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THE DEVELOPMENTAL OF WORKSHEET BASED ON SCIENTIFIC APPROACH ON THE TOPIC RECYCLING CARBON OF BIOGECHEMICAL CYCLE FOR TRAINING SCIENCE PROCESS SKILLS TO STUDENTS OF GRADE X

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Abstract

Worksheets based on scientific approach are one of the learning tools used to train science process skills for students of biogeochemical cycle material on the carbon cycle. This research aims to produce a valid, effective, and practical worksheet. This research method used a research development with 4D development model which aredefine, design, develop, and disseminate, but the stage disseminate are not done. Limited trials are done to 20 students at SMAN 1 Kedungpring, Lamongan in January-February 2019, the measured parameter is the degree of validity in terms of feasibility aspects which are content, presentation, language, the conformity withthe scientific approach and the suitability of the worksheet for practicing the process skills. For the level of practicality is reviewed by the implementation of students activities and responses while the level of effectiveness is reviewed in terms of the result of the analysis of indicators and the post-test score. The data collected by the validation method to determine the validity, methods of observation for student activities and student questionnaire to determine the level of practicality, the test method to determine the effectiveness of data analysis using a quantitative descriptive method. The data gives the result that the validity of worksheet obtaining a score of validity of 4 that are included in the category of very valid, effectiveness level of 85% which is entered in the category of very effective, and the level of practicality is very good and very practical to obtain a percentage of 92% of student activity on worksheet 1, 96.87% of student activity on worksheet 2 and 96% in terms response of students. It was concluded, worksheet based scientificapproach can practice the process skills because feasibility aspects whice are valid, practical and effectively in learning.

Keywords: Student Worksheet development, Scientific Approach, Recycling Carbon.

INTRODUCTION

Curriculum 2013 has competency standards for high school students who demand to learn in school using a scientific approach (Permendikbud, 2016). The learning process touches three domains, namely the attitude, knowledge and skills. The scientific approach (scientific approach) is an approach that can improve learning outcomes and process skills, to help students supply the learning process skills in biology, the learning approach is needed to help understand the material in biology lessons. The approach can be used is a scientific approach (Murjan, (2014).

Worksheet is one of the learning resources that can be developed by the teacher as a facilitator in learning activities, and can be designed and developed in accordance with the conditions and situations of learning activities that will be implemented (Widjajanti, 2008). Worksheet can be a guide for the student to do a particular work either individually or in groups to improve and increase the learning outcomes (Asra and Sumiati, 2007). Recycling carbon material is part of the biogeochemical cycle material which plays an important role in the aspects of living creatures on earth. Implementation of learning about the carbon cycle is still rarely applied to learn in class, where students are only given an understanding of the material aspects without being presented with the process of finding activities and proving the existence of carbon compounds itself, resulting in low student process skills (Depdiknas, 2012).Worksheet is one of the teaching media oriented to process skills so that it is expected to train students process skills as well as the concept (Abidin, 2014).

These study researchers use integrated process skills that are composed of more complex skills namely, observing, formulating problems, formulating hypotheses, identifying variables, designing experiments,

conducting experiments and concluding experiments (Ibrahim, 2010).

According to Permendikbud No. 69 2013 material biogeochemical cycle is a material that is included in the subjects of biology X class second semester loaded in the Basic Competence namely 3.10: Analyzing the components of ecosystems and interactions between these components, as well as the Basic Competence 4:10: Presenting work that shows the interaction between components of the ecosystem (food webs, biogeochemical cycles). Based on the Basic Competence demands of the biogechemical cycle material on carbon cycle, students must be able to devotethe ideas based on the analysis components of ecosystem and interactions between ecosystemthat obtained from practical activities. The existence of these demands can be taught by learning strategy using a scientific approach in learning activities at school to train students science process skills.

Based on this background, the development of worksheet based on scientific approach needs to be developed because with this worksheet, science process skills students will be trained to think critically, and ability to provide solutions to the problems of biogeochemical cycle material on carbon cycles that cover problems related to everyday life. Students will also conduct scientific activities in the form of biogeochemical cycle material practicum on the carbon cycle in the learning process so that students can implement it in their daily lives. The purpose of this study is to produce a worksheet based on a scientific approach of biogechemical cycle material on carbon cycle to train students science process skills. In addition, the purpose of this study was to analyze the level of validity, effectiveness and practicality of the worksheet developed.

