BioEdu
Berkala Ilmiah Pendidikan Biologi
Vol. 7 No.1 Januari 2018
ISSN: 2302-9528
http://ejournal.unesa.ac.id/index.php/bioedu

STUDENT WORKSHEET BASED ON SETS IN ARCHAEBACTERIA AND EUBACTERIA TOPICS TO TRAIN CRITICAL THINKING ABILITY FOR TENTH GRADE

Novi Nurmala Dewi
Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
Gedung C3 Lt 2, Jalan Ketintang, Surabaya 60231, Indonesia
Email: novinurmala2@gmail.com

Guntur Trimulyono
Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
Gedung C3 Lt 2, Jalan Ketintang, Surabaya 60231, Indonesia
Email: gtrimulyono@gmail.com

Abstract

The purposes of this research were to produce valid student worksheets based on SETS in Archaebacteria and Eubacteria topics to train critical thinking ability for tenth grade. The validity evaluated from several criteria, which are presentation, content, language, and suitable of task in worksheet with critical thinking indicators. The methods of this research is 4-D consisting of define, design, develop, and disseminate but disseminate didn't occur. Limited trial was done by 16 students in SMAN 1 Sidoarjo. Based on the validator assessment and the result of limited tested, the worksheet developed got percentage as follows: content criteria got modus 4 categoried valid, presentation criteria got modus 4 categoried valid, language criteria got modus 4 categoried valid, and suitable task in worksheet with critical thinking indicators got modus 1 categoried valid. This things supported by the result test average that there are 75% of student thorough posttest and also the student respon got 92% positive respon for the worksheet. Based on the result above, so that the student worksheet is valid to use.

Keywords: Development of worksheet, SETS, Archaebacteria and Eubacteria, Critical Thinking Skill.

INTRODUCTION

Student worksheets is a collection of sheets in which there are tasks that must be completed by the students. This worksheets generally contains instructions, and steps to complete the task. The tasks for students can be both theoretical and practical tasks. Theoretical tasks can be the task of making a summary based on the articles to be presented. While practical tasks in the form of work in the field or laboratory (Depdiknas, 2008).

The SETS approach (science, environment, techology, society) is a form of learning activity that reciprocally links the elements of science, environment, technology, and society (Binadja, 2005). The pioneer of the SETS approach is the STS approach (science, technology, society). Environment components are added because the environmental aspects will not be separated from the application of the role of knowledge and technology in society as part of the environment. In the STS approach the process of material development is inseparable from Biological features that are oriented not only on processes and products but also technologies utilized by the society. While in SETS approach, the learning process that presents the role of knowledge to be applied in the form of technology needed by the society requires thinking about the impacts caused to the environment in order to avoid environmental damage (Alina, 2016). The reciprocal relationship between SETS elements is shown in Figure 1.

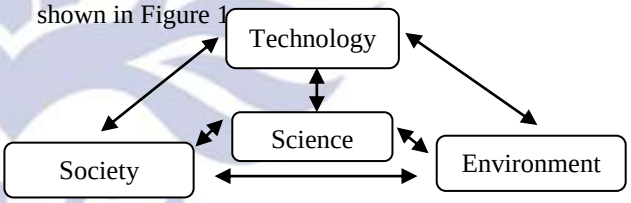

Figure 1. Reciprocal Relationships between SETS Elements (Binadja, 2005)

In order for biology learning to be directed to students deeper understanding about activities in the environment and everyday life, the student worksheets can be created based on SETS. The using of student worksheet based on SETS in learning is expected to enable students to connect the concepts of science with the problems that occur in society and the environment and can apply the learning outcomes for everyday life (Apsari and Ismono, 2014).

Critical thinking is an intellectual process actively and skillfully conceptualizing, analyzing, synthesizing, applying, and evaluating information gained from observation, experience, reflection,

reasoning, or communication to direct beliefs and actions (Gueldenzoph and Snyder, 2008). Some experts propose indicators of critical thinking, one of which is the critical thinking indicator proposed by Facione. This study uses Facione critical thinking ability indicators. This is because of the considerable amount of research to measure critical thinking skills using Facione indicators so that the Facione indicators can be used to measure critical thinking skills. Facione critical thinking skills indicators consist of interpretation, analysis, evaluation, inference, explanation, and self-regulation (Kriel, 2013).

