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The Effectiveness of Scientific Reasoning-Based Physics Module to Train the Students' Multirepresentation Ability at Physics Learning in High School

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Abstrak— *Module is a printed media written with the aim that students can learn independently or with the guidance of a teacher. The module based on scientific reasoning is a learning module that contains material, methods, boundaries, and ways to evaluate that are systematically designed with a scientific approach. This study aims to analyze the effectiveness of students' learning outcomes and multirepresentation abilities by using a module based on scientific reasoning. This research is a quasi-experimental research conducted at SMAN Pakusari. Based on the results of research that has been carried out, then the effectiveness of students' learning outcomes and multirepresentation using the scientific reason-based module has increased.*

Keywords— Module, Scientific Reason, multirepresentation, Learning Outcomes.

I. INTRODUCTION

The development and progress of a nation is closely related to education. In Javanese, education is defined as pengulawentah, which means processing, so cultivating the soul is maturing the feelings, thoughts, will and character of the child (Alfandi, 2011: 97). Education is applied in teaching and learning activities. The essence of the teaching and learning process is the process of communication, namely the delivery of information from sources of information through certain media to the recipient of information. The teaching and learning process requires learning models, teaching methods and learning media which are all interrelated and play an important role. Teaching materials are one example of media commonly used in educational institutions. Teaching materials in physics learning are materials that are systematically arranged which are used by teachers and students. (Ministry of National Education, 2009: 12). In addition, according to Mahardika (2012: 10) teaching material is a set of materials that are arranged systematically which aims to create a supportive atmosphere for students to learn.

The use of teaching materials in the learning process has an important role. According Belawati (2003: 1.4 1.9) the role includes the role for teachers, students, in classical learning, individual, or group. The role of teaching materials in the education process occupies a strategic position and also determines the achievement of educational goals, in living (Mahardika, 2011). Modules can also stimulate students to think more critically, because modules are widely used independently, and for critical thinking a student needs good thinking reasoning skills, beside that the module can also be used as an effective teaching guide for educators as well as material for training for participants learners in self-assessment (Prastowo, 2015: 109). According to Purwati et al. (2016: 482) the greater the ability of students' scientific reasoning, the greater the ability to understand students' physical concepts. Scientific reasoning and understanding of the concept are both at the stage of cognitive development, so they will be interconnected. Then, it is recommended for high school teachers to get used to the concept of scientific reasoning in addition to conceptualization ability, because scientific reasoning supports good results in understanding the concept of physics. Scientific reasoning is an important thing to be applied as a pedagogical framework in the process of learning Physics. So that there is a need for development to improve scientific reasoning in solving problems in various kinds of representation, according to Markawi (2013: 23) reasoning has a positive effect which results in an increase in learning outcomes in Physics. Reasoning also has a positive effect which results in an increase in problem solving abilities (Maryani, 2012). The module using the Scientific Reasoning approach to physics learning that can improve the ability of multi representation in students needs to be used because it will

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have an impact on students' learning outcomes. The purpose of this study was to determine the effectiveness of physics-based physics reason modules to train students' multirepresentation skills in physics learning in high school.

II. METHODOLOGY

This type of research is quasi-experimental research. It was held at SMU Pakusari in the 2017/2018 academic year consisting of 36 students. Based on the impact analysis, the module is based on scientific reason to train the multirepresentation skills used by students. Data collection techniques used in this study are observation, pre-test, posttest, and documentation. Data collection techniques used in measuring students' learning outcomes are in the form of written tests on 10 post test essay questions, while the data analysis technique was the N-Gain Test to determine the effectiveness of improving students' multirepresentation ability.

III. RESULT

Data of students' learning outcomes is used to find the value of effectiveness by using the N-Gain Test during teaching and learning activities using a scientific reason-based module obtained from the results of the pre-test and post-test. Students' learning outcomes using the N-Gain test with scientific reason-based module can be seen in table 1.

Table.1: Test scores of students' multirepresentation ability (pre-test and post-test) t in cycle 1, cycle 2, and cycle 3

Average Score					
Cycle 1		Cycle 2		Cycle 3	
Pre-test	*Post-test*	*Pre-test*	*Post-test*	*Pre-test*	*Post-test*
24,22	76.30	25.89	79.54	27.70	82.32

Table 2. N-gain for each cycle

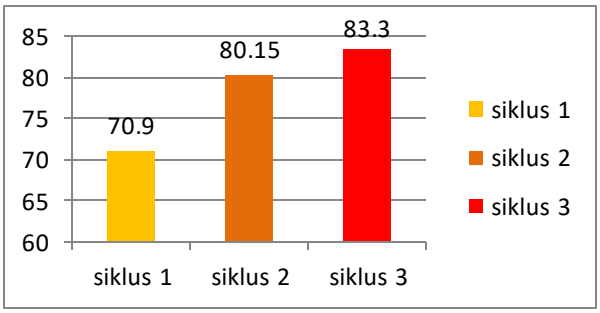
N-gain					
Cycle 1	ategory	Cycle 2	ategory	ycle 3	ategory
0,69	Medium	0,72	High	0,76	High

N-gain					
ycle 1	ategory	Cycle 2	ategory	Cycle 3	ategory
0,69	Medium	0,72	High	0,76	High

Multirepresentation ability is the ability to understand physics problems with various representations, such as being able to understand what is taught in a particular problem or situation. The ability of multirepresentation can be divided into 4 representations, namely verbal, graphical, mathematical and image representations. In this study analysis of 4 representations. Multi representation ability is measured through post-test activities which was carried out at the last meeting. The analysis of students' multirepresentation ability after using a module based on the N-gain value of students' learning outcomes.

