

The Effect of Mind Mapping-Aided Scientific Approach and Learning Style on Student's Reasoning

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Abstract. This study aimed at analyzing: (1) the effect of mind mapping-aided scientific approach on student's reasoning, (2) the effect of learning style on student's reasoning, and (3) the effect of the interaction between mind mapping-aided scientific approach and learning style on student's reasoning. This study used a quasi-experiment non-equivalent posttest only control group design. The data were collected by using reasoning test and the data on learning style by using a standard test. The data were analyzed the two-way ANOVA statistical analysis. Based on the analysis it was found out that 1) there was a significant effect of the mind mapping-aided scientific approach on the student's reasoning ($p < 0.05$). 2) there was a significant effect of field independent and field dependent learning styles on the student's reasoning ($p < 0.05$). 3) there was no significant effect of the interaction between mind mapping-aided scientific approach and learning style on the student's reasoning ($p > 0.05$).

Keywords: learning style, reasoning, scientific approach, mind mapping

1 Introduction

The problem in education always becomes a strategic issue for every country in the world. This of course can be understood since through education a nation can develop and become an advanced nation Indonesia, all this time, has the quality of education which is still far behind developed and developing countries in the world. [1] stated that the quality of education in Indonesia is lower than that in Malaysia and Thailand. The low quality has an implication on the low human resources. The low human resources lead to the low competitiveness of Indonesia in competition in the global era. [2] stated that humans that can "live" in the 21st century is the ones who are competitive, smart, and ready to face changes. In relation to the improvement in human resources, [3] stated that education can be made the means to produce quality human resources.

Various efforts have been made and are still being made by the government to improve the quality of education including in science education, i.e. (1) developing teaching models for science, 2) developing teaching media for science, (3) improving professionalism of teachers that is supported with improvement in their welfare, 4) providing infrastructures and facilities to support science teaching, and 5) providing trainings in various levels of education [4]. However, all of these have not yet shown good results. The survey entitled Trends in International Math and Science by Global Institute in 2007 reported that only 5% of Indonesian students were able to solve problems with a high category that need reasoning (critical thinking). As a comparison, with the same problems 71% of Korean students can solve the problem. On the contrary, 78% of Indonesian students can solve problems in a low

category that only need memorization. On the other hand, there is only 10% of Korean students can solve such kind of problems. Programmer for International Student Assessment (PISA) in 2009 places Indonesia at the bottom of the 65 participating nations. The criteria of evaluation included: cognitive ability and reading ability, mathematics, and science. Almost all Indonesian students could only learn lessons at the third level. While many students from developed and developing worlds have mastered the lessons at the fourth, fifth and sixth levels [5]. These facts show that the reasoning of the students need to be improved since reasoning plays an important role in improving the quality of human resources. Hence, the first and foremost thing that needs to be done is to shift the mindset in teaching from providing the students for level retention or recall to reasoning.

Related to science teaching, many people accept that the aspect of reasoning is important for the students. This is consistent with constructivism that states that reasoning is the most important thing in learning [6]. The ability to understand, according to [7] is at the basic thinking level. Basic thinking is the first level of reasoning before critical thinking and creative thinking. [8] interprets understanding as a mental process in which adaptation and transformation of knowledge occurs. Furthermore, it is stated that performance in the same or different contexts. This can be seen based on their ability to communicate ideas and the ability to solve problems that they are facing. Thus, the ability to solve problems calls for one's ability to understand the problems that he or she is facing. Understanding and ability to solve problems are part of the reasoning.

Some problems that have been identified as factors that cause the low college students' ability of reasoning. First, science is very theoretical and mechanistic. It means that the process of learning science starts with the explanation of concept followed by examples and solving problems. Secondly, the students have not been less facilitated to do scientific activities. Based on the interview with the students, they stated that they preferred learning science through direct experience to learning theories. Third, the students face difficulties in learning science concepts. This is supported by the result of interview with the students. The students admitted that one of the source that they thought to be difficult was science. This was caused by their ignorance of the use of learning science for them. The fourth, Science teaching does not take individual differences into account. All this time, the students' learning style has not been considered. While every student has his or her own learning style.

Based on the explanation above, as teacher who teach science, lecturers should be able to improve the students' reasoning. Thus, there is a need to make an effort to improve the students' cognitive ability. One of the ways, the lecturer who teaches the course can help the students to overcome their misconceptions, so that their conceptions become scientific concept.