Student worksheets based on SETS (science, environment, technologi, society) can be used to train students' critical thinking skills in the learning process. When given a student worksheets based on SETS which developed to train critical thinking skills, students will read material summaries, doing tasks appropriate with matter related to the SETS approach, and complete the SETS charts contained in the worksheets. That process can train students to think critically where students are trained to elaborate what they do and what they think. Gift student worksheets based on SETS to students can enrich their meaningful experience. Such meaningful experience can be an opportunity to practice critical thinking while doing the tasks at worksheets and when giving written or verbal opinions like a scientist. Therefore, to train the critical thinking ability to the students is required existence student worksheets of based on SETS.

METHOD

The type of research used is the development research using 4-D research method consisting of define, design, develop, and disseminate stage but disseminate stage is not done. This study is only done until the limited trial stage. The object of this research are student worksheets based on SETS in Archaebacteria and Eubacteria matter to train critical thinking ability in tenth grade students.

Research data sources are two biology lecturers and one biology teacher, and 16 students of X Science 1 SMAN 1 Sidoarjo. The research instrument used in this research is student worksheets validation sheet, and student response questionnaire. Determination of student worksheets validity is determined based on two components namely, component A and component B. The validity of component A includes the content, presentation, and language determined by looking at the modus or value that often arises from the validation result data then interpreted with the scale in Table 1. The student workheets which developed can be said valid for use based on component A when obtaining modus of 4.

Table 1. Interpretation Criteria of Validation Results Component A (Sugiyono, 2016)

Modus	Categories
4	Valid
3	Quite Valid
2	Less Valid
1	Not Valid

Determination of student worksheets validity based on component B in the form of suitability tasks in student worksheet with indicators trained critical thinking ability is also determined by looking at the modus or value that often appears. In this case if the validator chooses appropriate so the value is 1. However if the validator chooses not appropriate so the value is 0. The obtained modus then interpreted with the following Table 2 scale. The student worksheet which developed can be said valid for use based on component B when obtaining a modus of 1.

Table 2. Interpretation Criteria of Validation Result Component B (Sugiyono, 2016)

Modus	Categories
1	Valid
0	Not Valid

The validity of student worksheet based on SETS which developed is also supported by student responses and student learning achievement. Student response is obtained from student response questionnaire given after learning process using student worksheet based on SETS. Student response questionnaire then analyzed descriptively quantitative by giving an assessment of the worksheet with percentage obtained based on Guttman scale in Table 3.

Table 3. Guttman Scale

Answer	Score
Yes	1
No	0

The percentages obtained then interpreted into the criteria contained in Table 4. Based on these interpretation criteria, the student worksheet based on SETS in this study is said received a positive response from students if the percentage of students who answered "Yes" ≥ 70%.

Table 4. Interpretation Criteria of Student Positive Response (Sugiyono, 2016)

Percentages (%)	Categories
20-35	Negative
36-51	Less positive

Percentages (%)	Categories
52-69	Quite positive
70-85	Positive
86-100	Very positive

While student learning achievement after using student worksheet based on SETS can be measured by comparing the value obtained by students with minimum completeness standard (SKM) used by school for Biology subject, that is equal to ≥ 75. Next is calculate percentage of students who complete after learning using student worksheet based on SETS developed .

RESULTS AND DISCUSSION

Results

Student worksheets review was conducted in order to obtain inputs for the improvement of the student worksheets developed. Improvements made to the student worksheets include 1) Redistribution of sub chapters in student worksheets according to Basic Competency; 2) Material improvement according to correct theory; and 3) Replacing tasks in accordance with suggestions from biologists lecturer and specialists education lecturer.

