

The Effects of Mobile Virtual Laboratory Use towards Students' Metacognition in Practicum Learning

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Abstract: *This study was to analyze the effects of using mobile virtual lab for students in practicum learning, especially those related to their metacognition- knowledge and regulation. The method used was qualitative research. To collect the data, three instruments were used—closed and opened questionnaires, observation sheet, and practicum worksheet. The data were obtained from 105 junior high school students from seven different schools in Semarang. The data obtained showed that the students' metacognitive knowledge worked well. They were very aware of the materials they learnt and the strategy in doing their practicum. During using it, they could monitor and control their cognition. By using the practicum worksheet, they could know their comprehension of the practicum they did because the application directly showed the result of their experiments. When their experiment succeeded, they looked happy and shared their success with other friends. On the contrary, when they had a doubt with their experiments, they would read the worksheet again slowly and repeat their practicum. Even, sometimes they asked their teacher for guidance. To show their practicum performance, they noted the result in the worksheet. After checking their worksheets, it was found that there were 9 out of 105 students who could not do their practicum well. From this study it can be concluded that the use of mobile virtual laboratory could give more favorable effects to the students' knowledge and regulation metacognition in their practicum learning. Therefore, it is suggested that teachers and students use this model in the practicum learning.*

Keywords: *Mobile, Learning, Virtual, Laboratory, Junior High School*

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I. Introduction

Unit of Multimedia Development for Education and Culture, or so-called Balai Pengembangan Multimedia Pendidikan dan Kebudayaan, or for short BPMPK is one of Ministry of Education and Culture's unit having a main duty to develop multimedia for education and culture. There are many models of multimedia for learning and culture had been being developed. One of them is mobile virtual laboratory for junior high school students.

Mobile virtual laboratory, for short called mobile v-Lab, is a kind of learning multimedia being develop to overcome the laboratory capacity problem. Based the data from Ministry of Education and Culture (2017), it was shown that there are only 6.966 feasible labs out of 23.375. It means that 16.409 labs were broken, they cannot be used well for the students in practicum learning. For those, the existence of mobile virtual laboratory is very helpful for them. They can do their practicum wherever dan whenever without going to the real laboratory.

The condition that practicum can be done borderless of time and space is caused the application accomplished by the practicum worksheet. The application seems as the device and the material for doing the experiment. Meanwhile, the way the students doing the practicum, they can use the worksheet. In the application, users are available with a usage information which is enable them how to operate it. Not only the usage information, it is also completed with the experiment information. The users are given the guidance how they operate the materials in it. On the other hand, there are a little bit theory to stimulate them towards the experiment materials. In addition, in this worksheet the users are given a guidance how to do their practicum step by step.

Considering the model, it was assumed that the users' metacognition would work well, either knowledge or regulation. As stated by Flavell (1979), metacognition is thinking about thinking (Lai, 2011). Metacognition knowledge is about thinking how somebody knows about his/her own cognitive and what factors influencing his/ her performance. Then, he/ she tries to know what strategy/s he/she must take and why and when he/she will apply the strategy/s. Meanwhile, metacognitive regulation is how somebody monitors his/her cognition and performance, has awareness of his/ her comprehension and task performance, and evaluates his/

her effectiveness of the applied strategy/s. Based on the definition above, it can be concluded that metacognition is thinking about cognitive knowledge and strategy.

Some studies about metacognitive had been done. Cera, Mancini, and Antonietti (2013) found that there were relationship metacognition, self-efficacy, and self-regulation. They stated that self-regulation is linked to metacognitive skills, for examples, planning, monitoring, evaluation, and concentration. This skills, then, influenced the students' efficacy in learning. Habibian (2015) showed that by implementing the cognitive strategy, the learners' reading ability enhanced significantly. Amin and Sukestiyarno (2015) also found the positiveness of metacognitive and cognitive skills, particularly in mathematics. Concerning to the benefits taken by implementing metacognition, continuing this learning approach is needed.

