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EFECTIVENESS OF VIRUS MATERIAL TOPIC STUDENT WORKSHEET BASED ON KNOW-LEARNED (K-L) METACOGNITIVE STRATEGY TO TRAIN STUDENT METACOGNITIVE SKILLS

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Abstract

Metacognitive skill is essential for students. One of learning materials which can train metacognitive skill is worksheet based on metacognitive strategy. This research aimed to produce an effective student worksheet based on Know-Learned (K-L) strategy on virus material topic to train student's metacognitive skill. This research which had been held in Biology Department, FMIPA, Unesa. This study was a developmental research which referred to 3-D model namely define, design, and develop. The research stage started with define stage which conducted by analyzing curriculum on virus material. Then continued with design stage which conducted by designing and developing student worksheet. Student worksheet consists of know-learned phase, which equipped with self-confidence level column, comparing concept column, and score column, so it can facilitate students to practice monitoring and evaluation skills. Then at the develop stage, student worksheet implemented limitedly to fifteen 10th grade students of SMAN 4 Sidoarjo. Finally, the effectiveness of student worksheet evaluated based on student metacognitive skill, completeness of indicators, and gain score. The research result showed that the student worksheet was effective with the student's metacognitive score of 3.93 (very good category) and positive sensitivity in the range of 0.3-1.0. In addition, student worksheet was also effective to gain learning outcomes of 93.33% students with the high criteria and 6.67% student with the medium criteria. Therefore, student worksheet based on K-L metacognitive strategy was effective to train students metacognitive skill and gain their learning outcomes at once on virus material.
Keywords: worksheet, know-learned, metacognitive skill, virus material.

INTRODUCTION

Metacognitive skill is one of the complex skills which must be mastered by senior high school graduate (Permendikbud Number 20 of 2016). Metacognitive is essential for students to understand and monitor their cognitive process (Wati et al., 2015). Metacognitive play an important role in developing 21st century skills including critical thinking, problem solving, creative thinking, communication, collaboration, ICT mastery, etc. These skills must be mastered by students because is essential for them to compete in 21st century work world which is more global and multicultural. Aydin (2015) stated that metacognitive skill can accommodate some 21st century skills, including communication skill, reading comprehension, critical thinking and problem solving. It can also improve learning outcomes, develop character and improve self-assessment skills (Susantini, 2009). Metacognitive skill support students to learn actively and independently (Cera et al., 2013), so students become self-regulated learner.

The successness of the learning process is inseparable from the important role of metacognitive skill. The student's learning process result is the result of their cognitive process, so it closely related with metacognitive skill. Student's learning outcomes increased significantly due to the use of metacognitive strategy (Nuryana & Sugiarto, 2012). It is because metacognitive strategy can help student be able to apply specific learning strategies to do the difficult tasks (Susantini, 2009). Metacognitive skill also play an important role in the regulation of student's cognitive process, especially learning and thinking, so that both activities become more effective and efficient (Wati et al., 2015).

Metacognitive skill is characterized by the student's awareness in realizing their own abilities, identifiying information, assessing their goals achievement, selecting important information used in problem solving (Anderson & Krathwohl, 2010), assessing their self-confidence level,

and evaluating their cognitive process and product (Magno, 2010). In this research two metacognitive skills were chosen to be studied more deeply, namely monitoring and evaluation skills. Monitoring skill assessed based on the student's ability in (1) determining their initial and final knowledge, (2) determining their self-confidence level, and (3) comparing their initial and final knowledge, while evaluating skill assessed based on the student's ability to do the self-assessment. These skills are essential for student because it make student be able to manage their cognitive process. The good cognitive management makes students aware about the strength and the weakness of their learning processes, so they can find out their mistakes and try to find ways to improve it (Iskandar, 2014). When they are be able to do the self-evaluation, their understanding about concepts will increase indirectly (Iskandar, 2014).

Purnomo et al., (2017) reveal the facts that student's metacognitive skill still in the low category. It is because the learning activities can't empowering student's metacognitive skill. Metacognitive strategies still rarely applied. Learning processes are often still oriented on memorization, without regulation of cognitive process (Putri et al., 2016). It causes student become passive learner, not accustomed to use effective learning strategies and learning independently. In addition, the low level of student's metacognitive skill were also caused by the lack of teacher's ability to empower student's metacognitive skill. Another factor that cause the low level of student's metacognitive skill was the learning sources used in the learning processes which not accordance with the curriculum and the competencies. In several developing countries, teachers don't develop the learning sources (including worksheet) by themselves, but they use the learning sources which have been develop (Susantini, 2009). The low level of student's metacognitive skill influences their cognitive and their ability to think analytically, critically, and creatively, so it caused students often fail in learning and solving problem.

