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Student Self Monitoring Effect on Scientific Thinking Skills and Physics Learning Outcomes of Class X Students

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ABSTRACT

This research aims to investigate whether: (1) There is any difference in scientific thinking skills between students who have a high level of self-monitoring and students who have a low level of self monitoring on Physics subject in senior high school; (2) There is any difference among the students who have low self monitoring who follow the learning using scientific thinking method in learning Physics in senior high school; (3) There is any interactional influence between scientific thinking method with self-monitoring on Physics learning outcomes in senior high school. Descriptively, it was found that the low self-monitoring group, the students' average learning outcomes before treatment was at 58.55. After scientific thinking activities and treatment, in the learning outcomes average increased into 72.91 and 84.18. Likewise, in the high self-monitoring group, the students' average learning outcomes before treatment was of 58.33. After the scientific thinking activities and treatment, the learning outcomes average increased into 71.17 and 81.33. Based on the table, it was indicated that the learning outcomes of all groups increased after the scientific thinking activities and treatment. The application of the scientific method of thinking, the same relative effect on these two groups occurred, there was not any tendency that the scientific thinking and treatment to be more appropriate if given to merely one self-monitoring group.

Keywords: Thinking Skills, Self Monitoring, Physics, Learning Outcomes.

Introduction

In senior high school classes, it is still currently visible that there are teachers who act dominantly in giving lessons, while students are sitting quietly and paying attention to the teacher during the teaching and learning process. It is so rare for teachers to lead the students towards scientific thinking in explaining their lessons. Scientific thinking is a process of applying scientific techniques to observe phenomena, gain new knowledge that is integrated with the previous knowledge or correct the previous knowledge. It is also a systematic approach in collecting data in problem solving. Building a causal relationship within a system that involves one or more variables and various ways of thinking - about scientific subjects, content, or problems - such that one can improve the quality of his thinking skill as well as reflect the inherent structure in his mind and to adhere to his intellectual standard.

National education goals are to elevate the life of the nation and develop Indonesian people holistically: the people who are faithful and devoted to God Almighty and noble in character, knowledgeable and skillful, psychologically and spiritually healthy, steady and independent and responsible in social and national life. With education, it will arise within the person's life a competitive, motivated, and passionate awareness to be better in all aspects of life.

In essence, education is determined to establish one's character that is faithful and devoted to the God Almighty. Empirically, education only emphasizes the intellectual aspect supported by the evidence that the National Exam has been considered as one benchmark of education achievement with less consideration on the process of student's character and manner building process. It is questionable whether by following the learning process of Physics subject, students may undergo a good character building process or not. It is to be believed that every person has their own way in presenting themselves.

Some people concern more on their public image, some show more concern on strategic self presentation, while the others prefer to concern on their self-verification. According to Mark Snyder (1987), the difference is related to a certain personality trait called self-monitoring which is a tendency to regulate behaviors to adapt with social situation demands. Thus, self-monitoring is a tendency to alter behaviors in responding to the self-presentation that is focused on the Physics subject learning situations (Brehm & Kassin, 1993). Meanwhile, according to Worchel, *et al*. (2000), self-monitoring is adjusting behaviors towards situational norms and expectations from others. Besides, Brigham (1991) states that self-monitoring is a process in which the individual monitors the completed impression management.

Learning process is an activity that teachers do in delivering the materials to the students. This learning strategy is the first phase that must be known before the teachers conduct the teaching and learning process in the class. The various kinds of learning methods may facilitate the teachers to deliver the

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teaching materials to the receivers: the students. It is certain that a teacher apply a good learning strategy in order for the students to generate a good achievement. Using the appropriate strategy, it would be easier for teachers to teach and it would be easier for learners to gain the learning materials from the source of information. There are several kinds of learning methods that can be applied during the teaching process; one of them is called scientific thinking method. Scientific thinking means thinking systematically. Starting from formulating the problems the process is then followed by formulating the hypothesis, collecting the data and solving the problems. Scientific thinking is an experimental method to help confirm or reject the hypothesis. The data is collected from the completed observations which is then processed and summed to draw conclusions.

The selection of problem in this study is motivated by the presence of several research findings which were completed by previous researchers who argued that student meta cognition empowerment in conducting self-monitoring in regard to understanding topics in Physics. Furthermore, Ratih (2010), the percentage of changing off-task behaviors presented by the three research subjects during the treatment, all experienced a decline of 50% to 83.1%. This percentage of change implied that the technique of self monitoring and self reinforcement were effective to reduce the students' off-task behaviors. In respect to gender difference in self-monitoring with an application of belief paradigm, there is no significant difference in the score achievement between men and women in conjunction with the gender disparity issue in the performance of solving Physics problems. Keban, *et al*. (2011) concluded that lab-work activities provide opportunities for students to conduct research similar to how experts do it. Therefore, by the end of the day, the students would be able to better understand the Physics subject materials since the students are actively involved in constructing the concepts and discussing the issues that arise in the lab-work process or in students' daily activities in the community.