Some implementation of metacognition by using media had also been conducted. Chun and Hsiu (2011) developed metacognitive skills by using web-based. They found that there were enhancement in students' scores after developing their metacognitive skills by using the web-based made. Hutauruk (2016) found that by using metacognitive card consisting some mathematic questions dealing with the class topic, students had metacognitive awareness to find their own strategy to remind and organize the information to solve their problem. Moreover, the students used to monitor, control, and evaluate what they had done. Concerning the previous researches, it can be seen that media, web-based and card, taking an important role in developing the students' metacognition. Then, it will be assumed that the students' metacognition will also be enhanced by using mobile v-Lab including in a practicum learning.

Based on the assumptions above, the researcher tried to analyze the effects of mobile v-Lab towards the students' metacognition in their practicum learning. She wanted to know whether mobile v-lab had the effects or not. Later on, she would investigate more about the cognitive knowledge components and regulation ones towards the students. In case of cognitive knowledge, she would focus on the students' awareness of materials they followed and the strategy they chose. Meanwhile, about the cognitive regulation, she would focus on the way the students monitor and control their learning while doing their practicum.

II. Literature Review

Mobile Virtual Laboratory

This multimedia-based learning model is so-called Mobile Virtual Laboratory or for short, mobile v-lab. This name is exactly from the term mobile, virtual, and laboratory. Mobile means easy to move. Oxford Dictionary (2018) defines mobile as able to move or be moved freely or easily, relating to mobile phones, handheld computers, and similar technology, able or willing. Dealing with this model, the term mobile means being able to be moved because the application is applied by handheld devices such as mobile phone or tablet. Then, virtual defines as not physically existing as such but made by software to appear to do so (Oxford Dictionary, 2018). According to this definition, the content inside is not really existed. It is represented by using application. Next, the word laboratory or lab by Oxford Dictionary (2018) defined as a room or building equipped for scientific experiments, research, or teaching, or for the manufacture of drugs or chemicals. Based on the definitions above, Mobile Virtual Laboratory is a learning model implemented just like doing a real scientific experiment by using handheld devices.

In case of mobile v-lab developed by Unit of Multimedia Development for Education and Culture (Balai Pengembangan Multimedia Pendidikan dan Kebudayaan, so-called BPMPK) is a learning model integrated with multimedia for facilitating the students to make an experiment and exploration in order to approve a learning precision by using mobile gadget (Manikowati, etc.; 2018). This model has been being developed since 2016. Up to now, there are twelve applications that can be used by the teacher and the students in a practicum learning. The all application can be downloaded from the site of m-edukasi.kemdikbud.go.id.

This model has two main components. First is the application as the equipment of the scientific experiment. The other is called Practicum Worksheet. As the practicum equipment, the application is completed with an operating manual, a practicum usage manual, and an experiment area. The operating manual is to guide the users how to operate the application. It is given the description of the icons in the application. The practicum usage manual is given to inform the competence being achieved, to guide the users how to operate the experiment area, and to notice them how should do while doing the experiment. Meanwhile, the practicum worksheet is a document taken separately from the application. The format of this worksheet is pdf. Therefore, if it is needed, the users can download it and use it with the application. This worksheet functions as the practicum guidance. There are a necessary theory dealing with experiment being practiced, the steps of doing the practicum, dan enrichment questions to gain the students' learning precision. This two components of mobile virtual laboratory is not separated in their practicum learning (Manikowati and Iskandar, 2018).

Metacognition

Metacognition comes from the word "meta" and "cognition". Meta according to Online Cambridge Dictionary (2018) means outside the normal limits of something while cognition means the use of conscious

mental processes. Therefore, metacognition means outside use of conscious mental processes. It means that the processes is not just the process of memorizing or thinking. The process is how to think about cognition.