Metacognitive skill can be trained by the use of learning sources based on metacognitive strategies (Andriana et al., 2016). The use of that learning sources can organize both metacognitive learning strategy and the learning materials, so students can understand the topic and their learning strategy at once (Wati et al,. 2015). One of learning sources based on metacognitive strategy which can be developed was student worksheet based on know-learned (K-L) metacognitive strategy. It was adapted from know, want, learned (KWL) metacognitive strategy. Learning activities in student worksheet can facilitate students to monitoring and evaluating their performance, so their metacognitive skill can be trained (Andarwati, 2017). In addition, student's initial and final knowledge can be distinguished through the use of that student worksheet.

Based on Permendikbud No. 24 of 2016, KD 3.4 stated that in virus material learning at the high school, students required to be able to analyze structure, replication, and role of virus. In addition, KD 4.4 students also required to be able to do campaign about the danger of viruses. The competencies demanded in KD 3.4 and 4.4 contain metacognitive dimensions which require student's thinking awareness and self-understanding. In terms of content, virus material contains some concepts which can't be observed directly and complex, so high order thinking skills are needed to construct the virus material. In order to meet the demands of that competencies, mastery of metacognitive skills are needed. It is because metacognitive skill can facilitate students to develop higher order thinking skills (Magno, 2010). Therefore this research aimed to produce student worksheet based on metacognitive strategy in virus material topic as an effective teaching material to train students metacognitive skill at 10th grade high school.

METHOD

This research was a developmental research which referred to 3-D model, namely define, design, and develop. Define stage was conducted by analyzing curriculum on virus material, including core competencies, basic competencies, indicators, and concept analysis. Besides, student characteristics and learning assignments were also analyzed. Design stage was conducted by developing student worksheet. K-L student worksheet consist of know-learned phase which can facilitate the students to train their capability to determining their initial and final knowledge. It also equipped with self-confidence level column, comparing concept column, and score column which can facilitate the students to practice monitoring and evaluation skills. Then at the develop stage, student worksheet implemented limitedly to fifteen students of 10th grade senior high school. The effectiveness of student worksheet evaluated based on student metacognitive skill, completeness of indicators, and gain score.

This research had been held from July 2018 to January 2019 in Biology Department, Mathematics and Natural Science Faculty, Universitas Negeri Surabaya and implemented limitedly in SMAN 4 Sidoarjo. Data was collected using self-assessment and test method. Students metacognitive skill were analyzed based on student's abilities in (1) determining their initial and final knowledge, (2) determining their self-confidence level, (3) comparing their initial and final knowledge, and (4)

determining score. Each indicator was assessed using 0 and 1 score, as shown in Table 1.

Table 1. Scoring Technique of Metacognitive Skill

Indicators	Scores	
	0	1
Determining initial and final knowledge	Student don't write done their initial and final knowledge	Student write done their initial and final knowledge
Determining self-confidence level	Suitability percentage of student's answer with their self-confidence level of < 65%	Suitability percentage of student's answer with their self-confidence level of ≥ 65%

Continued of table 1.

Indicators	Scores	
	0	1
Comparing initial and final knowledge	Student statement in the comparing concept column is match with the presence/ absence of difference answer in the know and learn column	Student statement in the comparing concept column is not match with the presence/ absence of difference answer in the know and learn column
Determining scores	Difference score between teacher and students was ≥7	Difference score between teacher and students was <7

Four metacognitive skill which have been analyzed then converted into score and interpreted, as shown in Table 2.

Table 2. Interpretation of Metacognitive Skill Score

Completeness of Metacognitive Skill	Category
1	Poor
2	Average
3	Good
4	Very good

(Adapted from Miller et al., 2009)

Then, the average score of metacognitive skill was converted into four value scale, as shown in Table 3.

Tabel 3. Classification of Metacognitive Skill Assessment

Score Range	Category
$3.25 < X \leq 4$	Very good
$2.5 < X \leq 3.25$	Good
$1.75 < X \leq 2.5$	Average
$1 \leq X \leq 1.75$	Poor

(Adapted from Miller et al., 2009)

K-L student worksheet was effective if student metacognitive skill get an average metacognitive score in the range of 2.50-4.00. The completeness of indicators analyzed by doing calculations as follows.

$$\%\ KI\ X = \frac{\sum \text{Student who complete the "x" indicators}}{\sum \text{Student in class}}$$

% KI X = percentage of indicator X completeness

Then, percentage of completeness of each indicator interpreted, as shown in Table 4 below.