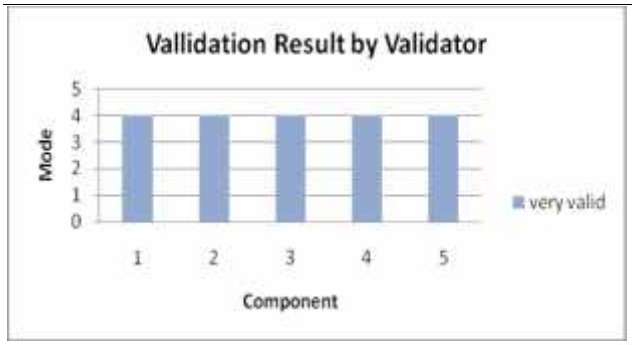
METHOD

This research is developing research that is developing a worksheet based on scientific approach of biogeochemical cycle material on carbon cyclewith reference to the 4D development model without disseminating stages. Development of worksheet was carried out in the Department of Biology, FMIPA, Universitas Negeri Surabaya. The trial was conducted on 20 students at SMAN 1 Kedungpring, Lamongan class X in January 2019. Validityof worksheet based scientific approach rated on:worksheet validity scores obtained from the two biology lecturers and one biology teacher, covering aspects of content, presentation, language, conformity with scientific approaches and suitability to practice science process skills. The effectiveness of worksheet is obtained from the achievement of student learning outcomes when did the post-test. The practicality of worksheets is obtained from student activities and responses. Research on the development of worksheet was carried out in three stages, namely: defining, designing and developing.

RESULTS AND DISCUSSION

Development worksheet based on scientific approach of biogechemical cycle material on carbon cycle as a learning tool for class X high school. Worksheet developed is equipped with a cover, topic, student identity, learning objectives and work instructions. Worksheet development is assessed based on the level of validity, effectiveness and practicality of the worksheet developed namely: assessment of worksheet validity obtained from validation by the validators, and worksheet obtaining a very valid category (4). The assessment of the practicality of worksheet was obtained from: Observation of student activities gained very good categories (92%) on worksheet 1 and (96.87%) on worksheet 2, and students responses obtained very practical categories (96%). The assessment of the effectiveness of worksheet was obtained from the achievement of student learning outcomes when did the post-test after learning gained a very effective category (85%).

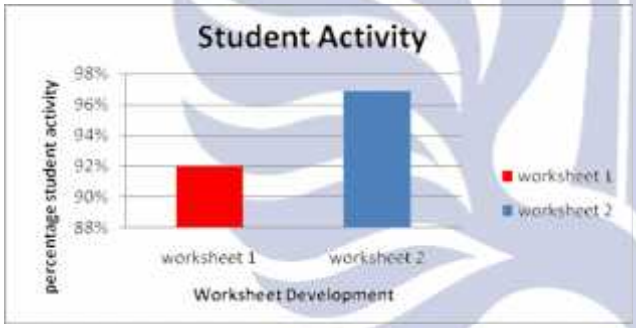
Worksheet validation is carried out by two biology lecturers and one biology teacher using avalidation sheet which includes several aspectsnamely, content, presentation, language, conformity with scientific approach and worksheet suitability to train students science process skills. The whole aspect gets a mode score of 4.Based on the three components of worksheet namely content, presentation and language that are stated to be very valid, then worksheet declared eligible because it has met the criteria a good worksheet which include didactic terms, terms of construction and technical requirements. Component contents of worksheet is a requirement didactic, the linguistic component is a requirement of construction while presenting the components of the technical requirements (Widjajanti, 2008).



Picture 1. Validation Results by Validator

Note:
1. Feasibility contents component
2. Feasibility presentation
3. Feasibility of language
4. Compliance with the scientific approach
5. Suitability for train process skills

Based on the validation results, worksheet based scientific approach obtains very valid category, which was very feasible. Appropriate worksheet can helpenable students to develop creativity, critical thinking, train ability to solve problems and provide solutions (Abidin, 2006).



