



Journal Homepage: -www.journalijar.com
**INTERNATIONAL JOURNAL OF
 ADVANCED RESEARCH (IJAR)**

Article DOI:10.21474/IJAR01/6995
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/6995>



RESEARCH ARTICLE

EFFECTIVENESS OF STEM-BASED SCIENCE STUDENT WORKSHEET IN IMPROVING MULTIPLE REPRESENTATION ABILITY OF JUNIOR HIGH SCHOOL STUDENTS

Ratna Indrianingrum, I Ketut Mahardika, Dwi Wahyuni, Sutarto, Indrawati and Slamet Hariyadi.
 Department of Post Graduate Science Education, Jember University, East Java, Indonesia.

Manuscript Info

Manuscript History

Received: 19 February 2018
 Final Accepted: 21 March 2018
 Published: April 2018

Keywords:-

Effectiveness Of Science Student Worksheet, Stem-Based, Multiple Representation Abilities.

Abstract

This research aims to identify the effectiveness of STEM-based Science Student Worksheet in improving multiple representation abilities of junior high school students. This research is expected to be the basis to find out more about the success rate of students through the use of STEM-based Science Student Worksheet. This research was conducted at SMPN 1 Rowokangkung, Lumajang Regency, precisely on 10, 12, 14 and 16 March 2018 in class VIIC which amounted to 23 students, in Even Semester of Lesson Year 2017/2018. The design of this study is a pre-experimental one-pretest-posttest design. The result of the research shows that based on the average value of each cycle, there is improvement found in student multiple representation capabilities after using STEM-based Science Student Worksheet. It is characterized by the average of the post-test score that is better than the average of pre-test score. The increasing multiple representation abilities can also be seen from the N-gain value in each cycle which belongs to the high category with the value of N-gain of the 1st cycle is 0.702, the 2nd cycle is 0.747, the 3rd cycle is 0.700, and the 4th cycle is 0.707. Based on the research, it can be concluded that STEM-based Science Student Worksheet is effective to improve multiple representation abilities of junior high school students.

Copy Right, IJAR, 2018,. All rights reserved.

Introduction:-

Science learning in Junior High School (SMP) was developed as an integrative science subject, not as pure science education. Both integrative science and pure science education belong to application-oriented education, the development of thinking ability, learning ability, curiosity, and the development of caring and responsible attitudes toward the natural and social environment (Prasetyowati, 2014). In science learning, learners are required to engage both physically and mentally. In science learning, providing the learners with direct experiences is essentials in developing the competence of learners that learners can explore their knowledge and can understand their surrounding environment. The material presented contains many concepts that are closely related to everyday life, thus linking the concept with everyday life makes learning more meaningful so that learners can apply it in everyday life.

The result of observations and interviews with the Science Teachers concerning the materials used indicating that 9 out of 10 Science Teachers at SMPN Rowokangkung, Lumajang Regency, have not made their teaching materials and still use Electronic School Book (BSE). Also, in a science lesson, they still use learning aids in the form of

Corresponding Author:- Ratna Indrianingrum.

Address:- Department of Post Graduate Science Education, Jember University, East Java, Indonesia.

Student Worksheet (LKS) which is not made by the teacher in charge but comes from the publisher. The existing worksheet only contains the material and the exercise, generally, in the form of essays or descriptions which learners find it difficult to do. Therefore, it is necessary to improve the Student Worksheet, from which only contains the exercise converted into the one that embeds the concept in a more meaningful way so that learners can understand directly the problems that exist in everyday life.

Learning materials at school should be integrated with everyday life. To meet these demands, it is necessary to create teaching materials that able to present the subject matter that relevant to the everyday life. One of them is by creating a creative and innovative Student Worksheet. A creative and innovative Student worksheet is expected to attract the interest and motivation of learners to deepen the existing concepts in science learning as well as understand directly the problems that exist in the environment. The Student Worksheet will present the concepts of science, technology, engineering and mathematics that are integrated and directly related to everyday life. This objective can be achieved by preparing STEM-based Student Worksheet. By this STEM-based Student Worksheet, learners are expected to be adept at problems solving and critical thinking also innovative. Thus, learners can better understand the concepts they already obtained.

Science lessons, especially the topic of magnetism and its use in technology products, are difficult if taught only by utilizing lecture methods. Therefore, this material should be taught directly and applied in everyday life considering the number of household appliances and electronic devices that use the concept of magnetism. Thus, the use of STEM-based Student Worksheet can be an alternative in the learning process in the classroom.