Table 4. Interpretation of Indicators Completeness

Average Score (%)	Category
0-24	Poor
25-49	Average
50-74	Good
75-100	Very good

The sensitivity of each test question calculated using the following equation.

$$S = \frac{(Ra - Rb)}{T}$$

S = test question sensitivity
Ra = the number of student who answer correctly in the final test
Rb = the number of student who answer correctly in the initial test
T = the number of student in the class

Student worksheet determined sensitive if the score had ≥ 0.30. Then, student cognitive learning outcomes calculated using the following equation.

$$\text{Score} = \frac{\sum \text{student score}}{\sum \text{maximum score}}$$

Students determined master the concept if they had score ≥ SKM (≥78). The effectiveness of student worksheet analyzed using the following equation.

$$\%\ \text{completeness} = \frac{\sum \text{student who got score} \geq 78}{\sum \text{student in the class}}$$

Student worksheet determined effective if the students completeness percentage got score ≥ 75%. The effectiveness of student worksheet also assessed based on gain score using the following equation.

$$G = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}}$$

N-gain index that1was obtained determined1in the high category if it got the score > 0.7; in the medium category if it got the score in the range of 0.3-0.7; and in the low category if it got the score < 0.3 (Hake, 1999).

RESULT AND DISCUSSION

The effectiveness of student worksheet based on know-learned (K-L) metacognitive strategy on virus material topic was assessed based on student's learning outcomes, including student metacognitive skill, completeness of indicators, and gain score. Metacognitive skill which trained through this student worksheet was focused on metacomprehension skill, including monitoring and evaluating skill. Metacomprehension is student ability to monitor their understanding level and evaluate their mistakes in the learning process (Soto et al., 2018). Monitoring and evaluating skill based on student's ability to (1) determining their initial and final knowledge, (2) determining their self-confidence level, (3) comparing their initial and final knowledge, and (4) determining scores independently. Recapitulation of student

metacognitive skill while practicing determining and comparing their initial and final knowledge through activity in the K-L student worksheet was presented in Table 5 below.

Table 5. Student Ability to Determining and Comparing Their Initial and Final Knowledge

Student Worksheets	A		B
	Initial Knowledge	Final Knowledge	
I	1	1	1
II	1	1	1
Completeness (%)	100	100	100

A : Student ability to determine initial and final knowledge
B : Student ability to compare initial and final knowledge

Based on Table 5, all student can determined and compared their initial and final knowledge. It indicate that 100% students have a good monitoring skill based on these two indicators. Although the concept written as their initial knowledge in the know phase is still wrong, but students have practiced their metacognitive skill. It is because students involves their cognitive arrangement to remember their initial knowledge. Initial knowledge was essential to streamline the function of metacognitive strategies because it can facilitate the acquisition of new knowledge, test the relevance and accuracy relating the new tasks (Susantini et al., 2013).

Then in the learned phase, student was facilitated to construct virus material concept independently trough discussion activity which equipped with handout. Through that activity, students got the new knowledge, so the most concept written in the learned phase as a final knowledge was right. The activities in the know and learned phase was a metacognitive strategy which can facilitate students to think independently (Jayapraba, 2013). Besides, the use of metacognitive strategy also can improve student awareness and help them to monitor their knowledge (Mok et al., 2006), so they can determined and compared their initial and final knowledge well.

Another metacognitive skill which trained through this student worksheet is student ability to determining their self-confidence level. That skill was presented in Table 6 below.

Table 6. Frequency Data of Student Metacognitive Skill in Practicing Determining Self-Confidence Level

Range of self confidence level	Student Worksheet I		Student Worksheet II	
	Frequency	Percentage (%)	Frequency	Percentage (%)
1-20	0	0	0	0
21-40	0	0	0	0
41-60	0	0	0	0
61-80	6	40	2	13.33
81-100	9	60	13	86.67

Based on data in Table 6, 100% student got score more than 60 in student worksheet I and Student Worksheet II. Furthermore data in Table 6, also showes that there is an increase in the frequency of students who got score more than 80 from 60% in student worksheet I increasing up to 86,67% in student worksheet II. It indicate that students have a good monitoring skill based on their ability to determining their self-confidence level. Students who have a good monitoring skill will respond confidently to the right answer. Student's ability to determining their self-confidence level can trained them to know their understanding about the concept by asking questions to themselves (Shannon, 2008).

Besides, monitoring skill which is based on three indicator described previously, another metacognitive skill which was also trained through this K-L student worksheet was evaluation skill. That skill based on student ability to determining their score independently. That skill described in Table 7 as follows.

