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EFFECTIVENESS OF CTL-BASED STUDENT WORKSHEET IN MEMBRANE TRANSPORT MATTER TO FACILITATE STUDENT'S CRITICAL THINKING ABILITY

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Abstract

The purpose of the research is to know the effectiveness of CTL-based worksheet that facilited the student's critical thinking ability in membrane transport matter. This research is done by limited trial implementation of valid CTL-based worksheet that developed before and involved 20 students of MIA 2 of Senior High School 2 Kediri on April 2019. Technique of data analysis in this research is descriptive quantitatively. The result of enhancement of student critical thinking ability was shown by improvement of every indicators critical thinking ability after learning by CTL-based worksheet. The pre-test percentage of interpretation, inference, analysis, explanation and evaluation succesively was 62.50%; 57.91%; 57.00%; 51.25% dan 41.25%. Then the post-test percentage was 78.75%; 82.91%; 86.00%; 76.25% dan 63.75%. Besides the percentage of every indicators, the improvement of student's critical thinking ability was shown by gain score that was 0.53 with middle category. Then efectiveness was based on the student's postitive responses that reach about 91.60% including the very good category.
Keywords : student worksheet, CTL, critical thinking ability, membrane transport

INTRODUCTION

The 13th curriculum development is based on defiance that must be faced by Indonesian human resources in order to compete in globalization at 21st century. It is one of challenge in the 21st century that requires human resources to be qualified and competent. Based on the explanation of the Ministry of Education and Culture in 2014 regarding the implementation of the 2013 curriculum stated that one of the competencies needed in the 21st century is the crical thinking ability. This term is match with Bart's statement (2010) that critical thinking is one of the main goals and main results of learning. Critical thinking is an intellectual process that actively and skillfully conceptualizes, applies, analyzes, synthesizes, and evaluates information collected or generated from observation, reasoning, experience, reflection, or communication, to guide beliefs and actions (Scriven and Paul, 2007).

The critical thinking ability of Indonesian students is seen from the involvement of participation in PISA from 2000-2015 which shows that Indonesia is only able to reach the Low international benchmark, which is the lowest cognitive level and weak in reasoning/thinking. The low literacy skills of Indonesian students indicate low level of critical thinking ability. This is due to indicators of scientific literacy skills in harmony and synergistic with indicators of critical thinking. In addition to the PISA results, the low critical thinking skills of students in Indonesia supported by the results of Susilowati (2017) critical thinking skills of Magetan Regency MAN students are only in the percentage of 45% -64% in all aspects which are categorized as low category.

Adeyemi (2012) said that learning which can develop student's critical thinking ability is learning that require students to identify problems, conduct rational investigations, analyze, and reasoning a concept logically, making questions to conclude. So one of learning models that suitable and able to facilitate critical thinking skills in students is learning based on Contextual Teaching and Learning (CTL). The statement is supported by the results of Hasrudin et al (2015) research on the application of Contextual Teaching and Learning can improve student's critical thinking ablitiy about 18.5%. It is because of Contextual Teaching and Learning (CTL) approach can emphasize the activity of students in building their own knowledge. So that it can be said that learning based on Contextual Teaching and Learning activities are

principled on learning by doing, so it is able to facilitate and improve student's critical thinking ability.

The CTL approach is learning that emphasizes the involvement of students maximally to find concept that is learned and relate it to the situations in real life so encourage students to apply the material learned in real life (Restanti et al, 2013). In addition, Restanti et al (2013) also explained that there are seven aspects in the Contextual Teaching and Learning approach including 1) constructivism; 2) inquiry; 3) questioning; 4) learning community; 5) modeling; 6) reflexes; and 7) authentic assessment.

Practicing critical thinking through learning must also suitable to the demands of Basic Competence. One suitable material is membrane transport material as contained in KD 3.2 and 4.2 class XI. This basic competence requires students to analyze bioprocess in cells including the mechanism of membrane transport, reproduction and protein synthesis. Based on the verb on basic competencies, students must be able to analyze bioproses that occur in cells. According to Bloom's taxonomy, analyzing is the fourth-order cognitive level (C4). This shows that students are also required to do high lecel thinking (higher order thinking skills), which one ability that included in high-level thinking (higher order thinking skills) is critical thinking ability. In addition to choosing the right strategy, learning tools are also involved in supporting the learning process. One learning device that important in learning process is student's worksheet. Lee (2014) argued that student's worksheet is written instructional materials which is important to assist teachers in effective teaching practices. The purpose of this study was to describe the effectiveness of student's worksheet based on Contextual Teaching and Learning in membrane transport material in facilited student's critical thinking ability.