IV. DISCUSSION

The effectiveness of physics modules based on secientific reasoning is assessed by an analysis of the improvement of students' multirepresentation abilities. Based on data from the results, the development of the students' multirepresent ability from the first cycle to the third cycle has increased.



4.1 Graph development test cycle

The data of students' rmultirepresentation ability in the first cycle shows that 70.9% have low multirepresentation ability in each representation. Reflection on the module is done to achieve better results in the next cycle. In the second cycle data, the students' multirepresentation ability increased by 80.15% and increased in the third cycle with a percentage of 83.3%. So that it can be concluded that the module used can be used or effective to train students' multi representation ability. Learning is said to be effective if the level of learning success is at least in the high category. These results also show the consistency of students' learning outcomes after learning with a physics-based secientific reasoning module.

Data analysis of students' multirepresentation ability is also used in determining the effectiveness of physics modules based on secientific reasoning. The level of students' multirepresentation ability in the first cycle can be known through the analysis of the value of the pre-test and post-test by using N-gain. The ability of multirepresentation is divided into four indicators, including verbal, graphic, drawing and mathematical. The average pre-test and post-test scores have increased in each cycle.

The first cycle of learning resulted in an analysis of the pre-test and post-test values using N-gain in the medium category so that to achieve the high category it needs improvement in the second cycle. In the second cycle After analyzing the N-gain the ability of students' multirepresentation has increased but there are still some

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things that are classified in the medium category. Furthermore, to achieve the expected category in the high category, some improvements were made in the third cycle.

After being analyzed, N-gain analysis thinking skills in cycle 3 obtained an average value of 0.76 so that it was in the high category. Based on the N-gain value which shows a high category in the analysis of multi representation ability, it can be concluded that the developed physics module can improve students' multirepresentation ability and be effective to use, so that it does not need to be tested again in the next cycle.

Empirical validation data in the form of multirepresentation test data at the deployment stage is also used in assessing the effectiveness of physics modules based on scientific reasoning. The distribution was carried out in three classes from three different schools. The first class is class X MIPA at MA Wahid Hasyim. Students' representation ability score data in this class shows 80% mathematical representation ability, verbal representation 81.83%, 78.8% graphical representation and 83.3% image representation with an average of 80.98% with the number of students who have classical completeness by 88%. This means that the level of students' multirepresentation ability is in the very high category. The level of multirepresentation ability tested was analyzed by N-gain showing the average multi representation ability of 0.70 and showing a high category.

The same analysis is carried out at the dissemination stage in other classes. The second and third distribution was carried out in class X Mipa at MA Al-Qodiri 2 Gumukmas and class X at Al-Qodiri Health Vocational School. Learning outcome score data in each class shows the average value of students' multirepresentation ability of 79.03% and 83.57% of classical completeness of 88%. This means that the level of multirepresentation ability of students is in the very high category. The level of multirepresentation ability based on N-gain analysis on the pre-test and post-test scores produces values of 0.73 and 0.72 indicating a high category.

The consistency of the trial results can also be assessed through the deployment stage. The results of the data analysis of the deployment stage carried out in different classes with the same majors showed the level of multirepresentation ability of students in the very high category. The level of students' multirepresentation ability also shows consistent results, namely in the high category. These results indicate that physics modules based on secientific reasoning are effectively used to train students' multirepresentation skills in physics learning in high school. This is in line with the opinion of Yuntawati and Aziz (2018), the developed module is said to be effective if it meets several aspects, among others, 1) the ability of the teacher in managing the learning, 2) the activities of students and teachers, and 3) completeness of learning.

The development of modules as teaching materials also participates in supporting the development of the learning process and the demands of the 2013 curriculum at this time, where a teacher acts as a facilitator, so that the teacher facilitates the needs of his students as much as possible. The material in physics is never separated from the scientific reasoning approach and multirepresentation ability. That is, the basic ability of scientific reasoning is needed in understanding the concepts of physics in various representations.

V. CONCLUSIONS AND SUGGESTIONS

Based on the research objectives and the results of the research that has been done, it can be concluded that the use of scientific reasoning based physics modules can improve students' multirepresentation ability with classical completeness about 82% with a high enough category. This has an effect on the results of the students' multirepresentation ability analysis after using the module with N-gane of 0.76.

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