The teaching that has been applied should also be modified to suit the individual characters of the students. One of them is by developing an innovative teaching, that can provide a conducive and joyful learning condition. In addition, the lecturer can help the students to solve the problem of misconception, so that the students' concepts become conceptions.

The teaching that has been done has also got to be modified to suit the students' individual characters. In relation to the teaching, every student has his or her own way of learning. Witkin [9] differentiates the types of learning style into two, namely, field dependent and field independent learning styles. Thus, the lecturer needs to know the learning style of the students, so that he or she can facilitate learning well. One of the teaching methods that is relevant is scientific approach aided with mind mapping. Scientific approach uses

scientific method to help the students to develop reasoning [10]. While mind mapping uses creative note taking using pictures to help the students to develop their creative thinking [11].

The effectiveness of scientific approach and mind mapping method has been proven. Each of them is effective in improving the quality of teaching. [12] stated that scientific approach can improve student's process skill. [13] in her study concluded that the implementation of mind mapping aided with direct objects can improve the descriptive writing skill of the fourth grade students of Sekolah Dasar No. 4, Kampung Baru. In this study in addition to studying the effect of scientific approach that was integrated with mind mapping method, and the effect of the interaction between approach and learning style on the increase in the students' reasoning.

2 Method

This study used a quasi experiment design with the non-equivalent posttest only control group design. The population consisted of the second semester students of Jurusan PGSD FIP of the academic year 2017 / 2018. The total number of the classes was 7. From the seven classes four were selected with two classes as the experiment group and two as control group. The classes were assumed to be equal because the grouping of the classes was done by using a parallel technique. It means that there were no superior class and nonsuperior class. The selection of sample in this study was done without individual randomization. This way was selected since it was difficult to change classes that had been formed. Based on the characteristics of the population, individual randomization could not be done. Thus, the sampling in this study was done using simple random sampling technique. The simple random sampling technique done to a class is a random class sampling technique, in which the sample is taken based on class (not individual), which is a member of population or part of population that has the same opportunity to be selected as sample.

The data that were collected in this study consisted of 2 types, data on reasoning and data on learning style. The data on reasoning were collected by a test and those on learning style by a standard learning style test. The data analysis used to test the hypothesis was two-way ANOVA. This study examined the effect of two independent variables on one dependent variable. The independent variables were teaching approach and learning style, while the dependent variable was student's reasoning. Before doing the two-way factorial ANOVA analysis, the normality, homogeneity of intergroup variance and matrix-covariance tests were used [14]. The research data set can be accessed in osf.io Open Science Framework.

3 Result And Discussion

The first aim of the study was to test whether there was an effect of the interaction between teaching approach and learning style on the attainment of students' reasoning. The result of this study showed that from the source of the effect of interaction between teaching approach and learning style on reasoning an F statistical value = 0.290 and $p > 0.05$. This means that there is no effect of the interaction between teaching approach and learning style on the students' reasoning. The result is consistent with [15] that found no interaction between the teaching models (quantum with mind mapping and conventional teaching models) and cognitive styles (field independent and field dependent) on science I basic concept.

The second aim was to test the effect of scientific approach with mind mapping (PSBPP) versus conventional approach (PK) in the attainment of the students' reasoning

(PM). The result showed that there was a difference in the students' reasoning between the group that learned through PSBPP and the one that learned through PK. The attainment of the reasoning of the PSBPP group of students was higher than that of the PK. In other words PSBPP is more effective than PK in attaining PM. Descriptively, this PM level has not achieved the adequate standard.

Empirically, in the attainment of PM, PSBPP is more effective than PK. This is in line with the theoretical review result. The philosophical basis of scientific approach is constructivism that states that students construct knowledge in their own minds. Constructivism also states that students have got prior knowledge that they got from daily experience and prior level of education. Teachers can bridge the gap between the students' prior knowledge and scientific knowledge that the students will learn. This can be illustrated by saying that the teacher helps the students to reach a higher level by giving them a ladder, however, it has to be attempted that the students by themselves climb up the ladder. The implementation of the scientific approach in the classroom starts from the posing questions and statements to the students and or giving a contextual phenomenon that is close to the environment where the students live. The initial question posed to the students is a contextual question, that is, an actual question about things in their environment and relevant to the material that they are expected to learn. The questions, illustrations that are presented to the students at the beginning of the lesson are stimuli for them to learn. When the students face problems related to their life, then they will become responsible to solve them, so that the students will aware to probe the information relevant to the solution to the problem being faced.

