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Practicum-Based Learning to Improve Critical Thinking Ability and Student Learning Outcomes on Cell Metabolism Material

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Abstract

Practicum in the laboratory makes students more engaged with the learning process and improves communication with the teacher. The aims of this research are to determine the effect of practicum-based learning to improve critical thinking skills and learning outcomes of students on cell metabolism material. This research includes a Pre-Experimental with One Group Pretest-Posttest Design. The sample was determined using simple random sampling techniques. Pre-tests and post-tests were done to collect data. Data analysis of learning outcomes and critical thinking skills using gain value analysis. The results of this study showed the student learning outcomes value was 24 and the value of students' critical thinking was 7. The effect size value of student learning outcomes obtained 2.3 points, which was included in the very high category and the effect size value for students' critical thinking was 1.4 points, which was included in the high category. We can conclude that practicum-based learning influences students' critical thinking and improves students' learning outcomes on metabolic matter.

Keywords: Cell Metabolism, Critical Thinking, Learning Outcomes, Practicum-Based Learning.

INTRODUCTION

Nowadays globalization guides in improving aspects of life. In teaching and learning activities there is a learning process where in this process the teacher must be more creative in teaching students. Memory and thinking are factors that are closely related to the learning process. If the learning process goes well, the learning outcomes will also be good. There are several types of thinking skills, one of which is the ability to think critically (Haerudin, Hery and Najuang, 2018).

Critical thinking is a mental process such as deduction, induction, classification and reasoning. Critical thinking is also defined as a process with the involvement of students to receive data, analyze data, and evaluate data and also formulate a decision based on evaluation results (Redhana et al., 2017). The main key in critical thinking is to develop an impersonal approach with argumentation and scientific facts (Aulia & Indana,2020). Critical thinking is very important and necessary for every student because with the ability to think critically, students will be able to carry out the process of developing other thinking skills, for example the ability to solve problems and make decisions (Hutapea & Purba, 2017). Critical thinking skills need to be integrated into learning as an objective of the learning process because it can provide experience to be able to compete in the future (Rachmawati, 2018).

One method that supports students in developing critical thinking skills is through practicum

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activities. Practicum is a learning activity that aims to give students the opportunity to test and apply theory using laboratory facilities and outside the laboratory.Practicum-based learning can be used as an alternative learning that can encourage students to actively learn to reconstruct their conceptual understanding (Bruhin et al., 2012).

Practicum is a way of teaching, where students conduct an experiment on something, observe the process and write down the results of the experiment, then the results of the observations are presented to the class and evaluated by the teacher. With the practicum method, students carry out activities to analyze, provide arguments, evaluate and make conclusions so that it has an impact on students' critical thinking skills (Pratiwi & Aslam, 2021).

Based on interviews with MTS teacher Aswaja Pontianak, cell metabolism material, one of the new materials learned by students. The material for cell metabolism is additional material for the energy chapter and living systems. Previously there was no specific discussion about cell metabolism material.

It may be known that practicum-based learning is rarely carried out by teachers for several reasons, such as the ability to manage limited learning strategies, less efficient time allocation, and limited laboratory room facilities that limit the space for teachers to do practicum. Limited tools and materials are also one of the reasons why practicums are rarely carried out in schools.With cell metabolism material that can be done with practicum outside the laboratory, it is hoped that students will find it easier to understand learning.Of course this makes learning biology fun and provides a great opportunity for students to explore their curiosity. Practicum-based learning can be a learning model that helps and facilitates students and overcomes these obstacles. The research aims to determine the effect of practicum-based learning to improve critical thinking skills and student learning outcomes in cell metabolism material.

RESEARCH METHODS

This research was conducted at MTs Aswaja Pontianak in class VII. The population in this study were all students of class VII MTS Aswaja Pontianak. The sample was part of the population. The sample in this study were all students of class VII MTS Aswaja Pontianak using practicum-based learning. The sample used consists of one class. Before determining research sample, the homogeneity of variance test is carried out first on the odd semester. The form of research conducted in this research is Pre-Experimental Design with models One-Group Pretest-Postest.

Table 1. Research Design*One-Group Pretest-Postest Design*

Pretest	**Treatment**	***Posttest***
O1	**X**	**O2**

Source: (Sugiyono, 2012:108)

Information:
O1 **:** Score *Pretest* before *treatment*.
O2 **:** Score *Posttest* after *treatment*.
X **:** Treatment

As for the research design, experimental class students during the research were treated through a practicum-based learning process.