Metacognition was firstly introduced by John Flavell (1979). Flavell in Lai (2011) defined metacognition as thinking about thinking. He explained that metacognition made someone know about their cognition and how to take a learning strategy. Then, how someone does and aware of the task performance. Beamon (2001) defined metacognition as a powerful phenomenon that enables students to set goals, plan, problem-solve, monitor progress, and evaluate their own thinking effectiveness... It provides the means for adolescents to oversee thinking as it happens, to determine what they know, to appraise what they need to know, and to orchestrate what they should do in a learning situation. The similar definition comes from Ormrod (2006). He defined metacognition as the ability to understand what we know, how we learned what we know, and how we manage and regulate or adjust our own thinking processes to maximize learning and memory.

Based on the definitions above, it can be seen that there two main components of metacognition- metacognitive knowledge and metacognitive regulation. Lai (2011) describes metacognitive knowledge as a knowledge how someone or learner knows about his/her own cognitive and what factors might influence it (declarative knowledge), his/her learning strategy (procedural knowledge), and when or why he/she uses it (cognitive knowledge). Meanwhile, metacognitive regulation is an activity to plan, monitor, and evaluate (Lai, 2011). Panning activity is how a learner identifies and selects the appropriate learning strategies. Monitoring is an activity to attend and be aware of comprehension and task performance. Finally, Evaluating is an activity to regulate of someone's learning processes. Lai (2011) later schemes the components into the following table.

Table 1. Metacognitive Components

Components	Descriptions	Outputs
Cognitive Knowledge	Knowledge about oneself as a learner and factors affecting cognition	Person and task knowledge
		Self-appraisal
	Awareness and management of cognition, including knowledge about strategies	Epistemological understanding
		Declarative knowledge
Cognitive regulation	Identification and selection of appropriate strategies and allocation of resources	Procedural knowledge
		Strategy knowledge
	Attending to and being aware of comprehension and task performance	Conditional knowledge
Cognitive regulation	Assessing the processes and products of one's learning, and revisiting and revising learning goals	Planning
		Monitoring or regulating
		Cognitive experiences
		Evaluating

(Lai, 2011)

III. Methodology

The method used in this research was qualitative. The researcher would investigate the data, identified, and analyzed them. The results of the data, then, were presented through graphics. Then, she interpreted the data and describe the results.

Before investigating the data, the researcher did the followings. First, she prepared the instruments being used to get the data. Second, she tested the instruments to know whether those were valid and reliable. Then, she decided the respondents.

In this study there were three instruments- closed and opened questionnaires, observation sheet, and practicum worksheet. Close and opened questionnaires were used to gain the data about the students' cognitive knowledge. Observation and practicum worksheet were used to get the data of their cognitive regulation.

In testing the instruments, the researcher used test and re-test. In case of questionnaires and worksheet, she firstly gave the instruments to some students of junior high school. She asked them to fulfil the instruments. She, then, omitted the ambiguous items or refreshed them with the acceptable ones. Finally, she tested again the revised instruments. Meanwhile, the observation sheet was tested to some people working in educational technology.

Dealing with the respondents, the researcher used random sampling purposive. She chose the students randomly. However, she still considered the students' grade equaled with the prototypes used. Moreover, she also thought the equaled numbers of the students' chosen. In this research she put seven junior high schools in Semarang as the sample.

Dated August 21st – 29th 2018, in investigating the data, the researcher tried to implement a practicum learning. She greeted, gave the apperception to the students. She grabbed the students by asking some questions dealing the material they would do through an experiment. Then, she asked them about the difficulty of the material. She, in the following steps, explained the material they would do, the goals they get, the device and

mobile v-lab they use, and the time they have. While doing the practicum, the researcher observed them. After doing their practicum, the researcher asked them to fulfil the questionnaires.

Identifying the data was the next step the researcher did. In this phase, she reduced the unsupported data. She grouped the data whether they belong, learning awareness or the strategy. She selected the photos and the videos supported. Finally, she checked out the students' worksheet and grouped who succeeded in their practicum and not.

The following step was to analyze the data. In analyzing the data, the researcher used descriptive analysis by using the presentation and narrative explanation. She offered the data through graphics and or table/s as needed.