Waldrup (in Mahardika, 2012: 47-49) says that multiple representations can be grouped specifically such as the knowledge about images, tables, models, graphs, and diagrams. In this case, the representation used to understand the concept of science learning, especially magnetism materials, is the representation of verbal, images, graphics and mathematics. This verbal representation is essential in learning, namely to know a law related to science learning that describes or defines the law by words very clearly. With the help of verbal representation then all the theories or laws that exist in the Student Worksheet will be more explicit. A concept will become clearer when it can be added with representation in the form of images because the images can help learners to visualize something that is still abstract. The advantage of using graphical representations in explaining the relationship of concepts is that graphs can present data more clearly, densely, briefly, and simply, than the delivery of information in writing. The representation of mathematics is the representation, translation, disclosure, reapplying, symbolism or even modeling ideas, thought, and mathematical concepts to apply physics formulas in solving physics problems. Because to solve the problems of physics, a good mastery of mathematics is required. The difficulty of mastering the mathematics concepts is a common complaint among learners.

Multiple representations can help the learner in learning and develop a concept, help them in solving problems, and help them in addressing the problems especially related to the application of science lesson materials related to science and society. This statement is reinforced by the statement of Izsak and Sherin (in Mahardika, 2011) which state that a multiple representation teaching provides a rich context for learners to understand a concept. Therefore, research needs to be done to identify the effectiveness of STEM-based Science Student Worksheet in improving multiple representation abilities of junior high school students.

Methodology:-

This research was conducted at SMPN 1 Rowokangkung on 10th, 12th, 14th and 16th of March 2018 in Even Semester of Lesson Year of 2017/2018. The subjects of the study were students of class VIII C, which amounted to 23 students. The research design used in this research is pre-experimental design one group pretest-posttest. The design of this study only used one group of respondents, where the data retrieval was performed in the form of test scores before the treatment (pre-test) and after the treatment (post-test). The design of this study according to Gall, Call & Borg in Setyosari (2010) includes three steps, namely the implementation of pre-test to measure the dependent variable; implementation of treatment; and the implementation of post-test to measure impacts on the dependent variables. To determine the level of effectiveness of learning, the author, first, looks for N-gain (Normalized Gain). The tests that researchers use are pre-test and post-test. An improvement of results of multiple representation tests was analyzed using the N-gain formula (Hake, 1999).

Result:-

Data from the pre-test and post-test results in cycle 1, cycle 2, cycle 3, and cycle 4 were used as supporting data on the effectiveness of magnetism topic of STEM-based Science Student Worksheet. The value of pre-test and post-test in each cycle can be seen in Table 1.

Table 1:-The Average Value of Pre-test and Post-test

No	Cycle	Average Value	
		<i>Pre-test</i>	<i>Post-test</i>
1.	Cycle 1	20.78	76.39
2.	Cycle 2	17.17	79.09
3.	Cycle 3	17.39	75.22
4.	Cycle 4	22.61	77.35

Then, the average values of pre-test and post-test of the students are used to identify the improvement of learning outcomes through N-gain shown in Table 2.

Table 2:-The Result of N-gain at Each Cycle

No	Cycle	<i>N-gain</i>	Category
1.	Cycle1	0.702	High
2.	Cycle 2	0.747	High
3.	Cycle 3	0.700	High
4.	Cycle 4	0.707	High

Discussion:-

Based on table 1 above, it can be seen that the average value in each cycle shows an improvement in the multiple representation skills between before and after using the STEM-based Science Student Worksheet. The increase of average multiple representation abilities is marked by the average post-test score which is better than the average pre-test score. This improvement is because learners can more easily understand the Science concept through STEM-based Science Student Worksheet in which presents the concept of science, technology, engineering and mathematics that are integrated and directly related to everyday life.

The improvement of multiple representation skills of students was also analyzed using N-gain as shown in Table 2. The figure shows that the N-gain value in each cycle falls within the high category with an N-gain value of cycle 1 as much as 0.702, cycle 2 is 0.747, cycle 3 is 0.700, and cycle 4 is 0.707. The highest N-gain value found in cycle 2 as much as 0.747. The data show that STEM-based Science Student Worksheet is effective in improving multiple representation abilities of the students. These findings are supported by research conducted by M. Syarifah, Adlim, and Mursal (2015) that by using STEM-based Science Student Worksheet, students' motivation and learning outcomes are improving. Similarly, research conducted by Fitriani, Karniawati, and Suwarma (2017) stating that STEM-based learning contributed greatly in influencing the improvement of causal reasoning ability of junior high school students on the concept of hydrostatic pressure. Based on the definition of STEM from California Department of Education (2015) it can be concluded that STEM Education can make students active, collaborative, and skilled also make learning activities more meaningful, thus expanding their horizons. The objectives of STEM-based learning are to make students acquire hard skills and soft skills in balance because the learning process is done by active learning methods that include communication, collaboration, problem-solving, and creativity. The development of STEM-based Student Worksheet for science learning in junior high school is expected to be one of the research development of teaching materials that is suitable for the character of students and the character of the junior high school students, so they can achieve the desired learning objectives.