Table 7. Students Ability to Determining Score Based on K-L Student Worksheet

Score difference	Student Worksheet I		Student Worksheet II	
	Frequency	Percentage (%)	Frequency	Percentage (%)
0-3	10	66.67	15	100
4-7	4	26.67	0	0
>7	1	6.66	0	0

Data in Table 7 shows that 93,34% student can determine score independently in student worksheet I. That percentage increase up to 100% in student worksheet II. It indicate that all students have a good evaluation skill based on their ability to determine score independently, so K-L student worksheet was considered successful to trained student's metacognitive skill. Students can determined score well because they have been guide to scoring clearly. Besides develop students metacognitive skill, scoring activities also intended to develop students honest character. Metacognitive skill can improve self-assessment skill and develop character (Susantini, 2009). Overall, four indicators metacognitive skill were presented in Table 8.

Table 8. Recapitulation of Students Metacognitive Skill Based on Four Metacognitive Indicators

Student	Metacognitive Skill				Score
	A	B	C	D	
Average	1	1	1	0,93	3.93 (very good)
Completeness (%)	100	100	100	93,33	

A : determining initial and final knowledge skill
B : determining self-confidence level skill
C : comparing initial and final knowledge skill
D : determining score skill

Based on Table 8, all student have a very good metacognitive skill with the value of 3.93. It indicate that student worksheet based on K-L metacognitive strategy on virus material topic was effective to train students metacognitive skill. This was suitable with the statement of Susantini et al. (2018) that the use of metacognitive strategies in learning process can trained student metacognitive skill.

K-L student worksheet can trained students metacognitive skill because learning activities in student worksheet can help them practicing to aware about their knowledge, their thinking activities, and their cognitive skill, so their metacognitive skill can improved (Mok et al., 2006). Learning activities in the student worksheet can facilitate student to be able to explore their knowledge, determine their self-confidence level, and evaluate their work independently, so the student worksheet can train their metacognitive skills, especially monitoring and evaluating skills.

Student metacognitive skill before and after practicing with K-L student worksheet also assessed through metacognitive skill test which integrated with cognitive learning outcomes test. The data of student metacognitive skill based on their ability to determine their scores presented in Table 9 below.

Table 9. Student Metacognitive Skill Based on Their Ability to Determine Self-confidence Level

Range of self-confidence level	Pretest		Posttest	
	Freq-uency	Percentage (%)	Freq-uency	Percentage (%)
1-20	6	40	0	0
21-40	2	13.33	0	0
41-60	2	13.33	0	0
61-80	4	26.67	4	26.67
81-100	1	6.67	11	73.33

Table 9 shows that there is 33.34% students who got the score more than 60 when pretest. That percentage increased up to 100% when posttest. In other words, 100% students were skillful to determined self-confidence level after practicing use K-L student worksheet. It is because students were not ready and their ability to determine self-confidence level have not been trained at the pre-test, while at the posttest, they have learned and have experience to determined self-confidence level through learning activity in the student worksheet. The high ability is because students do their tasks seriously (Susantini, 2004).

Student ability to determined score before and after practicing with K-L student worksheet also assessed through learning outcomes test. That ability described in Table 10.

Table 10. Student Ability to Determine Scores Based on Learning Outcomes Test

Score difference	Pretest		Posttest	
	Freq-uency	Percentage (%)	Frequency	Percentage (%)
0-3	9	60	15	100
4-7	4	26.67	0	0
>7	2	13.33	0	0

The data in the Table 10 shows that 86.67% students can determine score independently at the pretest. That percentage increased up to 100% at the posttest. It showed that student have a good evaluating skill. That ability was essential for student. It is because when they are used to evaluating their work, they can find out their weaknesses in the learning process and try to improve it, so their understanding about a concept will be increased (Iskandar, 2014). In addition, students can also find out their strengths in completing tasks, so they can develop the same way to solved the same problem (Anderson & Krathwohl, 2010).

Besides student's metacognitive skill, another learning outcomes which evaluated in this study are the completeness of indicators and student's cognitive learning outcomes. These learning outcomes were assessed based on learning outcomes test. Recapitulation results of the completeness of indicators and learning outcomes test sensitivities were presented in Table 11.

