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The Effects of Exercise Using Minnesota Strategy Problem Solving Model to Student Learning Outcomes and Critical Thinking Ability

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ABSTRACT

This study aims to look at the effect of the Physics Problem Solving Exercise by using the "Minnesota Strategy" Problem Solving Model to improve Student Learning Outcomes and Critical Thinking Abilities in state high school 3 Seunagan. The approach used is a quantitative approach in the form of experimental research. Then the data is analyzed using N-gain and t-test. Hypothesis testing used by one-party test that is the right hand side, with criteria accepted by H1 if $t_{count} > t_{table}$ and H1 is rejected if t_{count} t_{table}. Hypothesis test results obtained for student learning outcomes data $t_{count} = 4.18$ and $t_{table} = 1.68$ and for critical thinking data $t_{count} = 5.09$ and $t_{table} = 1.68$ then it can be concluded $t_{count} > t_{table}$, in other words H1 accepted. The conclusion of this research is that there is an influence on the use of Physics Problem Solving Exercises by using the "Minnesota Strategy" Problem Solving Model to improve Student Learning Outcomes and Critical Thinking Ability.

Keywords: Minnesota Strategy, Learning Outcomes, critical thinking skills.

INTRODUCTION

Education is a conscious effort of a person in exploring knowledge to develop their potential through a learning process so that they can create better knowledge in terms of cognitive, affective and psychomotor. In the learning process, of course it is inseparable from the educational guidelines which are often referred to as curriculum which is always changing and developing. This is because in essence the science itself is dynamic. Therefore it is very necessary curriculum in accordance with the educational goals to be achieved. In order to realize these educational goals, a 2013 curriculum was used which is able to help students become more active.

The 2013 curriculum encourages students to become active learners in the learning process. Active in the learning process referred to here is between the teacher and students transferring knowledge to each other in the teaching and learning process, not only the teacher as a center of knowledge, but students must also be able to explore the knowledge themselves. But in reality students only get an understanding of the material from the teacher

without digging by themselves. Then also at the time of solving problem, students must be able to solve it well and the right way is not just to memorize the formulas contained in the book alone, but must be able to apply it according to the problem given. As is the case in class X state high school 3 Seunagan, Nagan Raya, after observation and interviews with one of the physics studies teachers it appears that students are still often passive in asking questions, then students are also very less able to solve the problems given by teachers, they are only able to solve problems by using memorization from formulas obtained from books alone, but when they get a problem that requires them to analyze first they become overwhelmed in solving the problem.

Problem of Research

In order for students to be more active what is needed is not just a learning model that can help the learning process run well. Therefore teachers must pay more attention from various aspects, one of which is the steps that must be done in solving problems. From the steps to solve the problem, students are expected to be able to solve the problems given by the teacher so that they can be solved properly. One solution to problems in physics is to use the Problem Solving Model. Problem Solving Model is a model that uses skills in problem solving.

The problem solving model (Problem Solving) itself is a process of thinking and finding a way out of the problem (Thobroni, 2016: 274). "Most people spend more time and energy solving problems, rather than trying to solve them." (in Henry Ford). Problem solving is a complex process that is important for all citizens in our modern world and important for studying physics (Jenifer & Heller, 2009). Problem solving has been defined as a high-level cognitive process that requires more routine or fundamental modulation and control of skills (Goldstein, 1987). Based on the opinion of the experts above, it can be concluded that the Problem Solving Model or problem solving model is a model that emphasizes students to think critically not just to answer questions but also must be able to understand the purpose of these questions in the problem solving process that is given by his teacher. There are very many problem solving models, one of which is with the Minnesota Strategy. In this Minnesota Strategy model, there are several steps to solving problems in physics, namely: first focus on what the problem is, second, explain the physics, third plan the solution, fourth run the plan, and finally the evaluation of the answers obtained. Just as the opinion expressed in solving physics problems, in terms of students Edward (2005) in Yenni (2008) states, many students say "I understand material but I just can't do the problem". This means that in solving problems in physics problems, many students do not know what to do after they finish writing and know from the solved questions. Many students are only able to work on count problems that can be searched by substituting into a physical formula if the known physical quantities are explicitly stated (direct questions). Generally students have difficulty if the physics problems encountered require analysis and need to derive equations so that a specific equation is obtained in accordance with the conditions of the problem at hand. As a result, many students have problems in solving problems indirectly. It is also caused by the

teacher who only explains the material without expanding the concept understanding of the material. Whereas students must be able to solve problems with critical thinking so that the questions given are able to be solved properly and correctly.