IV. Result and Discussion

The followings are the results of the research conducted. First is about students' cognitive knowledge. The second one is about their cognitive regulation. There are two components of cognitive knowledge found- the students' learning awareness and their learning strategy. Meanwhile, in case of the cognitive regulation there were gained also two components- monitoring and controlling.

Dealing with the students' learning awareness, there were five items focused on. The items were about the students' knowledge of the material being experimented, the difficulty of the material, the time to comprehend the material, the learning software and hardware needed, and the concentration for learning the material.

The students' knowledge of the material, it was gained the data as follows.

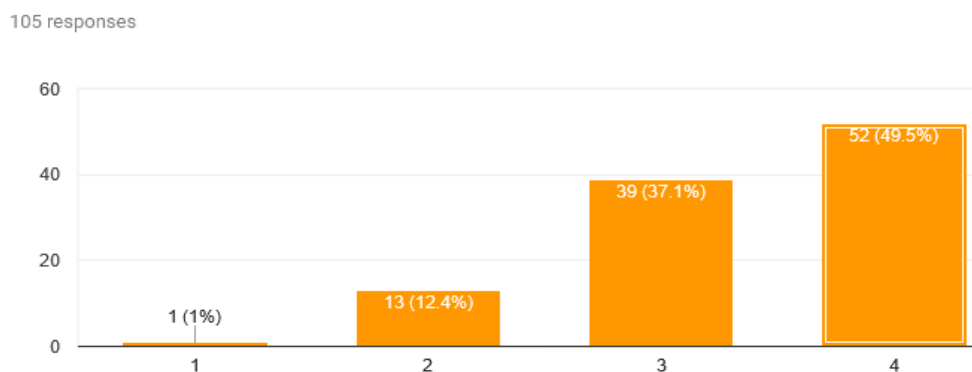


Figure 1. Students' Knowledge of Material

Based on the chart, it was shown that 49.5% students knew very well and 37.1% knew the material being experimented. 12.4% they did not know and just 1% did not know well. If 50% is the median of the range, it was found that 86.6% students knew the material. It means that almost the students know the material they being learnt.

Focusing on the material being experimented, it was found that there were 36.2% students felt difficult in comprehending the material and 30.5% stated very difficult. For those, there were 66.7% students facing difficulty in comprehending the material and just 33.4% stated that it was not difficult. The following is the figure of it.

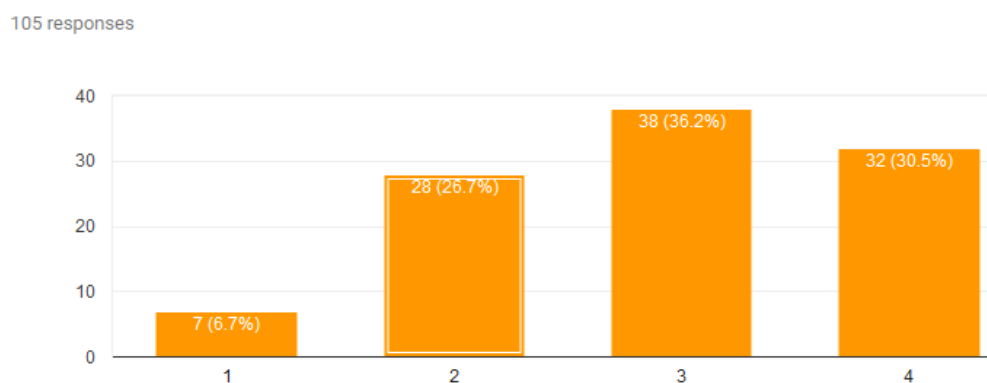


Figure 2. The Difficulty Perception of the Material

Looking at the figure above, the material looks to be important to solve. One strategy that might be used by the teacher is through practicum learning.