Picture 2. Percentage Comparison of Results of Student Activities at Worksheet 1 and Worksheet 2

Science process skills are very important to be trained because learning will become more meaningful. Asih, (2015) states that good biology learning is learning whose implementation is based on the principle of process skills, where students can discover and develop their own facts and concepts.

Based on observations of student activities, the value of each aspect of the average student activity on worksheet 1 and worksheet 2 ranged from 92% to 96.87% with very good criteria. The implementation of student activities gets very good categories of observations, makes hypotheses, makes conclusions, and communicates the results of discussions in front of the class, there is one aspect of the activity that gets a good category which is formulating problem questions. In the aspect of identifying variables, students spend more time to ask for mostly unfamiliar with these skills.

Based on Figure 2. it is known that there is a comparison of the results of student activities when working on worksheet 1 and worksheet 2 which is on worksheet 1 percentage of student activityis 92% while on worksheet 2 percentage of student activities obtained at 96.87% each activity gets a very good category. There are differences precentage of student activities when did the worksheets 1 and 2. Students get a percentage of 92% at worksheet 1 because at the previous learning students have not been introduced method of learning by using a scientific approach.The results shown by student activities when working on worksheet 1 are on the activities of students making the formulation of problems and hypotheses, only some students know the correct way to formulate problems and hypotheses. While most students have to ask first or read the information contained in the worksheet. The average student activity worksheets 1 while working on one that makes the formulation of the problem and hypotheses which amounted to 80% and 85%. The ability of student activities on worksheet 2 in making formulation of the problem and the hypothesis is increasingly trained after the first meeting until the second meeting. This is evidenced by the activity of students who experienced an increase in the second meeting which was 95% each.The average student is already familiar with the hypothesis after reading the explanation on the worksheet. Students are able to make hypotheses based formulation of the problem made. According to Piaget's theory that the students have been able to formulate problems and hypotheses. Based on Piaget's theory of cognitive development, the level of high school students has been on the formal operational stage. At this stage, the students are able to formulate problems and hypotheses as well as the stages of process skills (Handayani, 2016).

The activity of science process skills of students on worksheet 1 and 2 get a very good category. This means that the Worksheet-based Scientific Approach developed can be used to train students science process skillsin terms of student activities.Overall, from the first to the third meeting, the activity of students science process skills has increased. This is consistent with the research of Patrick's (2010) that students who learn with discovery, process skills will increase compared with students who study without the discovery process.

Table 1. Recapitulation of the student's response

No.	Aspect	Positive	Category

		response (%)	
1	Does the worksheet accordance with instructional materials ?	85	Practical
2	Can you more easily understand the carbon cycle material with worksheet based on scientific approach based?	100	Very practical
3	Does the content on the LKS interest you in studying carbon cycle material?	95	Very practical
4	Does the contents of worksheet can train the science process skills?	100	Very practical
5	Does the language in LKS easy to understand?	95	Very practical
6	Does the language in the worksheet accordance with the EYD?	95	Very practical
7	Does the terms in the worksheet be easily understood?	90	Very practical
8	Does the systematic of worksheet coherent?	100	Very practical
9	Does the presentation of worksheet accordance with the scientific approach?	100	Very practical
10	Does the letter, letter spacing, numbering and naming the table / picture on the worksheet clear?	95	Very practical
11	Does the allocation of time given enough to work on worksheet?	90	Very practical
12	Does the appearance of worksheet attractive?	95	Very practical
13	Does the worksheet motivate you to be active in learning activities?	100	Very practical
No.	**Aspect**	**Positive response (%)**	**Category**
14	Can you make observations with this worksheet ?	100	Very practical
15	Does this worksheet can help you to formulate a problem?	90	Very practical
16	Does this worksheet lead in collecting experiments and literature review to answer the questions?	100	Very practical
17	Does the worksheet developed can help you to associate concepts with everyday life?	90	Very practical
18	Can you communicate conclusions based on learning outcomes?	100	Very practical
The average positive response		**96**	**Very practical**

Score and Categories

49%-61% : Not practical
62%-74% : Quite practical
75%-87% : Practical
88%-100% : Very practical

There are 18 aspects of the student questionnaire responses sheet of 20 studentswho had completed the questionnaire, obtained a value of 96% with a very practical category. From the 18 aspects or criteria contained in the student response, questionnaire sheet can be seen in Table 1. that it received a positive response to the category of practical and very practical.