METHOD

This research was carried out by conducting a limited trial of CTL-based worksheet that had been developed and was declared theoretically feasible/valid based on the assessment of education experts, material experts and Biology teacher. Student's worksheet trials were conducted on 20 students of class XI MIA 2 of SMAN 2 Kediri who were heterogeneous both in terms of academic ability and gender. The student's worksheet trial was conducted in April 2019. Data collection techniques to determine the effectiveness of student's worksheet were test method and questionnaire. The test was carried out twice, conducted before learning using CTL-based worksheet (pre-test), and after learning using CTL-based worksheet (post-test). While the questionnaire method was conducted by giving a questionnaire response sheet about learning using student's worksheet based on CTL to facilitate critical thinking ability. So that the data analysis technique used is the analysis of critical thinking skills and questionnaire responses of students.

Student's critical thinking ability was obtained from the results of the pretest and posttest written tests will be analyzed using descriptive statistical methods. The values obtained by students are analyzed using the following formula:

$$Test\ score = \frac{score\ that\ obtained}{maximal\ score}\ x\ 100$$

Each question in the test indicates an indicator of critical thinking. So that the achievement of critical thinking skills is analyzed on each indicator of critical thinking. After calculating the indicator, the value of each indicator of critical thinking will be categorized.

$$Percentage = \frac{score\ that\ obtained}{maximal\ score}\ x\ 100\%$$

The percentage calculation results of each critical thinking indicator are categorized based on the percentage category of critical thinking skills table adapted from Karim and Normaya (2015). Based on the results of the pre-test and post-test values obtained, then analyzed the increase using the gain score method with the following formula:

$$(g) = \frac{(Sf) - (Si)}{Smax - (Si)}\ x\ 100\%$$

Note :

(g)	: gain score
Si	: pre-test score
Sf	: post-test score
Smax	: Maximal score (100)

The calculation results of the gain value are categorized based on the normalized gain score criteria table developed by Hake (1999). The response of students is obtained by filling out a response questionnaire distributed to students. Students give a check list "Yes" if appropriate and "No" if it is not appropriate. The response scores obtained are calculated using the following formula.

$$Percentage\ of\ student's\ response = \frac{\sum\ student\ who\ said\ "yes"}{\sum total\ students}\ x\ 100\%$$

The scores obtained are then interpreted with tables of criteria for student response results developed by Riduwan (2013). The developed CTL-based worksheet is said to be effective if there is an increase

in critical thinking skills and the percentage of positive responses ≥ 75%.

RESULT AND DISCUSSION

The results of the research about efectiveness of CTL-based student's worksheet to facilitate the student's critical thinking ability. The critical thinking skills of students who are trained include interpretation, analysis, evaluation, inference and evaluation. This ability is facilited by observing various phenomena of the application of the concepts of diffusion and osmosis in everyday life for example are imbibition of soybean seeds was soaked by water, making fruitsweets and pickles. The student's worksheet consists of four activities, first observing the differences in the size and texture of green bean seeds and diffusion and osmosis models made of thin membranes on semipermeable selective chicken eggs. Second is the activity of identifying the type of solution, predicting the results of osmosis in the U pipe and giving the reason. The third activity is practicum about the effect of concentration of sucrose solution on weight, taste, color and texture of apple pieces. The practicum activity is carried out based on the inquiry learning model. So that students are asked to formulate problems, create hypotheses, identify variables, process data results in table form, analyze to conclude. The last activity carried out was to make a project about diffusion and osmosis models.

Based on the results of the tests that have been carried out, the following is the percentage of each indicator of critical thinking ability based on the results of pre-test and post-test. The data is presented in Figure 1 below.