Validation of student worksheets based on SETS was done by biologist lecturer, biology educator, and biology teacher. The validation process is used to determine the validity of student worksheets that is assessed based on two components namely, component A includes content criteria, presentation criteria, language criteria. The results validation data of component A summarized in Table 5.

Table 5. The Validation Data of Component A

No	Criteria	Modus	Categories
1	Content	4	Valid
2	Presentation	4	Valid
3	Language	4	Valid

While the results of processing data validation of component B about the suitability of tasks in the student worksheets with the critical thinking ability indicators to be trained is contained in Table 6. The students worksheets which developed categoried valid when obtaining modus of 1.

The student worksheet based on SETS in Archaebacteria and Eubacteria topics to train critical thinking ability for tenth grade is said valid for use in learning process. Component A which includes the content feasibility, presentation feasibility, and language feasibility gets modus of 4 so that it is categorized as valid.

Table 6. The Validation Data of Component B

Criteria	Modus	Categories
The suitability of tasks in student worksheets with indicator of critical thinking ability to be trained	1	Valid

The student worksheets based on SETS which developed has fulfilled the content feasibility criteria covering eight components got modus of 4 with valid category. The presentation criteria with ten components gets a modus of 4 with valid category. The language criteria consisting of three components gets a modus of 4 with a valid category. While the component B covers the suitability of tasks in the student worksheets with the indicator of critical thinking that will be trained to students get a modus of 1 with a valid category. Fifteen tasks in the student worksheets by the validator is considered to be in accordance with the indicator of critical thinking skills according to Facione that will be trained to students. Facion's critical thinking ability indicator consist of interpretation, analysis, evaluation, inference, explanation and self regulation.

The validity of the student worksheets based on SETS which developed was supported by the student response of the limited trial result conducted on 16 students of class X SCIENCE 1 in SMAN 1 Sidoarjo. Most students responded positively to the student worksheets based on SETS which developed used during the learning process. The student response data can be seen in Table 7.

Table 7. Results of Student Response

No	Aspects	Percentage (%)
1.	Language	100
2.	Presentation	100
3.	Display	75
	Average	**92**

The average percentage of student responses to student worksheets based on SETS which developed is 92%. The language aspect gets a percentage of 100%, the presentation aspect 100%, and the display aspect 75%.

The result of student learning achievement showed that 75% of students stated complete, that is 12 of 16 students of class X SCIENCE 1 get value more than the minimum completeness standard (SKM) used by SMAN 1 Sidoarjo for biology learning (≥75). While 4 students who do not complete get value under the minimum completeness standard (SKM).

Discussion

The main purpose of the research was to produce valid student worksheet based on SETS in Archaebacteria and Eubacteria topics to train critical thinking ability for tenth grade. The student worksheet which developed has components of the SETS approach namely, science, environment, society, and technology. As the objective to show science aspect knowledge, student worksheets furnished with a material summary for each sub topics in Archaebacteria and Eubacteria. The emergence of environmental aspects is characterized by the existence of several case studies in the society relating to the material to be analyzed by the students.

Case studies related to Archaebacteria and Eubacteria material contained in the student worksheets will direct students to better understand the problems that exist in the environment and make them love the environment and to link between the impact and benefits of the science application to the environment. The technological aspect is appeared by reading additional information in the "Let's Surf on the Internet" column and internet usage to complete some tasks in the student worksheets.

The fourth aspect is the society raised in the student worksheets by answering the questions related to the literature in the task, the student is expected to know a problem in society and how to prevent or handle the problem so as not to reappear in the future. The four components of the SETS integrated in the SETS charts listed at the end of the student worksheets so that at the end of the lesson students asked to complete the SETS chart according to understanding they gain during learning using the student worksheets based on SETS in Archaebacteria and Eubacteria topics and their relation to science, environment, technology and society. This is in accordance with Apsari and Ismono (2014) research which states that the use of student worksheets based on SETS in learning can make students relate the concepts of science to the problems that occur in society and environment and can apply the learning outcomes for everyday life.