In criteria number 2, 4, 8, 9, 13, 14, 16, and 18 get 100% positive response from students. Based on student responses, it can be seen that instructions, language, writing and experimental procedures in student worksheets are easily understood by students because of language and writing uses standard language and is adapted for high school students of class X.

Students also feel that by using worksheet based Scientific Approach they are pleased. Submission of varied learning such as group discussions, case studies and using real events can increase student attention (Abidin, 2006). Students can also more easily understand the concept because the LKS is based on Scientific Approach so that students can be directly involved in the learning process by going through a series of processes so that students become more active. This is in accordance with Luckyinita (2016) which states that the activities that make students active learning and student-centered, making the students find their own concept to be learned.Students also felt that the use of worksheet based on Scientific Approach can train them to make the formulation of the problem. As it is known that the activity of students in making the formulation of the problem increases from the first meeting to the second meeting. This is because the worksheet based scientific approach was developed to train students process skills, one of which is the ability to formulate a problem.

The criteria number 3, 5, 6, 10 and 12 obtain a positive response by 95% categorized as very practical.Students declare that the images presented in the worksheet is very clear and by carrying outobservation activities, students become easier to understand the concept of recycling carbon, accordance with Arends (2008)students observation activities aimed at trying to find a real solution of the problems encountered, where students have to analyze the problem, collect and analyze information and draw conclusions from these problems.

Criteria number7, 11, 15, and 17 obtain a positive response of 90% with a very practical category. Generally worksheet based on scientific approach is good,activities in the worksheet based on scientific approach trained to perform experiments and by conducting activities within worksheet based scientific approach can train students ability to solve problems in everyday life. Based on these data it is known that most of the students responded positively. So it can be said that in general worksheet based on scientific approachis already well developed, the activities worksheet based onscientific approach to trainingstudents to perform experiments and students are trained to solve problems that exist in everyday life. This is in accordance with the

previous discussion on the aspects of the activity, where the students are very active when doing observations and experiments with authentic problems. According to Arends (2008), authentic problems are problems that exist in real life, avoid simple answers and allow the emergence of various solutions to solve these problems.

Based on trials worksheets that have been conducted, it is known that the students are skilled in making the formulation of the problem. But even though most respond positively, there are still some students who respond negatively. This is very possible because students in one group are heterogeneous students where the ability of each student is different between one student and another so that in group learning activities tend to lead the division of tasks in the group (Karinasari, 2017).

Criteria number 1 is the suitability of worksheets in accordance with the material got a response lowest among other criteria, which is 85% in the practical category. Even though there were 3 students who responded negatively, 17 other students responded positively. Most students still feel unfamiliar with the material contained in the worksheets because they had never received the material for the carbon cycle in the previous lesson. For students who give a negative response can be caused by several things, among others, students are not familiar with carbon cycle material which in learning activities there are a series of processes or practicum becausethey get immediate previous knowledge from the teacher (lecture-method), Other factors that maybe because students do not read carefully the instructions on the worksheet so that did not really

No.	Student's name	Score	Information
1.	Aisa	95	T

understandthe problem presented. However,the overall response of students to the worksheet based onscientific approach is very positive. So development worksheet based Scientific Approach is feasible and can be used in the learning activities to train students science process skills.

Picture 3. Completeness Learning Activities of Each Indicators Using Student Worksheet Based on Scientific Approach

Note :
3.10.1 = Describe the components of the carbon cycle
3.10.2 = Analyzing processes on carbon cycle
4.10.1 = formulate the problem by trial
4.10.2 = Identifying variables trial
4.10.3 = Formulate hypotheses
4.10.4 = Formulate operational definitions of variables
4.10.5 = Plan your experiment
4.10.7 = Analyzing the experimental results
4.10.8 = Presenting the carbon cycle scheme
4.10.9 = Make conclusions

Based on Figure 3. note that of the 10 indicators, 8 of them declared complete, because obtaining a score of ≥75. While 2 others declared incomplete.The indicators with the highest completeness are indicators 3.10.1, 3.10.2, 4.10.3, 4.10.4, 4.10.5 and 4.10.9 with a score of 100. While indicators that are not complete are indicators 4.10.2 and 4.10.8 with a score of 70 namely determining research variables and presenting carbon cycle schemes.