Considering the difficulty the students faced, most of them (80%), then, thought that they needed time more to comprehend the material. Even, they (86.6%) also needed media to facilitate them while in their practicum learning. Not only media, the students must concern to do that. There were 87.6% students stated that. Therefore, there are three items the students needed to support their practicum learning. They are time, media, and concentration.

In short, in case of the students' awareness of learning, the students know well about the materials being learnt. They thought that they were difficult so that they thought through practicum learning an appropriate strategy to occupy the material. However, they still needed time, media, and concentration to help them.

Dealing with the learning strategy, there were two components supported. Those were the way they arranged and the time they did their steps in their practicum learning.

It was gained the data that 41.9% of the students indeed in arranging their steps of learning. Then, 44.8% of them stated that they arranged their steps before learning. The rests said not really to do so. Here is the figure.

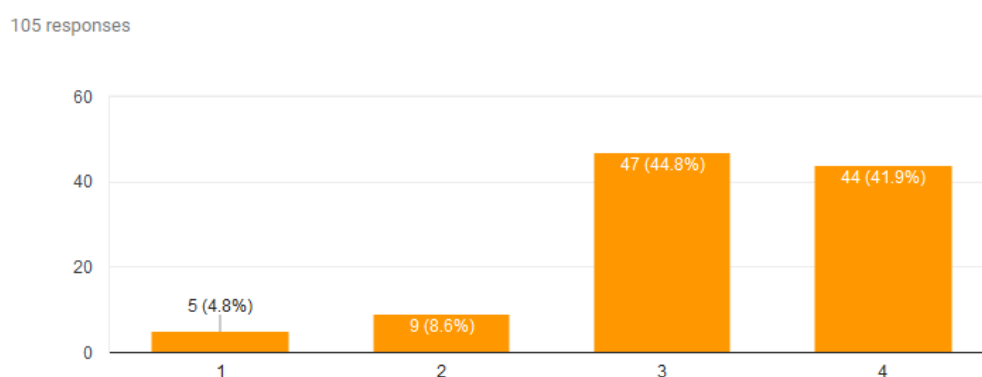


Figure 3. Learning Steps Arrangement

Looking at the data, it was found that mostly the students (86.7%) arranged their steps before practicum learning. The following is the table of the way they did before doing the practicum.

Table 1. The Students' Strategy in the Practicum Learning

No.	Strategy/ ies	Quantity/ ies
1	Listen the teacher's instruction	1 student
2	Prepare the device	2 students
3	Prepare the practicum worksheet	2 students
4	Install the application	8 students
5	Read the theory	15 students
6	Read the manual	17 students
7	Read the practicum steps	22 students

From the above table, it was found that 67 students connected to the strategy of the practicum learning. Meanwhile, the other 38 students stated the normative way of learning, pray before learning. The rests data did not really support. They, then, were omitted. The data seem show how they think of solving the problem.

After making the strategy, it was found that the students were good in choosing an appropriate time to apply the strategies. There were 43.8% of the students knew very well when they must apply the strategies. Then, 38.1% knew when they applied them. On the other hand, 18.1% students did not know when they must apply them. Here is the figure of it.

105 responses

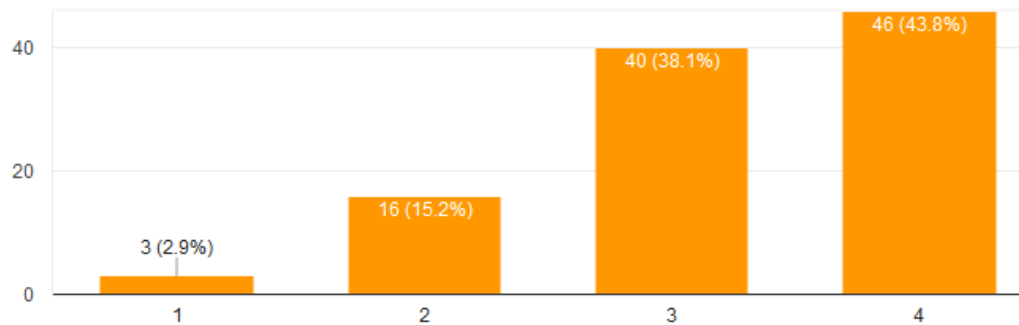


Figure 4. The Time for Implementing the Learning Strategy

Based on the data above, it was gained that most of the students knew what they should do before doing their practicum learning. Then, they also knew when they should apply the strategy.

