

THE EFFECTIVENESS OF HANDS ON AND MINDS ON STUDENT WORKSHEET ON CELL MATERIAL TO TRAIN THE SCIENTIFIC PROCESS SKILLS OF XI GRADE

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Abstract

Scientific process skills need to be mastered by students to strengthen the knowledge and understanding the scientific theories and concepts. Hands on and minds on is an appropriate approach to trained the scientific process skills. This research aimed to describe the effectiveness of Hands On and Minds On student worksheet on Cell material to train the scientific process skills of XI grade. This research was a developmental research which used the 4D development model (Define, Design, Develop and Disseminate). But, in this study carried out only until the stage of development (develop) and not doing disseminate (disseminate). The trial of this research was implemented to 20 students of SMA Negeri 1 Prambon in April-May 2018. The effectiveness of this worksheet which reviewed from test result and students' responses showed very good with the students' average score percentage mastery in scientific process skills is 100% and 90.45% of students responded positively. Based on the data, it can be concluded that Hands On and Minds On student worksheet on Cell material to train the scientific process skills of XI grade is effective so it can be used in the teaching and learning process.

Keywords: Effectiveness, Hands On, Minds On, Scientific Process Skills, Cell Material.

INTRODUCTION

Cell material in XI grade referred to Basic Competency 3.1. Describes the chemical components of the cell, structure, function, and process that take place in the cell as the smallest unit of life. Cell material is one of the materials which is considered difficult for students and abstract due to its microscopic size. Purwati (2013) in her research found that only about 56% of students who scored above the Minimal Mastery Criteria. It shows that almost half of all students do not achieve the competence and do not understand the cell material yet. Based on Melati's research (2016), from 31 students who took the test, 21 students had difficulties and 10 students were able to complete the test well. The highest difficulty faced by students was in understanding the concept of chemical components of cells, the function of animal cells and plant cells with percentage of 95.23%.

The results above are parallel with the research conducted by researcher who interviewed the XI grade biology teacher of SMA Negeri 1 Prambon and gave questionnaires to XI grade students. Students' questionnaire data showed that 59,46% of 37 students had difficulties in understanding the cell material. Cell

material requires them to memorize the concepts that were too abstract. This data are parallel with the interview result conducted to biology teachers which stated that teaching and learning process was more often done using the explaining method which is not based on the scientific process skill, so the students feel bored and less interested in teaching and learning process. In fact, 94.59% of students wanted to learning using experiments to understand the concepts in biology lessons. Based on these results of questionnaires and interviews, it takes an effort to train their scientific process skills so they are more understand the cell material.

Government Regulation No. 32 Year 2013 showed that the Graduates Competency Standards of 2013 Curriculum requires students to able learn independently and expected to be able in developing the 3 domains of graduate qualification includes knowledge, attitude and skill. These three domains can be achieved by using learning method that develops skills related to the scientific process (Puspita, 2016).

Scientific process skills are very important for students as a provision to use scientific methods in developing science that have been owned by students or to gain a new knowledge (Dahar, 1985). There are two

types of scientific process skills, known as basic scientific process skills and integrated scientific process skills. The integrated scientific process skills in this matter is the ability of students to acquire concepts through the activities of formulating problems, hypothesizing, identifying variables, formulating variable operational definitions, designing experiments, conducting experiments, and processing & analyzing data (Ibrahim, 2010).

Teachers required a media that can facilitate students during the teaching and learning process especially when studying the integrated scientific process skills. Student worksheet is a media that able to bridge the increasing of scientific process skills to students. Student worksheet is a printed material in the form of sheet of papers containing materials, summaries, and instructions that must be done by the learners, which refers to the basic competencies that must be achieved. The worksheet aimed to make the students able to complete tasks based on supporting information and reports to work on. In addition, students are required to study independently so the worksheet is expected to guide students to think logically, critically and systematically (Prastowo, 2015).

To make students more active in the teaching and learning process, it requires an approach which is able to help students acquire the concept by thinking and doing. Hands on and minds on is an approach designed to engage students in digging information and inquiries, activities and finding, collecting data and analyzing and making their own conclusions. Learners are given the freedom in concept building during the activity with no load, fun and with high motivation (Hatta, 2003). Haury and Rillero (1992) stated that during the experimental process, students also perform psychic activity (minds on activity). By using the hands on activity students will gain the knowledge directly (minds on) through their own experience (Hatta, 2003). Other researchs have also shown that hands on and mind on activity correlates positively in learning outcomes obtained by students, not just conceptualizing but by doing the hands on activities, the students' scientific process skills become better (Tan & Wong, 2011).