In addition to completeness of indicators, to determine the effectiveness of student worksheet. Also viewed from the completeness of the results of student learning. The completeness of student learning outcomes was measured using a post-test consisting of 10 questions. Students are declared complete if they score ≥75. Student learning completeness can be seen in Table 2 below.

Table 2. Recapitulation of the performance of the students worksheets.

No.	Student's name	Score	Information
2.	Aldy	85	T
3.	Ananta	87	T
4.	Antlers	85	T
5.	Anisa	80	T
6.	Dwiky	72	TT
7.	Fandy	69	TT
8.	Fitria	97	T
9.	Hafiz	87	T
10.	Irma	97	T
11.	Ricky	92	T
12.	Mirza	80	T
13.	Hanif	90	T
14.	Nadhila	88	T
15.	Nadini	87	T
16.	Neva	70	TT
17.	ninik	96	T
18.	Nur	95	T
19.	Nurul	89	T
20.	great	80	T
	Percentage (%)	**85**	**Effective**

Score and Categories :

49%-61%	: Not effective
62%-74%	: Quite effective
75%-87%	: Effective
88%-100%	: Very effective
T	: Complete
TT	: Incomplete

Based on the data in Table 2, it is known that the completeness of student learning outcomes is 85% with a complete category so that the development of student worksheet based on a scientific approach to train students process skills is declared effective for completing student learning outcomes. This is also supported by the research of Yuniastuti (2013) that learning by emphasizing process skills will have an impact on increasing the completeness of student learning outcomes.

Students are said to be complete if they get a value of ≥75. The 20 students who did on the post-test, 17 students (85%) were declared complete and 3 students (15%) were declared incomplete. Students who are not complete, each of them gets a score of 72, 69 and 70. These three students did not really work hard in working on the worksheet so that they did not understand the material. Students like this need to be given special attention to increasing their learning interest.

Of the 10 questions describing each measure one indicator, 8 of them otherwise completed while the other 2 did not complete. The lowest indicators are declared incomplete indicator 4.10.2 and 4.10.8. Indicator 4.10.2 which is about research variables. After being asked to make a formulation of the problem and hypotheses, then students are asked to specify the variables that will be used. However,some students still have difficulty distinguishing between a variable control, manipulation and bound variables. This is because these terms are still very new to them, so they need several more exercises so they can really understand and get used to making research variables. While indicator 4. 10.8 is about presenting a carbon cycle scheme. After being asked to conduct observations about the carbon cycle, students are asked to make a carbon cycle scheme. Apparently, there are still many students who can not make the carbon cycle scheme appropriately. This is because students are less carefull in making observations that have been made as well as for students cycle is a material that is quite difficult to understand (Ongowo, 2013).

Overall, the achievement of indicators and student learning outcomes is declared complete. So the development worksheet based on scientific approach of the carbon cycle to train studentsscience process skills are effective and feasible to use in learning to train science process skills of class X SMA.

CLOSING

Conclusion

Based on the results of data analysis and discussion, it can be concluded that the worksheet based on scientific approach of biogeochemical cycle material on the carbon cycle. Worksheet development based on the level of validity, effectiveness and practicality. Assessment the validity of worksheet obtained from the validation by the validator, and worksheet obtain very valid category (4). The worksheet was very good and very practical with a percentage of 92% worksheet enforceability of student activity on Worksheet 1, 96.87% of student activity on worksheet 2 and 96% in terms of the students responses. Efficacy data obtained through post-test results for 85% in the complete category. The conclusion of this study is the student worksheet based on scientific approach can train science process skills because it is declared valid, practical and effective so that it can be used in learning at school.

Suggestion

The researcher needs to pay attention to students who do not concentrate on the learning provided by the researcher and emphasize more on the students towards indicators that have not been completed, namely identification of research variables and presenting carbon cycle schemes.

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