The use of problem-solving models with Minnesota Strategy also trains students to think critically. Critical thinking is a systematic process that allows students to formulate and agree and express themselves, critical thinking is an organized process that allows students to approve, assume, understand, and base the language of others. (Alwasilah 2010: 185). With the problems given, students will try to solve these problems by analyzing the phenomena that are seen.

Research Focus

There are several studies that have been conducted on the effect of problem solving in physics in general, such as the research conducted by Yenni (2008) stating that the results of the literature study obtained by skil-ski1 are needed in solving indirect problems. In general, skil-ski1 is needed, among others: Visualize the problem in physics and identify the physical quantities that are known and asked. Describe the description of the forces acting on objects using free diagrams. Applying the difference in the nature of scalar quantities with vectors. Convert various units to similar units. Derive general formulas to get formulas that are specific to the problem being solved. Use a special formula in solving problems and evaluating the correctness of the solution. Using Minnesota problem solving strategy which consists of 5 steps, namely: (1). Focus the Problem, (2). Describe the Physics, (3). Plan the Solution, (4). Execute the Plan and (5). Evaluate the Answer. Agree with Arif, et al (2014) in their research in the form of CAR showed that the results of the study analyzed descriptively showed an increase in critical thinking skills in problem solving students who initially had a percentage of 64.9% test scores in pre-cycle activities increased to 72% at the end cycle I and increased again to 80.2% at the end of cycle II. The results of the questionnaire also showed an increase in critical thinking skills from the percentage of 74.2% in pre-cycle activities, to 77% at the end of the first cycle and increased again to 79.9% at the end of the second cycle. Then, from the research results Rahmad, et al (2014) by using different independent variables stated that, "The scientific approach model based on solving physical problems can train students' critical thinking more. In addition, the scientific approach applied in the phyisc problem solving model provides better learning outcomes.

For the problems and results of previous studies that have been described above, the researchers plan to make a research problem-solving process using the Problem Solving Model with Minnesota Strategy. So that researchers are interested in raising the title, "The Effect of Physics Problem Solving Exercises with the" Minnesota Strategy "Problem Solving Model Against Student Learning Outcomes and Critical Thinking Ability".

METHODOLOGY OF RESEARCH

This research will be conducted in April 2019 at SMAN 3 Seunagan having its address at Jln. National. Paya Kuta Village. Nagan Raya. The research will be carried out in the even semester of the 2018/2019 school year. For the experimental class X MIA 1 class with 18 students and the control class X MIA 2 with 18 students. Data collection techniques by means of tests. Namely the initial test (pre-test) and the final test (post-test). Tests are a series of questions or exercises and other tools used to measure the skills, knowledge of intelligence, abilities or talents possessed by individuals or groups. (Arikunto, 2010: 193). Data processing techniques in this study using *N-gain*, with the following formula:

$$g = \frac{S_p - S_p}{S_m - S_p}$$

Calculation results are interpreted using the gain index. According to the classification of Meltzer (2002) the gain index is as follows:

Tabel 1 Gain Index

Gain Index	Interpretation
g>0,70	High
0,30<g<0,70	Medium
G<0,30	Low

Sumber : Meltzer, 2002

and by *t* test, with the following formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Information :
$\bar{X}_1$ = Sample average 1 (experimental class)
$\bar{X}_2$ = Sample average 2 (control class)
S = Standard deviation of the combined sample
n_1 = Sample number 1 (experimental class)
n_2 = Sampel number 2 (control class)

To test the hypothesis using the t-test statistical formula, with a significance level of 5% (0.05), a one-party test was used.