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After completing the discussion related to cell metabolism material which was given 2 meetings, the experimental class students were given*Posttest* at the end of learning. This is done to see the results of learning. The student learning outcomes obtained will be calculated on average using the formula for the score obtained divided by the maximum score multiplied by 100. The data processing uses*Microsoft office excel* .

Meanwhile, critical thinking skills are given*posttest*after learning is done. to see students' critical thinking skills by calculating the effect of using *effect size cohen (*Becker, 1999). Based on the calculation, it is seen that it is included in the very high, high, medium, low, very low categories.

RESULTS AND DISCUSSION

The results of research regarding student learning outcomes on cell metabolism material in class VII MTs Aswaja Pontianak Academic Year 2022/2023. As for the average value of learning outcomes value*Pretest* and *posttest* experimental class at MTs Awaja Pontianak (Table 4.1)

Table 2. The average result of learning and critical thingking ability of experiment class

Dependent Variables	*Pretest*	*Posttest*	*N Gain*
Critical Thinking	61	84	24
Learning Outcomes	75	82	7

Average value*pretest* obtained by experimental class 61 and*posttest* experimental class 84. So that the average value of gain in the experimental class is 24. Based on the average value of learning outcomes, after being given treatment (*Posttest*) is higher than the value before the treatment (*pretest*).

Effect of Experimental Class Learning Outcomes

Learning results in a change in one's conduct both in knowledge and in attitude after undertaking the learning pocess of both formal and non-formal learning. According to Rusmono (2017), study results are changes in behavior. Such behaviors are acquired after students have completed their learning program through interactions with various learning and learning resources.

The effect of using practicum-based learning on learning outcomes is then calculated*effect size*. Based on calculations using*effect size*a value of 2.3 is obtained which is included in the very high category and gives effect based on the interpretation table*Cohen's* (1999).

Critical Thinking Results

The results of research on critical thinking skills in cell metabolism material in class VII MTs Aswaja Pontianak in the 2022/2023 academic year. The average value of critical thinking in the experimental class at MTs Awaja Pontianak (table 2)

The average value of the pretest obtained by the experimental class was 75 and the posttest for the experimental class was 82. So that the average gain in the experimental class was 7. Based on the average value of learning outcomes, after being given treatment (*posttest*) is higher than the value before the treatment (*pretest*). The influence of the use of practicum-based learning on critical thinking is calculated*effect size* . Based on calculations using*effect size*a value of 1.4 is obtained which is included in the high category and gives effect based on the interpretation table *Cohen's* (1999).

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Practicum-based learning on cell metabolism material has a very high influence on learning outcomes. Based on the results of calculations regarding practicum-based learning on student learning outcomes in cell metabolism material for class VII MTs Aswaja Pontianak, the effect of learning outcomes is 2.3 which is included in the very high category and gives effect based on the interpretation table*Cohen's* (1999). Cognitive tarning indicators on thhis research are given to a student with LKPD which there is a material on the metabolism of a cell. Afterward the teacher delivers cellular metabolic materials to the student, and then the student is given the opportunity to ask about the material being presented whether there is anything that is not understood about the material being presented.

For domain effects syudents are given instruction to do an imractical on the metabolism of Hydrilla plant cells. Students were divide into four group of 4/5 people, after which students were given instruction to assemble a reactional tube that contained Hydrilla. Then answer whatever tolls and materials to use when it's immobile. (Daveau et al., 2017) stated that practicum-based learning helps students more easily understand subject matter because students can discover it for themselves and can interact directly with the environment. And also allows students to use experience or knowledge that has been previously owned directly so that it can improve learning outcomes. In this learning students are not only listeners but they are active in the learning process.

Indicators of learning outcomes in the cognitive domain in this study students were given worksheets in which there was material about cell metabolism. After that the teacher conveys cell metabolism material to students, then students are given the opportunity to ask questions about the material presented whether there is something they have not understood about the material presented.

For the effective domain, students are given instructions to do practical work on plant cell metabolism*Hydrilla.* Students are divided into 4 groups consisting of 4/5 people. after that students are given directions to assemble a test tube in which there are plants*Hydrilla.* Then answer what tools and materials will be used during the practicum. In the psychomotor domain students make observations on plants*Hydrilla* see what happens when the plants*Hydrilla* are indoors and outdoors. Students see how many bubbles are produced when photosynthesis occurs.