Table 11. The Completeness of Indicators and Learning Outcomes Test Sensitivities

No	Test Indicators	% Completeness		Sensiti-vities
		Pretest	Posttest	
1	Analyzing the correlation between sturucture and characteristics of virus	0	73.33	0.73
2	Comparing the structure of complex and simple viruses	33.33	86.67	0.53
3	Determining virus replication	26.67	80.00	0.53
4	Comparing the characteristics of lytic and lysogenic cycle	26.67	93.33	0.67
5	Analyzing the causes of HIV/AIDS and how to preventing it	46.67	80.00	0.33
6	Analyzing virus characteristics as a Basis for classifying viruses	0	73.33	0.73
7	Analyzing virus transmission	6.67	80.00	0.73
8	Evaluating the correlation between virus replication and its characteristics	0	66.67	0.67
9	Evaluating viruses role	13.33	73.33	0.60
10	Analyzing the causes of phenomena caused by viruses	0	73.33	0.73

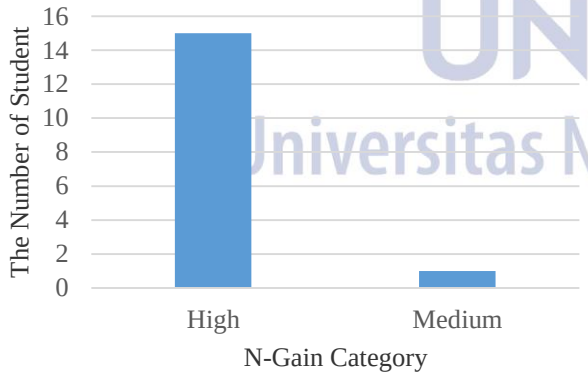
Scores and Categories

0-20% : poor
21%-40% : not good
41%-60% : average
61%-80% : good
81%-100% : very good

The data in Table 11 showed that learning outcomes test sensitivities got score in the range of 0.30-1.00. It showed that K-L student worksheet have a good sensitivities on learning effects. Aiken (1997) stated that question which have good sensitivities have sensitivities score more than 0.30. The data in Table 11 also showed the increasing of the percentage of the indicators completeness on the posttest questions. All indicators of learning outcomes test also determined complete with the good category in the eight indicators and very good category in the two indicators. Learning outcomes test indicator that was developed have been adjusted with the basic competence of virus material topic. These indicators were at the C4 cognitive level (analyze) and C5 cognitive level (evaluation).

The data showed that K-L student worksheet had positive impact for student to understand the concept. Student worksheet could help students to understand virus material concept. It is because they already have good metacognitive skill after practicing using K-L student worksheet. Van der Stel & Veenman (2010) stated that high order thinking skill can be achieved through metacognitive skill. It is because metacognitive skill make students have a better cognitive management. Good cognitive management through planning, regulating, and reflecting the thinking activities makes students be able to achieving better comprehension and retention about concepts (Iskandar, 2014).

Then, the score of learning outcomes test also used to assessed the presence/absence of students improved learning outcomes. It was calculated using gain score method. Recapitulation of students learning outcomes was presented in Pictures 1.



Picture 1. Student Learning Outcomes

Before using K-L student worksheet there was no student got scores more than 78. But after using K-L student worksheet, the percentage of student completeness increased up to 93.33%. Gain score test showed that student learning outcomes have increased in the posttest. Student worksheet was successful increasing 93.33% student learning outcomes in the high category and 6.67% students in the medium category. It indicate that K-L student worksheet can increase student's cognitive learning outcomes. It was because cognitive and metacognitive skill were closely related and interdependently.

Cautinho (2007) stated that there is a positif correlation between learning achievement and metacognitive skill. It is because student with their own abilities can monitor and evaluate their learning process, so it can help students to learning actively and independently (Cera et al., 2013). Metacognitive skill was enable students to manage their cognitive skill and evaluate their mistakes, so they can solved it and increased their understanding (Iskandar, 2014).

The activities in the student worksheet could help student connecting their initial knowledge with the new information, so it could help students to achieved the highest cognitive processes (Susantini *et al*., 2018). Metacognitive strategy also help student to be a critical and reflective thinkers (Susantini *et al*., 2018), so besides to trained metacognitive skill the used of metacognitive strategy also could increase students cognitive learning outcomes.

In addition, K-L student worksheet can organized students's learning material with metacognitive skill at once, so students can practicing metacognitive skill and also the concepts (Wati et al., 2015). Therefore, student worksheet based on metacognitive strategy on virus material topic was very effective to trained students metacognitive skill and increased their cognitive learning outcomes, so K-L student worksheet determined very effective to use in the learning of virus material topic.

CLOSING

Conclusion

Based on the research result, it can be concluded that K-L student worksheet on virus material topic was very effective to trained student metacognitive skill and increased their learning outcomes at once.

Suggestion

Metacognitive skill which can be assessed through the learning outcomes test in this research were limited on indicators of determined self-confidence level and score. So it is essential to develop another learning outcomes test which can assessed other indicators of metacognitive skill, namely determining and comparing initial and final knowledge.

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