In the previous studies related to learning using representations, obtained from scientific journals, articles, and research reports, showed that learning models that use representation have a good impact on student learning outcomes. The study was conducted by Maimunah S, Mahardika I, and Subiki (2017) which found that the use of RGM-based momentum and impulses Student Worksheet also the PBL model, in learning activities in secondary school, can improve student learning activities and student retention. Meanwhile, Suhadi and Wibowo's (2012) study showed that the use of multiple representations could sharpen and strengthen conceptual understanding and

reduce student's difficulties because the meaning of a concept will be clearer when presented with various representations so that students will be easy to predict a problem.

Learners will learn more effectively when they process information obtained at school in a variety of ways. By using teaching materials, learners are expected to learn more effectively and efficiently. Representation will create an active learning atmosphere and exercise all potential of the learners, enable the learning ability of learners, either mind-on or hands-on, that makes learning activities of Science more meaningful. Multiple representations provide important advantages for the realization of meaningful learning activities (White in Kurnaz & Arslan, 2014) since multiple representations will contribute to cognitive configuration and enable information mapping (Schnotz; Schnotz & Bannert in Kurnaz & Arslan, 2014)

Conclusion:-

STEM-based Science Student Worksheet is effective based on the average N-gain value of multiple representation ability tests in each cycle. With N-gain in cycle 1 as much as 0.702, cycle 2 is 0.747, cycle 3 is 0.700, and cycle 4 is 0.707 with the high category.

References:-

1. California Department of Education. 2015. Science, Technology, Engineering, and Mathematics. Online. <http://www.cde.ca.gov/pd/ca/sc/stemintrod.asp>.
2. Fitriani, Karniawati, Suwarma. 2017. The Effect of STEM-based For Learning Hydrostatic Pressure Concept on Causal Reasoning of Junior High School Student. Proceedings of the National Seminar on Physics (*E-Journal*) SNF 2017. Volume VI, October 2017. <https://doi.org/10.21009/03.SNF2017>.
3. Hake, R. R. 1999. Analyzing Change/Gain Score. (Online). <http://www.physics.indiana.edu/~sdi/AnalizingCahnge-Gain.pdf>.
4. Kurnaz & Arslan. 2014. The effectiveness of Multiple Representations for Learning Energy Concepts: Case of Turkey. *Procedia-Social and Behavioral Sciences* 116 (2014) 627–632. www.sciencedirect.com.
5. Mahardika, I.K. 2011. Mathematics Learning Materials Development to Improve Verbal, Mathematics, Visual, and Graphical Ability of The Student of Physic Teacher Candidate. *Repository. UPI. Edu*. Bandung: University of Education Indonesia.
6. Mahardika, I.K. 2012. Mechanic Representation on Study: A Theory and Research Result of Mechanic Teaching Material Development. Jember: University Press.
7. Maimunah S, Mahardika I, Subiki. 2017. Momentum and Impulse Learning Helped by Worksheet Based RGM to SMA by Using PBL Model. *ISSN: 2320-5407 Int. J. Adv. Res. 5(9), 348-352. Journal Homepage: - www.journalijar.com*
8. M, Syarifah, Adlim, Mursal. 2015. The Development of Student Worksheet Based On STEM (Science, Technology, Engineering, And Mathematics) for Improving Motivation and Learning Activities of State Senior High School of Beutong 1 on Electromagnetic Induction Materials. *Indonesia Science Education Journal*, Vol. 03, No.01. page 239 – 250, 2015 <http://jurnal.unsyiah.ac.id/jpsi>.
9. Prasetyowati, R. 2014. Science Learning of Junior High School Based On 2013 Curriculum. PPM Paper. Faculty of Science. UNY.
10. Setyosari, P. 2010. Research Method of Education and Development. Kencana Prenada Media Group: Jakarta.
11. Suhadi & Wibowo, F.C. 2012. The Multiple Representations Approach for Learning Energy Force and Its Impact on Students' Understanding of the Concept. *Indonesia Education Journal* 8 (1): 1-7.