The learning outcomes in this study are to see the achievement of understanding the concepts that have been carried out in practicum-based learning, because through the learning outcomes test it can be seen whether this learning has been successful in achieving the Minimum Completeness Criteria (KKM) determined by the school. Learning achievement tests are needed by schools to determine KKM achievement, because students' cognitive abilities captured through learning achievement tests are also needed to determine the success of practicum-based learning. The indicator of the success of this study was determined by the achievement of an increase in learning outcomes of 2.3%, and the percentage of complete learning outcomes was included in the very high category.

The high and low learning outcomes can be seen from the learning methods taught in cell metabolism material about photosynthesis. The method used is the practical method. The practicum method can be carried out to students after the teacher gives directions, instructions, instructions for implementation. This activity takes the form of practice using certain tools, in this case training students' skills in using the tools that have been given to them and the results they achieve. Before the students carry out the practicum the teacher gives an explanation of the rules in the practicum. After that the teacher divides students into 4 groups consisting of 4/5 students.

LKPD it is a helpful and easier tool for learning and teaching activities so that effective interactions

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between learners with education can manifest and enhance the learning activity and acchievements of learners.The teacher gives LKPD as a guide for students. The teacher directs students to see the LKPD that has been distributed, after that the teacher explains what steps will be taken to see the photosynthesis process that occurs in plants*Hydrilla*. The tools and materials used in the cell metabolism practicum on photosynthesis are water, funnel, beaker, wire, stopwatch, test tube, and plants*Hydrilla*. The practicum is carried out in the classroom and outside the room. The purpose of the cell metabolism practicum about photosynthesis is to study and know the process of photosynthesis.With practicum-based learning in the learning process, very good learning outcomes are obtained for students.

In practicum-based learning this makes students more active, motivated and more eager to learn. According to Susanti (2013) interesting learning activities can make students more enthusiastic and motivate students in learning. As research conducted by Farid, and Pramukantoro, (2006) and Ani Hastuti, (2013) states that learning practicum methods can improve learning outcomes and is in line with previous research, researchers also found that learning practicum methods with materials in everyday life can improve student learning outcomes.

According to Roestiyah (2002) learning with practicum methods so that students are able to find and find problems on their own or do it themselves by experiencing it themselves students will be more confident about something that can enrich experience and develop a scientific attitude, whereas according to Balram (2017) in learning with this experimental method students are given the opportunity to experience themselves or do it themselves, observe a process, observe an object, analyze, prove and draw conclusions or the process they experience. In science learning activities using the practicum method, there are many advantages to be gained, including 1). Students will learn more curious, 2). Students become more skilled and more creative, 3). Students will practice respecting and be more accepting of opinions between friends and others.

This is in accordance with the opinion of Fatimah (2011: 95) saying "in the context of learning there are several benchmarks that can be used to determine student achievement. One of the benchmarks used is learning achievement which refers to the achievement of an educational taxonomy that includes cognitive, affective, and psychomotor aspects. This is in accordance with the opinion of Situmorang (2020) as the end result of non-conventional learning, students have the skills to recall and even be able to convey information that has been previously obtained quickly and precisely. Practicum-based learning is a good learning strategy for students to develop manipulative skills, hands-on and mind-on skills, because students are challenged to be active in solving problems, thinking critically and creatively in uncovering facts, building concepts, and applying principles to become more meaningful (Sukaesih, S., 2011).

The Influence of Critical Thinking Ability

Critical thinking ability is an intellectual ability possessed by a person to understand wrong. They are able to analyze these problems, and can decide on appropriate solutions to these problems (Haeruman et al., 2017: 159). The researchers explained that basically learning thinking skills can be easily done. Unfortunately, the learning conditions that exist in most schools are not very supportive for the implementation of learning critical thinking skills. Some of the obstacles include that learning in schools is still focused on teachers, and the focus of education in schools is more on memorizing knowledge. That the ability to think critically is actually a person's ability that can be learned and taught, both in school and in independent learning.