Learning process using student worksheets based on SETS can train students to think critically. The tasks in the student worksheets lead students to understand science as a knowledge and its relation to society, technology, and the environment. During the learning using student worksheets based on SETS students directed to understand the problems that exist in the environment society related to the topics and how to overcome them by utilizing the existing tenologi. This is in accordance with Sudibyo (2012) statement that SETS approach can foster students' critical thinking skills. Student's critical thinking skills can be used as an effort to solve environmental problems, both local environment and environmental relation with everything related to society and participate in problem solving according to its capacity in the future.

The student worksheet based on SETS has been developed through the review phase to obtain inputs for the improvement of the student worksheets developed. Improvements made to the student worksheets include re-dividing sub chapters in the student worksheets according to Basic Competence; correct the material according to the correct theory; and replace the task in accordance with the advice of biologists lecturer and education experts lecturers. After the improvement of student worksheets based on SETS developed can be said valid because the components in the student worksheets accordance with the criteria of good student worksheet. This is evident from the results of student worksheets validation on component A includes the feasibility of the content, presentation, and language all got a modus of 4 with a valid category. The student worksheets developed has become a good student worksheet, because it has characteristics such as mentioning Basic Competence to be achieved, learning objectives, material substance related to basic competence or subject matter that must be mastered by learners, and equipped with easy instructions teachers and students in teaching or learning (Depdiknas, 2008).

The tasks in the student worksheets based on SETS in Archaebacteria and Eubacteria topics to train critical thinking ability for tenth grade according to the validator in accordance with the critical thinking indicator that students want to practice. This is evident from the validation of component B which according to the validator is appropriate and can be said valid. Fifteen tasks in the student worksheets which developed obtain a modus of 1 so that it can be said that these tasks can enable students to think critically in accordance with the critical thinking indicators will be trained. The critical thinking indicators used in this research are interpretation, analysis, evaluation, inference, explanation and self regulation (Facione, 2015).

Student responsiveness and completeness of student learning outcomes also support the validity of student worksheets based on SETS which developed. There were 92% of students gave good responds to learning process using the student worksheets based on SETS which developed. The student response questionnaire given to the students consists of aspects of

language, presentation, and display. The result of the student's response shows that from the three aspects, the feasibility aspects of the student worksheets display get a less positive response than the others from the students. According to some students the student worksheets display which developed less interesting. Response to the student worksheets display is less interesting indicates that the student worksheets need to be made more interesting for students. However, these small shortcomings do not prevent the student worksheets which developed from obtaining a positive response from students. Sugiyono (2016) explains that the media developed declared a positive response from students if the percentage obtained from the data analysis of ≥ 70%. There were 75% students reached SKM (Standard Minimum Completion) after learning process using student worksheets based on SETS.

However, there are still 25% of students who have not reached SKM yet. This is because limited trials are conducted in the afternoon at 1 o'clock in the afternoon so that some students are less than maximized during the learning process, not answering the question perfectly and misinterpreting the given problem. This is consistent with Prayitno's (2009) statement that the most effective learning time is in the morning when the atmosphere is cool and fresh because the air is still not polluted by the smoke of the vehicle and the physical condition is still fresh. Unlike the afternoon when the atmosphere is hot, the body tired, the memory of the brain decreases due to the many things that have absorbed the brain on that day so to learn less effective.

Based on the description it can be said that the student worksheet based on SETS in Archaebacteria and Eubacteria topics to train critical thinking ability for tenth grade is valid for use in learning. The validity of student worksheets which developed was obtained from the validation of biologists lecturer, biology educator, and biology teacher. The validity of student worksheet developed is also supported by students' responses and student learning outcomes.

ACKNOWLEDGEMENTS

Writer would like to thank to mentor lecturer namely Guntur Trimulyono, S.Si., M.Sc., validator lecturer namely Prof. Dr. Muslimin Ibrahim, M.Pd, and Dr. Mahanani Tri Asri, M.Si, and reviewer lecturer namely Erlix Rakhmat Purnama, S.Si., M.Si who patiently guided me to produce this good article.