In respect to the above issue, Soedijarto (2000) argues that, "The learning process that takes place in schools generally has not reached the level in which the students enjoy the learning and have interest to explore the learning objects.". Looking at some of the above research findings and statements, it is obvious that there are weaknesses in learning Physics that covers the ability to find the concept which has not yet been optimum. Therefore, there is a need of effort in improving the students' ability of concept finding. One of the efforts comes from the teacher's duty itself in order that the student learning can be completed at a maximum effort, such as by manipulating the learning process with a variety of learning strategies and concerning each student self-monitoring.

Based on the above research findings and empirical evidence, then through this research the issue to be discussed is the Student Self Monitoring Effect on Scientific Thinking Skills and Physics Learning Outcomes of Class X Students.

Objectives/Purpose of the study

This study aims to determine whether or not the effect of students' self-monitoring on scientific thinking skills and learning outcomes on Physics subject for class X Senior High School and to investigate whether:

1. There is any difference in scientific thinking skills between students who have a high level of self-monitoring and students who have a low level of self monitoring on Physics subject in senior high school.
2. There is any difference among the students who have low self monitoring who follow the learning using scientific thinking method in learning Physics in senior high school.
3. There is any interactional influence between scientific thinking method with self-monitoring on Physics learning outcomes in senior high school.

Methodology

Time and Place

This research was conducted at SMA 22 Jakarta Timur. This research was carried out for 2 (two) months. The first month, is filled with testing the research instruments and processing the data in order to determine the level of validity and reliability of the research instrument. Meanwhile the second month is filled with data collection, and data analysis activities.

Self-monitoring in this study was measured using a questionnaire given to students before the Physics class was started. As for the steps to measure scientific thinking skills was conducted by teacher when teaching Physics at class X SMA 22 as the teaching method or approach. Starting from (1) Observation; (2) Comparison (3) Classification; (4) Prediction; (5) Experimentation; (6) Evaluation; and (7) Application. For cooperative learning approach, the steps are taken together in conjunction with the scientific thinking measurement. The implementation of this study followed the steps describe as follows.

Result/Findings

This study was conducted to determine the effect of self monitoring and providing treatment to the student learning outcomes. The study was conducted with 37 students. The students were initially grouped based on the scores of self-monitoring. The students' self-monitoring scores are sorted from the lowest to highest score. Then, 27% of students with the lowest were chosen and put together to represent the students who had low self-monitoring and 27% of students with the highest scores were also chosen and put together to represent the students who had high self-monitoring level.

Thus, the number of students employed in the subsequent analyzes were as many as 23 students. Descriptively, it was found that the low self-monitoring group, the students average learning outcomes before treatment was at 58.55. After scientific thinking activities and treatment, in the learning outcomes average increased to 72.91 and 84.18. Likewise, in the high self-monitoring group, the students' average learning outcomes before treatment was of 58.33.

After the scientific thinking activities and treatment, the learning outcomes average increased to 71.17 and 81.33. Based on the table, it was indicated that the learning outcomes of all groups increased after the scientific thinking activities and treatment.

To determine the differences in the improvement of the student learning outcomes between the low self-monitoring group and high self-monitoring before and after the scientific thinking activities and treatment, the analysis process using a Two Way ANOVA was then carried out. Before further analysis, a test was conducted prior to assumptions underlying ANOVA.