Based on research conducted by researchers, the aspect that becomes a benchmark for the level of

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success of students in learning to use practicum-based learning is the ability to think critically. These aspects are contained in the practicum report where students are required to be able to answer the right problems in accordance with the objectives of practicum learning. In practicum-based learning it is required that students play an important role in learning at school with students who are active in carrying out practical activities to identify the photosynthetic process that occurs in plants.*Hydrilla,* so that students can understand the cell metabolism learning material about photosynthesis.

Based on the results of calculations using*effect size* regarding practicum-based learning on student learning outcomes in class VII cell metabolism material at MTs Aswaja Pontianak, the effect of learning outcomes is 1.4 which is included in the very high category and gives effect based on the interpretation table*Cohen's* (1999).

Students' critical thinking skills have increased with an average value*posttest* of 82 higher than the value *pretest* with an average value of 75 it is influenced by hands-on learning based on practicum to train students' critical thinking skills, foster student initiative, study motivation, and cultivate interpersonal relationships in individual work, so that the criteria for students' critical thinking skills are classified as critical. The learning process is more organized with time used as efficiently as possible, students are more active and take a role in practicum, actively ask and answer questions from the teacher, and can conclude the results of the practicum carried out.

Making time efficient also increases students' understanding of the material being taught, in accordance with the characteristics of the practicum-based direct learning model which is directed at achieving goals so that teachers have high expectations of the tasks that must be carried out by students. Hunaipi, Samsuri, & Afrilyana (2014) stated that the direct learning process greatly optimizes the use of time. The direct learning process greatly optimizes the use of time (Hunaepi, et al. 2014) so that students can focus and find their own ideas or ideas that can be poured into the answers to the questions they are working on.

Tuti (2014) states that the results of the study show that students' critical thinking skills using practicum methods are very good. So that it can be said that the practicum-based direct learning model is effectively used as a learning model that is used to train students' critical thinking skills. From the results of this study, it shows that there is an influence from the practicum-based direct learning process which requires students to be active in the learning process and prove the material being taught so that students are able to think critically in analyzing and concluding the practicum results.

The practicum-based hands-on learning process is more organized with time used as efficiently as possible, students are more active and take a role in the practicum, actively ask and answer questions from the teacher, and can conclude the results of the practicum carried out. The increase in students' critical thinking skills was also due to the level of students' knowledge and science process skills which were getting better at each meeting. The thing to remember is that all forms of critical thinking cannot be done without the main component, namely knowledge. Knowledge is something that is used for critical thinking and is also obtained as a result of critical thinking (Surya, 2015).

In the learning process students are also expected to be able to develop critical thinking skills that can be used to analyze their thoughts in making choices and drawing conclusions carefully (Kurniawati, et al., 2014). The teacher is tasked with optimizing the basic abilities of students so that they develop effectively. A teacher must be able to become a student facilitator, so that students do not experience difficulties and boredom in teaching and learning activities. For this reason, an appropriate learning method is needed to improve critical thinking skills and student learning outcomes and one of them

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is through a practicum-based learning model.

Ibrahim (2007) states that in order to lead to learning that can develop critical thinking skills, it must start from learning that makes students active. In analyzing, concluding to answering questions given by the teacher. So for this reason researchers need to conduct research using a direct learning model based on practicum on Science Process Skills and Students' Critical Thinking Ability.

The increase in critical thinking skills experienced by students after the learning process is because students have been actively directed to develop their critical thinking skills through practicum activities and direct observation (Sukmana, 2008). In addition, these findings also reinforce previous research on the effect of practicum in developing critical thinking skills (Akhyani, 2008; Rustaman 2006). This research is supported by Litasari, et al (2014) which shows that students are more interested in participating in laboratory-based biology learning in teaching and learning activities at school. Students consider that laboratory-based learning is more fun, not boring and more interesting because they can know and experience directly about the material obtained.

This research is supported by previous research data found in Hastuti's research (2014) the results of the study show that students' critical thinking skills using practicum methods are classified as very good. So that it can be said that the practicum-based direct learning model is effectively used as a learning model that is used to train students' critical thinking skills. From the results of this study, it shows that there is an influence from the practicum-based direct learning process which requires students to be active in the learning process and prove the material being taught so that students are able to think critically in analyzing and concluding the practicum results.

CONCLUSION

Based on data analysis results from study and critical thinking abilities obtained from research, there is an impractical-based learning impact on critical thinking capabilities with a 1,4 effect size value, including high levels and student study results with a 2,3 in high-category.

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