Based on the description, this research aimed to describe the effectiveness of hands on and minds on student worksheet on cell material to train the scientific process skills of XI grade. The advantages of this developed student worksheet are on the content. This worksheet containing activities that can train integrated scientific process skills to the students, including activities to formulating problems, hypothesizing, identifying variables, designing experiments, conducting experiments,

and processing & analyzing data, making conclusions and communicating.

METHODS

This research used the developmental research model of 4D (define, design, develop and disseminate). But, this study carried out only until the develop stage and not do the disseminate stage. The development of Hands On and Minds On student worksheet on Cell material to train the scientific process skills of XI grade was conducted in Biology Department, The Faculty of Mathematics and Natural Science UNESA in October-December 2017. Meanwhile, the limited trial was conducted by 20 students XI grade of SMA Negeri 1 Prabon on April-May in the academic year 2018-2019.

This research designed with the "One Shot Case Study Design". In this design, the study target was assessed after the treatment. The instruments used in this research were a test sheet of students' scientific process skills and students' response questionnaire. Test method and questionnaire method was used in this research. The data result of the scientific process skill test then analyzed to find out the students' scores and to know the achievement of the indicators obtained.

Test result analyzed by calculating the values of student's learning outcomes and the appropriate indicators. Students are passed the test if got the value of ≥ 75 . Indicators achievement analyzed by summing the scores obtained on each item then calculate the average. The percentage of each question of the test was also calculated to know the indicators achievement. The indicators achievement on each number stated well if got the value of $\geq 61\%$. Students' responses analyzed using Guttman scale which have been developed by category "yes" or "no". Student Worksheet stated effective if got the value of $\geq 61\%$.

RESULTS AND DISCUSSION

The effectiveness of student worksheet can be seen from the developed worksheet whether it is effective or not in terms of test results of scientific process skills and students' responses conducted in a limited trial to 20 students of XI grade in SMA Negeri 1 Prabon.

a. Result of Scientific Process Skills Test

The learning outcomes were taken from the students' skill tests which conducted to find out the students' understanding of the concept given after the Hands On and Minds On student worksheet on Cell material.

Table 1. Students' Scientific Skills Test Results

Student's Name	Score	Category
Student 1	83,3	Complete
Student 2	91,6	Complete
Student 3	87,5	Complete
Student 4	83,3	Complete
Student 5	91,6	Complete
Student 6	91,6	Complete
Student 7	91,6	Complete
Student 8	87,5	Complete
Student 9	87,5	Complete
Student 10	95,8	Complete
Student 11	95,8	Complete
Student 12	95,8	Complete
Student 13	87,5	Complete
Student 14	91,6	Complete
Student 15	87,5	Complete
Student 16	87,5	Complete
Student 17	91,6	Complete
Student 18	91,6	Complete
Student 19	87,5	Complete
Student 20	79	Complete
Completeness (%)		100%
Category		Very good

Table 1 shows that all students got the value of ≥ 75 and got a total percentage of 100% on mastering the subject. The maximum percentage obtained on student learning outcomes showed that learning using the hands on and minds on student worksheet has a positive impact on student learning outcomes, especially in trained integrated scientific process skills that includes making the formulation of the problem, making hypotheses, determine variables, write data and communicate the results of the experiment (Qomariyah, 2015).

It is suitable with the statement that hands on activity is a learning model designed to involve students in digging information by asking, moving and finding, collecting data & analyzing and making conclusions. Learning by doing (hands on activity) and thinking (minds on activity) (Ahmad, 2010). It is also suitable with Aini (2013) who stated that to achieve an integrated scientific process skills required a suitable approach and it must

suitable with the goals that will be achieved. Hands on and minds on activity is an appropriate approach to improve the learning outcomes.

In addition to the completeness of science skills test results, student's answer tests were also analyzed to determine the achievement of indicators. The results of the completeness of indicators achievement presented in Table 2.

Table 2. The Percentage of Indicators Achievement

Basic Competencies	Indicators	Question Number	Percentage of Achievement (%)
4.2	Make a problem formulation about osmotic process in the potato	1	97,5
	Make a hypothesis about the experiment that will be done	2	100
	Determine the variables associated with the experiment that will be done	3	95
	Make an experimental design of osmotic process on potato	4	82,5
	Analyze data of experimental results that have been obtained	5	90
	Make conclusion based on experiments that have been done	6	72,5
Average Percentages (%)			89,6

Based on Table 2 it can be seen that the results of students' science skill test scores obtained an average percentage of 89.6% with very good category. The percentage score was calculated in each indicator. The largest percentage is in the indicator of Make a hypothesis about the experiment that was equal to 100% with very good category. Meanwhile, the lowest percentage is in the indicator of Make a conclusion based on the experiments that was equal to 72.5% with good category.