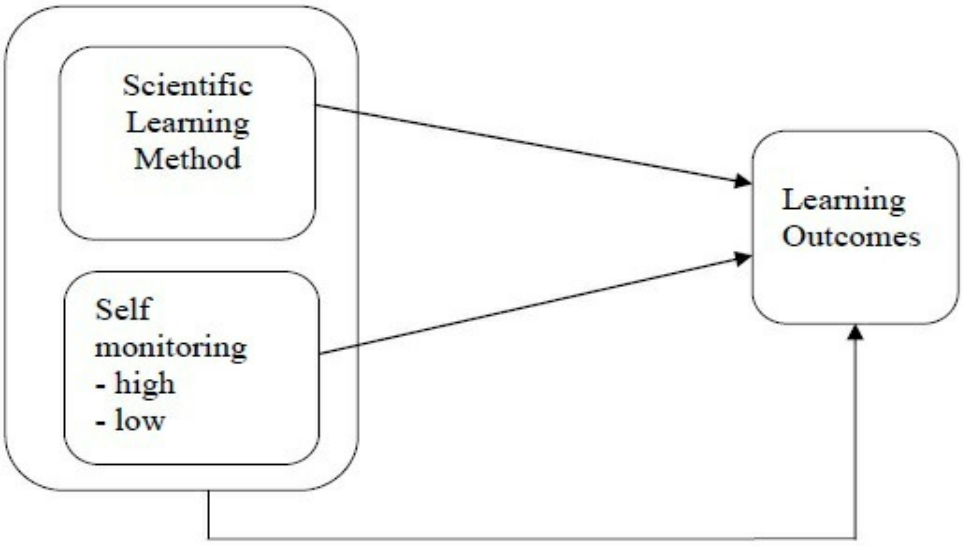
There are two underlying assumptions of ANOVA, the assumptions of normality and homogeneity of variance. Testing the assumption of normality then needs to be completed using the Kolmogorov-Smirnov test. The assumption of normality will be fulfilled if the p-value calculation result is greater than $\alpha = 0.05$. The testing of the assumption on homogeneity of variance was later performed using Levene test. The assumption of homogeneity of variance is said to be fulfilled if the p-value calculation result is greater than $\alpha = 0.05$. Thus, from the tests it could be concluded that the assumption of homogeneity of variance was fulfilled. Based on the ANOVA results above, regarding the source of diversity treatment, The p-value of 0.000 ($p < 0.05$) was obtained. This suggested that giving treatment to the student was shown to be able to increase the score of student learning outcomes. In other words, there was a significant difference in the average student learning outcomes before treatment and after the scientific thinking activities and treatment. That the average value of student learning outcomes before treatment is 58.43. After the scientific thinking activities and treatment, the average student learning outcomes increased to 72.0 and 82.70.

Based on the ANOVA results, regarding the source of diversity Self Monitoring, the obtained p-value was 0.009 ($p < 0.05$). This suggested that the kind of self-monitoring of students affect the value of the student learning outcomes. In other words, there was a significant difference in the average student learning outcomes between the low self-monitoring group and the high self-monitoring.

While the average student learning outcomes in the high self-monitoring group was 70.28. This showed that the average of the students learning outcomes in the low self-monitoring groups was higher than that of the high self-monitoring group. Based on the ANOVA results, regarding the source of the diversity of interactions, the obtained p-value was 0.197 ($p > 0.05$). This suggested that the interaction factor did not have any significant influence on the student learning outcomes value. In other words, there was no significant difference in the average of student learning outcomes from the interaction factor. Before the treatment, it was known that the average value of the student learning outcomes in the low self-monitoring group amounted to 58.55. While the average value of the student learning outcomes in the high self-monitoring group was 58.33. The difference between the value of student learning outcomes in the low self-monitoring groups did not differ significantly with that in the high self-monitoring group before the treatment.

After the scientific thinking activities, the average value of the student learning outcomes in the low self-monitoring group amounted to 72.91. While the average value of the student learning outcomes in the high self-monitoring group was at 71.17. The difference between the value of student learning outcomes in the low self-monitoring group did not differ significantly with that in the high self-monitoring group after the scientific thinking activities.

After the treatment, the average value of the student learning outcomes in the low self-monitoring group amounted to 84.18. While the average of the student learning outcomes in the high self-monitoring group was 81.33. The difference between the value of the student learning outcomes in the low self-monitoring groups did not differ significantly with that in the high self-monitoring group after treatment.



Based on the graph above, it could be explained that the average increase of the student learning outcomes after the application of the methods of the scientific thinking between the groups of low self-monitoring and high self-monitoring was relatively the same. In other words, the scientific thinking and treatment had relatively similar effects in both groups, there

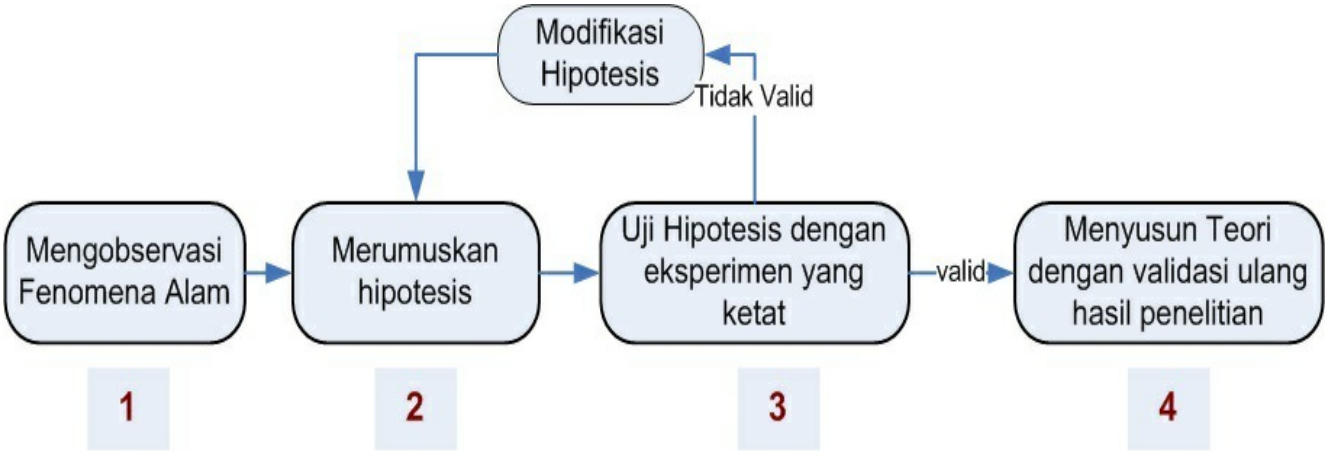
was no tendency that the scientific thinking and treatment was more appropriate if given to one of the self-monitoring group. Thus, scientific thinking and treatment in both groups self-monitoring could improve the student learning outcomes similarly.