CLOSING

Conclusion

Student worksheet based on SETS in Archaebacteria and Eubacteria topics to train critical thinking ability for tenth grade was valid to used as learning tool with scoring criteria as follows:

1. Component A of the developed student worksheets includes content, presentation, and language feasibility. feasibility of contents with eight components has modus of 4 with valid category. The presentation feasibility with ten components has modus of 4 with valid category. The language feasibility with three components has modus of 4 with valid category.
2. Component B on the developed student worksheets about the suitability tasks in the student worksheets with indicator of critical thinking ability will be trained to the students with fifteen tasks obtain modus of 1 which means the validator agrees that the task in the student worksheets is accordance with the indicator of critical thinking ability and can be categorized valid.
3. Student response and student learning achievement after the use of student worksheets which developed support the validity of student worksheets. After using the student worksheets, 92% of students responded, it means that the use of student worksheets which developed got positive response from the students. In addition, as many as 75% of students get a test score above SKM (minimum mastery standard).

Suggestion

Suggestions that can be given for this research are:

1. Student worksheet based on SETS to train critical thinking ability can be developed for other different subject matter.
2. Research on the development of student worksheet based on SETS to train critical thinking ability in such students can be developed using critical thinking indicators according to experts other than the critical thinking indicator according to Facione.

REFERENCES

Alina. 2016. Pengembangan LKS Ekosistem Mangrove Berbasis SETS (Science, Environment, Technology, and Society) pada Materi Ekosistem untuk SMA di Wilayah Pesisir Surabaya. *UNESA Journal of BioEdu*. Vol 5 No 3 P. 1-5.

Apsari, D.Y. & Ismono. 2014. Pengembangan Lembar Kegiatan Siswa Berorientasi SETS pada Materi Pokok Zat Aditif Makanan. *UNESA Journal of Chemical Education* Vol 3 No 2 P. 1-6.

Binadja, A. 2005 . *Pedoman Pengembangan Bahan Pembelajaran Bervisi dan Berpendekatan SETS (Science, Environment, Technology, and Society) atau (Sains, Lingkungan, Teknologi, dan Masyarakat)*. Semarang: Laboratorium SETS Universitas Negeri Semarang.

Depdiknas. 2008. *Pedoman Penyusunan Lembar Kegiatan Siswa dan Skenario Pembelajaran Sekolah Menengah Atas*. Jakarta: Direktorat Jenderal Pendidikan Dasar dan Menengah.

Facione, P.A. 2015. *Critical Thinking: What It Is and Why It Counts.*Insight Assessment. Diakses dari http://www.insightassessment.com.

Gueldenzoph, L. & Snyder, M.J. 2008. Teaching Critical Thinking and Problem Solving Skills. *Delta Pi Epsilon Journal*, 50(2): 90-99.

Kriel, C. 2013. *Creating a disposition for critical thinking in the mathematics classroom.Proceedings of the 2 nd Biennial Conference of the South African Society for Engineering Education*. Diakses dari http://www.sasee.org.za.

Prayitno. 2009. Pengaruh Waktu Pembelajaran dan Suasana Kelas Terhadap Prestasi Belajar KiSCIENCE Siswa Kelas XI Semester I SMA Muhammadiyah 2 Yogyakarta Tahun Pelajaran 2008/2009. *Skripsi*. Yogyakarta: Universitas Islam Negeri Sunan Kalijaga Yogyakarta.

Sudibyo. 2012. Penerapan Model Pembelajaran Kontekstual Berwawasan SETS Untuk Peningkatan Hasil Belajar Ekonomi dengan Pokok Bahasan Permintaan Penawaran Dan Harga Pasar Pada Siswa Kelas X 2 SMA Negeri Karangpandan Tahun Pelajaran 2011/2012. *Tesis*. Surakarta: Universitas Muhammadiyah Surakarta.

Sugiyono. 2016. *Metode Penelitian & Pengembangan Research and Development*. Bandung: Alfabeta.