RESULTS OF RESEARCH

1. Student Learning Outcomes

Data on learning outcomes is measured using tests, both control classes and experimental classes. Can be shown in the following diagram:
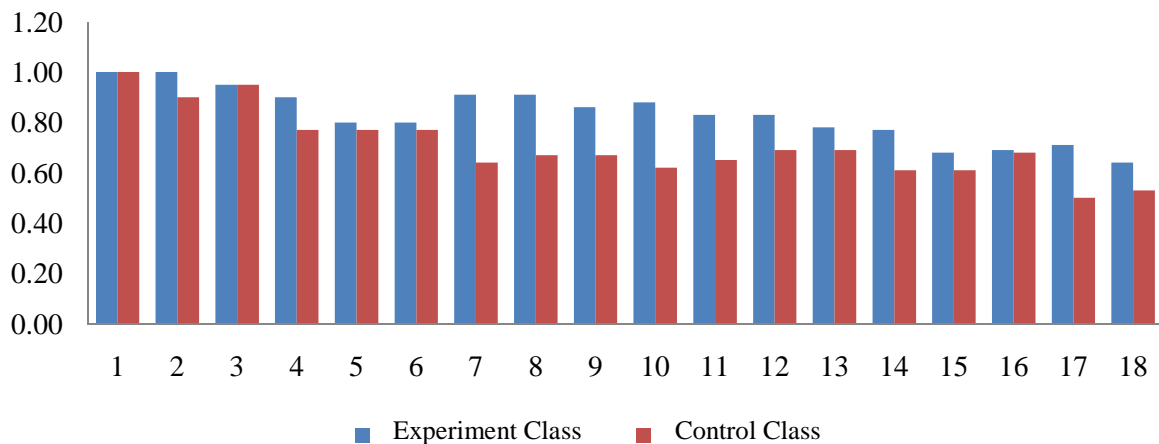
Figure 1. Gain Value Diagram of Students' Learning

Based on the results obtained in the normalized gain values, it is found that the learning outcomes in the experimental class are higher in interpretation than the dick class. In the experimental class the normalized gain value was 0.83, while in the control class the normalized gain value was 0.71. This proves that, learning outcomes using the problem solving model "Minnesota Strategy" affect the increase in student learning outcomes, as evidenced by the magnitude of the normalized gain in the experimental class of 0.83. Just as in Nurfadilah's research (74: 2015) which states that by using the *N-Gain* test it can be seen that the pretest data for the experimental group obtained an average value of 66.82 while for the posstest an average value of 86.36 . So it can be said that there is an increase in student learning outcomes by 19.41 which means there is a significant influence between mastery learning strategy and student learning outcomes. This is also supported in Latief's research (25: 2014) the acquisition of post-test scores and N-gain in both classes of research which basically is a learning progress score after treatment shows a significant difference between post-test scores and N-gain experimental class using contextual models with post test scores and N-gain control classes that use conventional learning. Where the post test and N-gain scores in the experimental class are higher than the post test scores in the control class.

While the final results using the hypothesis test in the experimental class for student learning outcomes data obtained an average ($\bar{x}1$) = 46.61, standard deviation (S1) = 3.59 and variance (S12) = 12.89. To test the hypothesis used t-test with a significance level of 5% (0.05), with degrees of freedom dk = 34 and a probability of 0.95 obtained t_{table} = 1.68 while t_{count} = 4.18. Therefore, t_{count} is in the H1 acceptance and reject H_0.

In accordance with Mari's research results (2017) about learning outcomes with different independent variables namely learning outcomes as a concept has experienced a resurgence since the beginning of the Bologna Process in 1999. The purpose of this review is to study how its historical roots of learning outcomes are recorded in current research articles since the Bologna process launch and whether the concept of learning outcomes is used critically or uncritically. Only a minority of articles, namely 8%, were found to be critical of the behavioral meaning of learning outcomes. Then in the research results of Nangkula (2011)

using models and methods of evaluation and evaluation inherited in the design studio is an important part of the architectural design studio. This paper tries to align the assessment model with learning outcomes through measurement of the Rasch model. Then in Ramona (2013) in this article it increases the importance of developing information literacy competencies for higher education students. Web-based Portofoli represents a comprehensive instrument for evaluation that can be used in all academic fields, highlighting learning outcomes and learning procedures.

Based on the results of the n-gain analysis and the results of hypotheses about learning outcomes it can be obtained that the learning outcomes of a student are greatly affected from various aspects. Not only certain models can influence the improvement of learning outcomes, but aspects of the learning environment also determine the learning outcomes obtained by these students.