This was related to the teaching and learning process by using hands on and minds on student worksheet where the researcher was pay less attention to the time allocation when students worked on the worksheet. There were some groups which not completed the worksheet until the conclusion caused by they running out of time. The role of researcher was also very influential in guiding students

when concluding the data results after doing the experiment. In concluding stage the students need to be guided by the teacher because making a conclusion is one element of the scientific process skills that require students to think high level (Juhji, 2016). Therefore, to train and improve the scientific process skills of students in making conclusion stage requires an intensive teacher's guidance and students need to be familiarized to perform the skills of the scientific process as this is still a new thing for students of SMA Negeri 1 Prambon.

Indicators that have the highest score percentage were the indicator of Make a hypothesis about the experiment which got a percentage score of 100% and on the indicator of Make the formulation of the problem about the osmosis process on potato got a percentage score of 97.5% with very good category. It showed that students have understood with the information which was presented in the form of problems about the membrane transport experiment which used soaked potato slices in sugar solution with different concentrations and then observed the length changes of the potato slices. The information in reading part which demand the students to formulating problem has been conical so that students were able to make the formulation of problems and hypotheses which was according to the researcher's expectation. The differences in the indicators achievement among students are also caused by the initial knowledge of each student (Syah, 2006). Similarly, according to Dimiyati and Mudjiono (2009) who argued that the initial knowledge of students have differences between one student with another, but the teacher wants each student can complete the tasks, able to achieve the expected indicators and learning objectives.

In the indicator of Determine the variables associated with the experiment got the score percentage of 95% with very good category. It shows that students have understood the meaning of the three variables, specifically controlled, independent and dependent variable. Based on the results of questionnaires given to students, it showed that students' scientific process skills were new for them. After the teaching and learning process used hands on and minds on student worksheet, the students have a new scientific process skills, specifically formulating problems, making hypotheses, identifying variables, designing experiments, analyzing data and making conclusions. This indicated that hands on and minds on student worksheet can be used to train the scientific process skills in the students.

Through the scientific process skills, students can sharpen their thinking patterns so they can improve the quality of their learning outcomes (Sagala, 2010). This is also reinforced by the opinion of Legiman (2012) which

stated that experiment can improve the intellectual skills of students with a complete and selective information to solve problems, apply knowledge and skills, train in designing experiments, analyze data and foster scientific attitudes.

b. Result of Students' Response

Students' responses were obtained through questionnaire filled by students after the teaching and learning process using Hands on and minds on student worksheet. The questionnaire included presentation criteria, material, language, and suitability of component of integrated scientific skill process which is considered feasible if got percentage of $\geq 61\%$ with good category. The students' responses questionnaire was used by the researcher to find out the students' responses after using the developed student worksheet. The result of students' responses are presented in Table 3 below.

Table 3. The Result of Students' Response

No	Questions	Scoring Scale		Percentage (%)		Cat.
		YES	NO	YES	NO	
1.	Is the worksheet provided interesting?	20	0	100	0	Very effective
2.	Is the presentation of this worksheet arranged systematically?	18	2	90	10	Very effective
3.	Is the structure of sentences in the worksheet clear?	20	0	100	0	Very effective
4.	Is the language used in this worksheet easy to understand?	20	0	100	0	Very effective
5.	Is the material summary in this worksheet complete?	12	8	60	40	Very effective
6.	Does the material in this worksheet help you in doing the questions?	15	5	75	25	Effective
7.	Is this worksheet in the cell material new to you?	16	4	80	20	Effective
8.	Is the worksheet facilitate you in understanding the subject matter of Biology?	18	2	90	10	Very effective