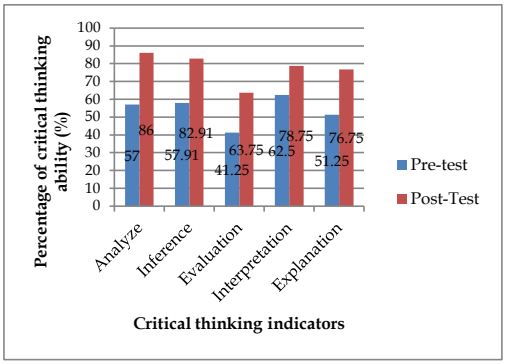

Figure 1. Percentage diagram of each indicator of critical thinking skills

Based on the picture above, it shows that each critical thinking indicator which facilited with CTL based worksheet has increased in the post-test results. The analytical ability that gets the highest percentage is 86% with very high category (Karim and Normaya, 2015). Analytical skills are facilited in activities 1 and 3 by analyzing the results of observations and experiments that have been carried out. Then the activity analyzes the application of the osmosis principle to the U pipe by analyzing the type of solution and making a prediction of the results of the osmosis process in the U pipe, followed by analyzing the discussion given. So that the percentage score of the analysis ability based on the worksheet assessment is 78.25%, the score is the highest score compared to other critical thinking indicator scores. Based on the developed worksheet, the majority of critical thinking skills are facilited in activities that refer to the components of inquiry and constructivist. Hasibuan (2014) revealed that inquiry activities that are based on the process of discovery through a systematic process of thinking also use the ability to think critically. Further more Nurhadi (2002) argues that constructivists are a process of building understanding based on learner's experiences, and integrating concepts that are gained through experience and observation.

The lowest percentage of critical thinking ability indicators is the evaluation indicator with a percentage of 63.75% which is in the medium category (Karim and Normaya, 2015). The ability to evaluate is facilited in activities that refer to one component of CTL, namely reflection. The activity is carried out at the end of the lesson. This activity is divided into two types, namely verbally with presentations and discussion session then in writing was done by writing down what student's has been obtained during learning. Then evaluation capability based on the worksheet assesment is also the lowest compared to other aspects, which is only 60%. The low evaluation score on the worksheet assessment is because some of the concepts written are not perfect.

Pratama (2016) states that the ability of student's capability to understand material is different. The majority of students whose abilities are higher will understand the material faster than students with low abilities. In addition to these reasons, when viewed from the revised sequence of Bloom's cognitive taxonomy, the ability to evaluate is part of C5 ability (Anderson and Krathwohl, 2001). This is due to evaluating not only analyzing the interrelationships between components or inferential relations of just revelation, but evaluation also includes checking

activities and even criticizing to assess whether the matter or statement is appropriate (Gunawan and Palupi, 2012). So to master the evaluation ability, student must able to master the abilities in under C5 capability, especially the ability to analyze. Improving evaluation ability can be trained by optimizing the discussion session when students do the observation result presentation and apply the learning that facilitate the evaluation ability continuously.

Data on increasing student's critical thinking skills is proven by calculating the gain score in the pre-test and post-test scores. The following is a table of values for pre-test, post-test and n-gain.

Table 1. Result of pretest, postest and gain score

Student's Name	Score		*Gain Score*	Category
	Pre-test	Post-test		
Student 1	43.18	65.00	0.38	Medium
Student 2	43.18	77.27	0.59	Medium
Student 3	43.18	84.09	0.71	High
Student 4	36.36	84.09	0.75	High
Student 5	56.81	86.36	0.68	Medium
Student 6	47.72	81.81	0.65	Medium
Student 7	59.09	72.72	0.33	Medium
Student 8	52.27	84.09	0.66	Medium
Student 9	52.27	79.54	0.57	Medium
Student 10	61.36	70.41	0.23	Low
Student 11	54.00	79.54	0.55	Medium
Student 12	59.09	88.63	0.72	High
Student 13	50.00	84.09	0.68	Medium
Student 14	45.45	79.54	0.62	Medium
Student 15	68.18	88.63	0.64	Medium
Student 16	47.72	72.72	0.47	Medium
Student 17	72.72	84.09	0.41	Medium
Student 18	56.81	68.18	0.26	Low
Student 19	77.27	88.63	0.49	Medium
Student 20	79.54	84.09	0.22	Low
Average	**55.31**	**80,18**	**0.53**	**Medium**

Note :
0.71 – 1.00 : High
0.31-0.70 : Medium
0.00-0.30 : Low

Based on the results of the recapitulation in the table above showed that the average obtained from the pre-test value is 55.31. Whereas for the post-test range the value has increased compared to the average pre-test value, the score was 80.18. In addition, the average N-gain of student's critical thinking ability is 0.53 in the medium category. So the learning using worksheet based on Contextual Teaching and Learning (CTL) is effective in facilited student's critical thinking ability. The argued was supported by Mulyasa (2014) who revealed that to know the improvement of student's abilities was done by comparing the results of the pre-test and post-test. In addition, supported by the results of Bustami, et al (2018) where student's critical thinking ability increased after the implementation of Contextual Teaching and Learning (CTL) based learning, in terms of an increase in the average post-test score of 19.42 compared to the average pre-test.