2. Critical Thinking Ability

This critical thinking ability data is measured using tests, both the control class and the experimental class. Can be shown in the following graph:
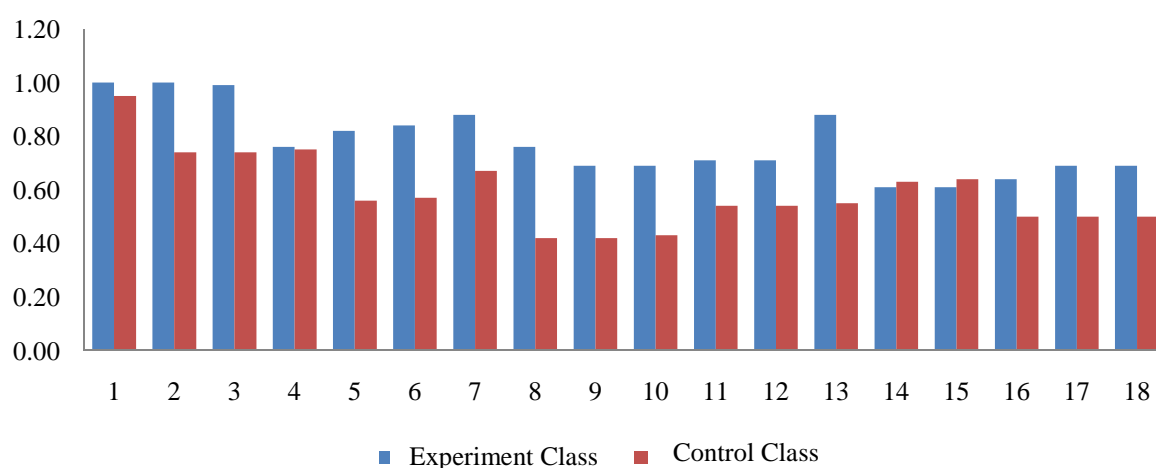

Figure 2. Gain Value Diagram for Critical Thinking

Based on the results obtained in the normalized gain values, it is found that the ability to think critically in the experimental class is higher in interpretation than the dick class. In the experimental class the normalized gain value obtained was 0.78. While in the control class the normalized gain value is 0.59. This proves that, the critical thinking ability of students generated by using the problem solving model "Minnesota Strategy" affects the increase in critical thinking skills in students, as evidenced by the amount of normalized gain in the experimental class of 0.78.

While the final results using the experimental class hypothesis test for students' critical thinking data ($\bar{x}1$) = 41.72, standard deviation (S1) = 5.29 and variance (S12) = 28.03. To test the hypothesis used the t-test with a significant level of 5% (0.05), with degrees of

freedom dk = 34 and the probability of 0.95 was obtained t_{table} = 1.68 while t_{count} = 5.09. Therefore, tcount is in the H_1 acceptance and reject H_0.

Critical thinking can also be improved in other learning as in the results of Nadire's (2009) research with the aim of this study being to investigate the effect of mobile learning on critical thinking skills It was found that after research, student creativity increased significantly. Furthermore, researchers found that outdoor experiences positively influence student attitudes. In addition, the results show that in this study, collaborative work and information sharing were built into group activities. Then in Daniela (2011) this research concentrates on the transferability and development of critical thinking skills using integrated programs in Romanian higher education. In this study concludes that critical thinking skills are complex psychological realities with different components and it is unlikely that they are automatically transferred to other fields, once formed in the domain, and also that integrated education programs are better than unintegrated lecture types, when transfer to daily life critical thinking skills come in discussion. From the results of previous studies found that there are many ways to improve critical thinking skills in students, including the model applied by researchers now.

CONCLUSIONS

Based on the data analysis and discussion in this study, it can be concluded that there is an effect of the Physics Problem Solving Exercise with the "Minnesota Strategy" Problem Solving Model Against Student Learning Outcomes and Critical Thinking Ability on particle dynamics material in state high school 3 Seunagan. There are several obstacles in this study one of which is that it takes a lot of time when students solve questions using the problem solving model with Minnesota strategy. Suggestions for subsequent writers to conduct research similar to the polya problem solving process.

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