Analyzing the data, it can be seen that the students' metacognitive knowledge worked well by using mobile virtual laboratory. It can be approved by their learning awareness- knowing their difficulty, time needed, the media facilitated, and the concentration to do. Not only their learning awareness was the effects of the mobile virtual laboratory, the students' learning strategy was also the effects of it. It can be approved when they can arrange the steps before doing their practicum learning and the time when they should execute it.

Dealing with the students' metacognitive regulation, there were two components gained. They were the students' learning monitor and their control. The followings are the data found.

By using the practicum worksheet, the students tried to follow every step in their practicum. By using the application, they tried to experiment the material. Because the application directly showed the result of their experiments. By doing so, they can monitor their own comprehension toward the material being experimented. When their experiment succeeded, they looked happy and shared their success with other friends. On the contrary, they scratched their hair and tried to find somebody else for confirming. They seemed doubt with their experiments. Those were some ways showing how they monitored their practicum. Here are some pictures to show it.



Picture 1. Students Retried their Experiment Together



Picture 2. One of Students Scratched his Hair and Grabbed his Friends looked at him

In case of controlling their cognition, there were some solutions they did. First, they would read the worksheet again slowly and repeat their practicum. They sometimes collaborated with their other friends to replay their practicum. Even, sometimes they asked their teacher for guidance. By using the application they can try and try the practicum until they succeeded. By using the practicum worksheet they can control their way of doing their practicum. Considering the findings, the mobile virtual laboratory had given big effects for the students' metacognitive regulation in their practicum learning. Here are some proved documentation.



Picture 3. Students Tried to Solve the Practicum but Sometimes Asked to the Other



Picture 4. Students Collaborated with Friends and Asked to their Teacher

The third data resource was from the practicum worksheet. After identifying one by one the students' practicum result, it was found that there were just nine out of all students having not really succeeded with their practicum. The practicum had not finished until time was up. Meanwhile, the other ones, could finish their practicum during the time and made a conclusion as the learning precision.

Considering the all data above, it was shown that mobile virtual laboratory had given good effects for the students to solve their own learning problem. It means that mobile v-lab had made them think about thinking, how they should be aware to the materials they had, the difficulty that might be faced, and the needs that might be helpful. Not only those, the students, then, arranged the strategy to execute their problem through a practicum and bargained with the time given. During their practicum, they looked monitor their own cognition toward the materials and control their own learning by asking and or collaborate with others.

V. Conclusion and Suggestion

Based on the result gained, it can be concluded that the use of mobile virtual laboratory being developed by Multimedia Development Unit for Education and Culture had great effects dealing with the students' metacognition of Junior High School. Their metacognitive knowledge worked well. It could be approved by both their learning awareness and strategy. During the practicum it also shown that the students could monitor and control their own learning. The expressions released when they experimented and how they asked and collaborated with others were some proves how their metacognitive regulation worked well.

From the results above, there are some suggestions must be followed up. It is suggested for teachers and students to use mobile virtual laboratory in teaching and learning process, especially in practicum learning. Since it has great impacts for the students to have higher order thinking skill, it is better for the teacher to implement the learning process applied with it. Then, it is suggested for Unit of Multimedia Development for Education and Culture (in Bahasa called- BPMPK) to produce some qualified applications and the worksheets more to facilitate the practicum process. It is also better for BPMPK to make an official relation with the other general directories of Indonesian Education and Culture Ministry dealing with its dissemination. By doing so, it is hoped that there will be a good circle in developing mobile virtual laboratory. It starts from teachers and students and ends with them also.

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