The students use books as sources of information to solve problems. The students will do an investigation together with their friends in group to acquire the concepts in science that are needed to solve problems. This learning activity is able to optimize the involvement of physical experience, logico-mathematical experience, social transmission, and self regulated learning. The students can have the opportunity to think reflectively and to process what they are learning through self-directed learning and are able to do a metacognitive process exercise. In teaching the lecturer plays the role of facilitator and creative mediator that give the responsibility to the students to acquire concepts that are needed by themselves through the interaction with the group members. At the end of the teaching, the students are asked to make a mind map according to what they have understood. This can stimulate the mind to think creatively and to use a high reasoning skill. The making of mind maps can also develop the students' imaginations in understanding concepts that they have learned.

The scientific approach aided with mind mapping gives opportunities and responsibilities to the students to develop knowledge by themselves and at the same time use their knowledge to solve contextual problems in their environment. This makes it meaningful since the students can remember, understand, and implement knowledge that they learn, making an analysis, synthesis, and evaluation of everything that they learned.

On the other hand, conventional approach starts with the presentation of material by the students. Theories, concepts, or principles in science that are expected to be acquired by the students are explained first in front of the class by the lecturer. After this, the students are faced with problems that are related to the concepts that have been explained. The problems that are presented to the students are the same as those used in Quantum Learning, that is, actual problems that are faced in the environment (contextual). The presentation of contextual problems makes science teaching more meaningful than if it is only read or listened to from the lecture. However, in the conventional teaching model that presents problems to the

students after information on the material is presented is less constructivistic. The students' responsibility for their own learning becomes small since the students learn only because the lecturer assigns them a task to learn the material. This will make the students less autonomous in learning to build their knowledge by themselves, so that it has an impact to their thinking ability that leads to a low learning achievement. Based on the description of the theoretical operational basis, it can be understood that PSBPP is better than PK in the attainment of reasoning.

The third objective of this study was to test the effect of learning styles (field independent (FI) and field dependent (FD) in attaining reasoning. The result of the study showed that there was a significant difference in the students' reasoning between the group that had FI learning style and the group with FD learning style. In other words, the students with FI was better than that with FD in attaining reasoning.

The finding in this study is consistent with the theory and studies that have been reported before. The use of mind mapping method makes the student autonomous and enables them to continue to the learning process in life and career. Thus, there will be an increase in the students' learning [16], [17], [15] showed a similar result to what the present researchers have shown. In her study it is concluded that the students with field independent cognitive style was better in their learning achievement than that of those with field dependent cognitive style.

[18] in his study concluded that scientific approach could improve learning achievement in biology of the MA students. [19] in his study showed that scientific approach could improve learning achievement in Indonesian. [13] in her study concluded that mind mapping method aided with direct objects was effective in improving the students' descriptive writing skill. [20] in their study showed that creativity and narrative writing skill could be improved by using personal experience-based mind mapping of the fourth grade students.

Based on the findings and explanation above, this study has implications as follows. (1) to achieve understanding optimally in science teaching, mind mapping - aided scientific approach can be implemented as alternative learning facility; (2) the process of making a mind map is very important. The students have to be trained to make a mind map. It can help them to organize their ideas and optimize the work of their brain; (3) related to learning facilities to train thinking ability, the implementation of mind map aided scientific approach has to consider three things: the activity of making a mind map, learning activity, and the evaluation implementation. The making of mind mapping should be given more time or the students can do it at home before the material is discussed on campus. The course starts by presenting contextual problems or events that are close to the students' life. The implementation of the evaluation for learning favors authentic assessment and is done sustainably; (4) the use of varied methods in teaching is very important since it accommodates students' different characteristics, for example, the difference in learning style.

4 Conclusion

Based on the results of this study and discussion, it can be concluded as follows. (1) there is an effect of the interaction between approach (scientific aided with mind mapping and conventional) and learning style (field independent and field dependent) on reasoning. (2) there is a difference in the students' reasoning between the students taught with scientific approach aided with mind mapping and the one taught with conventional approach. The students' reasoning of those who learned with scientific approach aided with mind mapping was better than that of those who learned with conventional approach. (3) there was a

difference in reasoning between the group with field independent learning style and that with dependent learning style. The students with field independent learning style were better than those with field dependent learning style.

Based on the findings and discussion, the following suggestions are made as follows. (1) the result of study showed that there was a significant effect of the interaction between approach and learning style on the students' reasoning. (2) the teachers and educators are expected to use a variety of methods to facilitate the different characteristics of the students. (3) other researchers are expected to do further research of the same type to test the consistency of the result of this study, both in the similar courses and other courses.

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