Karim et al (2018) stated that learning that can facilited and improve critical thinking ability is learning that involves the student's active role during learning, collaborates and supports students to construct their own understanding. Then learning that has shifted from the teacher-oriented learning paradigm to student-oriented. Based on the statement, it can be said that Contextual Teaching and Learning (CTL) based learning is facilited critical thinking ability, especially the components of the learning community and constructivist society. The components of the learning community conducted students to collaborate with each other, exchange opinions and provide opportunities to discuss concepts and make and answer questions (Bustami et al, 2018).

Ariyanti et al (2013) revealed that critical thinking ability can increase by frequently exchanging opinions, ideas and information in groups. Furthermore, the constructivist component is a component of CTL that requires students to build their own knowledge, so that learning becomes more meaningful (Nurhadi, 2002). In addition, by developing their own knowledge makes students more active in thinking, not only memorizing. So that students can build their understanding based on the experience gained (Bustami, 2018).

Furthermore, the results of student responses are presented in table 2 which contains a summary of the average percentage of each aspect asked.

Table 2. Average of every aspects in questionner

Aspects	Average of positive response percentage (%)	Category
Worksheet presentation, component and linguistic	88,3	Very effective
Comformity of worksheet component with CTL component	93.3	Very effective
Comformity of worksheet component with critical thinking indicators	93.5	Very effective
The Average of all aspect percentage	**91.6**	**Very effective**

Based on these three aspects, the percentage of positive responses was 91.6% which included very effective category (Riduwan, 2013). The presentation, component and linguistic aspects get the lowest percentage score, only 88.3%, which classified as very effective (Riduwan, 2013). Based on the nine questions written, the percentage of the highest positive response on the aspect of using the writing language on reading and work steps is easy to understand. The percentage obtained is perfect, which is 100%. The use of language in the LKPD must refer to the use of Indonesian language that is good and correct and in accordance with the development of student's language (Widodo, 2017).

While the lowest positive response found in the aspect of using LKPD in learning is something new, only getting a percentage of 70%. Students of class XI MIA 2 of SMAN 2 Kediri have used worksheet in Biology learning, but the content only contains a summary of the material and a collection of questions. Then the percentage of positive responses of only 75% is also obtained in the aspect of ease in obtaining tools and materials. The low positive response to this question is due to the use of diffusion and osmosis models made from thin layers of chicken eggs. The use of the model includes something new and in the manufacturing process is indeed complicated and difficult.

Furthermore, the conformity aspect with learning based on Contextual Teaching and Learning (CTL), the total percentage obtained was 93.3% with a very effective category (Riduwan, 2013). The aspect that gets a positive response is LKPD which is very helpful for students in describing real events in daily life, the percentage obtained is 100%. This shows that the LKPD developed has referred to CTL-based learning. Restanti et al (2013) revealed that CTL-based learning is learning that emphasizes the involvement of students in discovering the material learned and relates it to situations in real life so as to encourage students to be able to apply the material learned in everyday life. The last is the suitability aspect of the LKPD with the critical thinking indicators being trained. The percentage obtained in this aspect is 93.5% with a very effective category (Riduwan, 2013). The highest percentage of positive responses was found in the aspect of LKPD asking students to evaluate and rethink what things had been obtained during learning, the percentage was 100%. This evaluation activity is carried out at the end of the lesson where students make presentations and question and answer and write down what has been obtained during the learning in the column available at the LKPD.

Based on the explanation of the results and discussion of student's critical thinking skills, it can be said that CTL-based worksheet developed were effective in faciliting critical thinking ability.

CONCLUSION

LKPD based on Contextual Teaching and Learning (CTL) to facilitate critical thinking ability in membrane transport material produced, was declared effective based on the increasing percentage of each indicator of critical thinking skills trained in the post-test results and the increase was evidenced by the n-gain value amounting to 0.53 with the medium category. Then based on the average percentage of positive responses of 91.6% including the category of very effective.

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