Discussion

Scientific thinking is to think systematically, starting from the formulation of the problem, followed by formulating the hypotheses, collecting data and solving problems. Scientific thinking is an experimental method to help confirm or reject the hypothesis. Data was collected through experiments observed, the data was then processed, and then summed. Students were trained to think, although at first they had some trouble because many students were not accustomed to it and they made mistakes while discussing. But after being given a direction and guidance, the students began to formulate the problems. After understanding how to construct research problems, students can then make hypotheses and begin to gather the necessary data.

Scientific thinking is the process of applying scientific techniques to investigate phenomena, gain new knowledge that is integrated with prior knowledge or be used to correct prior knowledge. Students, during the learning process, have to make corrections on prior knowledge and also have been able to accept new knowledge provided by the teacher. Students have started to think systematically whenever they are confronted with everyday problems that are found in the community. They also can establish a causal relationship to the system involving one or several systems of a given subject matter from the physics teacher. Students have started to identify the physics issues in various difficulty level by sorting out the issues into several part of physics material.

Scientific thinking is a way of thinking - about scientific subjects, contents, or problems so that students would been able to improve the quality of their thinking skills and reflect the inherent structures in mind and adhere to intellectual standards. In accordance with that opinion, the application of scientific thinking by Antonio Zamora (2000) consists of four phases; (1) Conducting observations and describe natural phenomena. Observation can be done visually or with the help of technology; (2) Formulating a hypothesis to explain the phenomenon in a causal or in a mathematical relationship; (3) Testing the hypothesis by analyzing the results of observations and predictions on the existence of a new phenomenon. If the experiment cannot confirm the hypothesis, then the hypothesis must be rejected or modified. The following activity should then be back to formulating the hypothesis; (4) Establishing a theory through repeated verifications.



Mengobservasi fenomena alam = Observing natural phenomena

Merumuskan hipotesis = Constructing a hypothesis

Uji hipotesis dengan eksperimen yang ketat = Thoroughly testing the hypothesis with experiments

Modifikasi hipotesis = Modifying the hypothesis →valid / invalid

Menyusun teori dengan validasi ulang hasil penelitian = Constructing a theory with repeated validation on the research findings.

In implementing this concept, there are things that students need to consider so that they are consistent in applying the methods of scientific thinking. Among these are (1) developing a question or a problem, formulating the problem clearly and precisely; (2) collecting and assessing the scientific and relevant data or information, applying abstract ideas to interpret data effectively; (3) developing a solid foundation to obtain scientific conclusions and solutions and testing it by using relevant criteria and standards; (4) Thinking convergent by applying a system of scientific thought, recognizing and assessing scientific assumptions, implications, and practical consequences. Convergent thinking leads to a certain answer

and is focused on the final target. (On the other hand, divergent thinking is a way of thinking to explore and create, open and move away); (5) Communicating effectively with a variety of people to develop the best solutions to solve complex problems. The above rules are the foundations to develop the students' skills of scientific thinking through some examples of competence indicators proposed by Mosby's (2009), as follows. (1) Formulating the problem by asking questions about specific objects which have been clearly demarcated; (2) Developing a thinking framework to put forward the hypothesis or question that might explain the relationship between the related factors that may cause the problem; (3) Formulating conclusions and hypotheses as temporary answers to questions or issues that serve as a mind frame; (4) Testing the hypothesis by collecting facts relevant to the proposed hypothesis. Data used to either confirm or reject the hypothesis; (5) Interpreting the data obtained to become meaningful; (6) Drawing conclusions; assessing whether the proposed hypothesis is to be rejected or accepted; (7) Communicating the results of the study in the form of research reports; (8) Communicating the results of his study in a class presentation; (9) Maintaining the conclusions that have been drawn by using arguments based on the data; (10) Presenting the results of the study in scientific forums; (11) Posting the results of the study on the school web.

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