No	Questions	Scoring Scale		Percentage (%)		Cat.	No	Questions	Scoring Scale		Percentage (%)		Cat.				
		YES	NO	YES	NO				YES	NO							
9.	Are the tools and materials listed in the worksheet easily find around you?	20	0	100	0	Very effective	19.	Do you think this worksheet can train your skills in designing procedures and conducting experiments?	20	0	100	0	Very effective				
10.	Are the steps in the worksheet easy to understand and to do?	17	3	85	15	Very effective	20.	Do you think this worksheet can train your skills in writing and analyzing data?	17	3	85	15	Very effective				
11.	Are the questions in the worksheet easy to understand?	16	4	80	20	Effective	21.	Do you think this worksheet can train your skills in making conclusions?	20	0	100	0	Very effective				
12.	Is the language used in the worksheet easy to understand?	18	2	90	10	Very effective	22.	Do you think this worksheet can train your skills in communicating your experimental results?	17	3	85	15	Very effective				
13.	Are you motivated to follow Biology lessons through this worksheet?	18	2	90	10	Very effective	<table border="1"> <tr> <td colspan="2">Average</td> <td>90,45</td> <td>9,55</td> <td>Very effective</td> </tr> </table>						Average		90,45	9,55	Very effective
Average		90,45	9,55	Very effective													
14.	Do you think this worksheet can train your skills in doing observations?	20	0	100	0	Very effective											
15.	Do you think this worksheet can train your skills in classifying?	18	2	90	10	Very effective	<p>Based on Table 3 it can be seen that the effectiveness of worksheet based on students' responses got an average score percentage of 90.45% with very effective category. It proved that teaching and learning process by using Hands on and minds on student worksheet got positive response from students.</p> <p>Hands on and minds on student worksheet was the suitable media for students to do experiment on cell material. In the Hands on and minds on student worksheet helped them in training their scientific process skills that include (1) formulating problems, (2) identifying variables, (3) formulating hypotheses, (4) designing experiments, (5) defining operational definitions of variables, (6) conducting experiments, and (7) formulating conclusions (Ibrahim, 2010). Thus, on Hands on and minds on student worksheet is very effective to trained the scientific process skills in students.</p> <p>In presentation component, sentence structure and language used in the worksheet got very effective category. It indicates that students can easily understand the contents of the worksheet. In accordance with the Ministry of National Education (2004) that stated the use of the language used in the worksheet should be easy to understand and compatible with the enhanced spelling</p>										
16.	Do you think this worksheet can train your skills in formulating the problem?	19	1	95	5	Very effective											
17.	Do you think this worksheet can train your skills in formulating hypotheses?	20	0	100	0	Very effective											
18.	Do you think this worksheet can train your skills in identifying variables?	19	1	95	5	Very effective											

and use the terms that easily understood by students so it does not creating double meaning. In addition, language is also one of the conditions of construction that must be considered in developing the good worksheet (Darmodjo and Kaligis, 1992). Therefore, in composing the worksheet should use a language appropriate to the students' thinking level, easy to understand and use the standard language in accordance with the enhanced spelling.

Meanwhile, the question component that received less positive response was in the point of Completeness of the material which got the score percentage of 60% with the effective enough category. It related to worksheet validation result done by expert lecturer on material completeness component in this developed worksheet. In worksheet 1 the material did not reflect the activities that will be done. So, the material should be replaced with the appropriate material. The mismatch of the material with the activities will make the students difficult to understand the teaching and learning process and in carrying out the next activity because the student worksheet should be used as the basis for doing the activity while obtaining some sort of material summary (Surachman, 1998).

Student learning outcomes related to students' responses. According to the students, the worksheet given can help them in understanding the material and mastering the integrated scientific process skills. This is in line with the skills that must be mastered by students, specifically integrated scientific process skills that included formulating problems, making hypotheses, designing experiments, identifying variables, conducting experiments and making conclusions. Hands on and minds on student worksheet is an appropriate approach to improve the learning outcomes (Aini, 2013).

The students with the lowest score mentioned that the material contained in the developed worksheet less than complete. Whereas the worksheet is served to facilitate students to do activities and obtain a kind of summary of the material that became the basis of the activity (Surachman, 1998).

CLOSING

Conclusion

Based on the results of the research, it can be concluded that Hands on and minds on student worksheet on cell material to train the scientific process skills is very effective to be used and applied in the teaching and learning process. The results of scientific process skills test obtained 100% student completeness percentage with very good category and the average percentage of students' responses obtained 90.45% with very effective category.

Suggestion

Suggestions that can be given for further researches are as follows: (1) Need to do similar research on other Biology subject matters to trained the scientific process skills to the student. (2) Development stages of student worksheet needs to be continued until disseminate so that the developed worksheet can be used more widely. (3) Teachers/researchers more intensively in guiding students' activities and give more attention in the time allocation during the teaching and learning process.

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