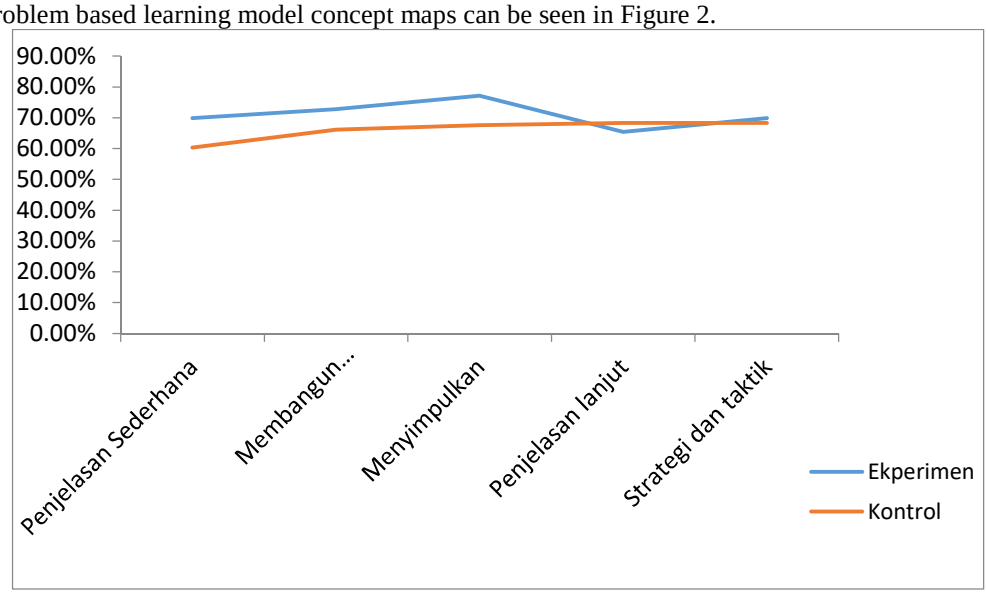

Figure 2. Graph Each Indicator of Student Critical Thinking Skill.

The highest percentage of achievement lies in the indicator of critical thinking lies in the third indicator that is concluded in the experimental class while the lowest percentage of achievement in the first indicator is a simple explanation on the control class. Then it can be explained that the indicator of critical thinking in the experimental class is better than the control class.

Ha2 accepted that the critical thinking skills of students who are taught with problem-based learning models are better concept-based maps than conventionally-taught students.

Based on the data descriptions of students problem solving skills and critical thinking students can conclude that the indicator of problem solving ability experiment class indicator plan strategy higher students are more capable or more can plan strategies, if connected to the indicator of critical thinking students who have plan and strategies Either it is not able to infer the problem and seen in the indicator of critical thinking is at the lowest percentage. The result of this research can be concluded that problem solving ability which is learned with problem based learning model assisted by concept map shows better result than students taught by conventional learning in line with Sahyar research (2017); Nduru (2016); Parandiangan, R, N. (2016) and critical thinking skills taught by problem-based learning models with concept maps show better results than students taught by conventional learning in line with Masek, A and Sulaiman, Y, research. (2011).

4. Conclusion

Problem solving skills of students who were taught with problem-based learning model assisted with concept maps better than conventional learning students

The ability of critical thinking of students who are taught by the problem-based learning model assisted concept map better than the conventionally-taught students.

5. Implications and Suggestion

Model problem-based learning can create a more effective and innovative learning because because students are taught by model problem based learning more stimulate students' thinking ability and students more active role when learning process takes place, seen during the learning process takes place, where the students In the face of a problem such as material issues related to the daily life of classroom students using the problem-based learning model more tends more trying to find the results of problem-solving that has been given by the teacher and when at the time of learning or discussion students are also more daring to issue what Which is in his mind as in asking, answering questions from teachers or arguing with other students or with arguments to teachers.

Through the model of problem-based learning students are more creative have a sense of want to know high because during the course of the student presented authentic problems so that the ability to think increased, based on the ability of thinking students will be able to develop students problem solving skills.

Model problem-based learning aided concept map produces more optimal learning results because at the time of learning process through the concept map the students more easily understand the lesson material delivered and the students more foster the problem solving skills of students, the use of problem-based learning model assisted concept map Improve the students' problem solving skills physics is with the problem-based learning model assisted with the concept map students are more utilizing the laboratory facilities, learning media, and more to provide opportunities for students to innovate and creatively, and presents real problems to students in solving problems in learning roses. The results are in line with the research.

In applying model problem-based learning better educators prefer the adjustment of selected problems in learning, especially in the student worksheet (LKS) for more effective and efficient learning.

In the model of problem-based learning should educators guide students in developing knowledge and solve problem solutions and help explore the skills that have to construct knowledge can be more meaningful.

At the end of the lesson it is better to convey the purpose of learning for the next meeting in order to streamline the time to be used in the learning process so that students prepare beforehand.

To the next researcher is expected to continue the research model problem based learning, researchers should design variations of the various learning. Besides, it is expected to reflect and provide inputs with the aim of improving the implementation of the results of this research.

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