



## Problem-based learning (pbl) model: How does it influence metacognitive skills and independent learning?

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### Abstract

The problem-based learning (PBL) model creates an active and creative learning atmosphere. It is expected to positively influence students' cognitive skills and learning independence. This research aimed to determine whether the PBL model influence 1) students' metacognitive skills; 2) students' learning independence; and 3) metacognitive skills and learning independence simultaneously. This research was a quasi-experimental research with a Posttest-Only Control Group Design. This research employed the quantitative method with the cluster sampling technique. The instruments of this research were a metacognitive skill description test and a learning independence questionnaire. The research hypothesis was tested using the MANOVA test after the data had been tested for their normality and homogeneity. The results showed that the PBL model influenced 1) students' metacognitive skills; 2) students' learning independence; and 3) metacognitive skills and learning independence simultaneously. The results indicated that the PBL model produced a better result on students' metacognitive skills and learning independence compared to the conventional learning model.

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### INTRODUCTION

Education is an activity that must be carried out intentionally and regularly to create a learning atmosphere and learning process where the students can actively develop their character, mind, and body (Andayani, Tindangen, and Haryanto 2017; Assidiqi 2015; Siagian 2016). Education is one of the spearheads in improving the quality of life of every human being (Apriyani 2017). One of the sciences that must be studied by students in formal education in Indonesia is biology.

Biology has become a means for students to increase their knowledge, skills, attitudes, values, and responsibility toward the environment. Therefore, practicum activities are needed to support students' concepts understanding (Hamidah 2014; Suryaningsih 2017). The concepts in biology lessons are interrelated so that understanding one concept affects other concepts (Lase 2016). One of the skills needed to understand the biology concept is students' metacognitive.

Metacognitive knowledge that can be used to strategically achieve cognitive goals is called metacognitive skills (Sari 2012). These skills need to be developed, which in turn will produce higher-order thinking skills (Aprilia and Sugiarto 2013; Sumampouw 2011). Sari (2012) states that there is a significant relationship between metacognitive skills and students' learning outcomes. That is why metacognitive skills are one of the essential skills to be possessed by students. Also, learning independence is an important factor that influences students' learning outcomes.

Independent learning has become the basis of the learning process in achieving certain goals (Youngest et al. 2019). Students with good learning independence can usually think critically, creatively, and innovatively. They are not easily influenced by others' opinions (Prayuda, Thomas, and Basri 2014). Therefore, learning independence is an important factor in achieving students' learning outcomes (Aini and Taman 2012; Mulyaningsih 2014; Ningsih and Nurrahmah 2016). An educator is required to always pay attention to students' learning independence. Poor learning independence will negatively impact students' learning outcomes. The Problem-Based Learning (PBL) model is expected to be one of the solutions that can be used to improve students' metacognitive skills and learning independence.

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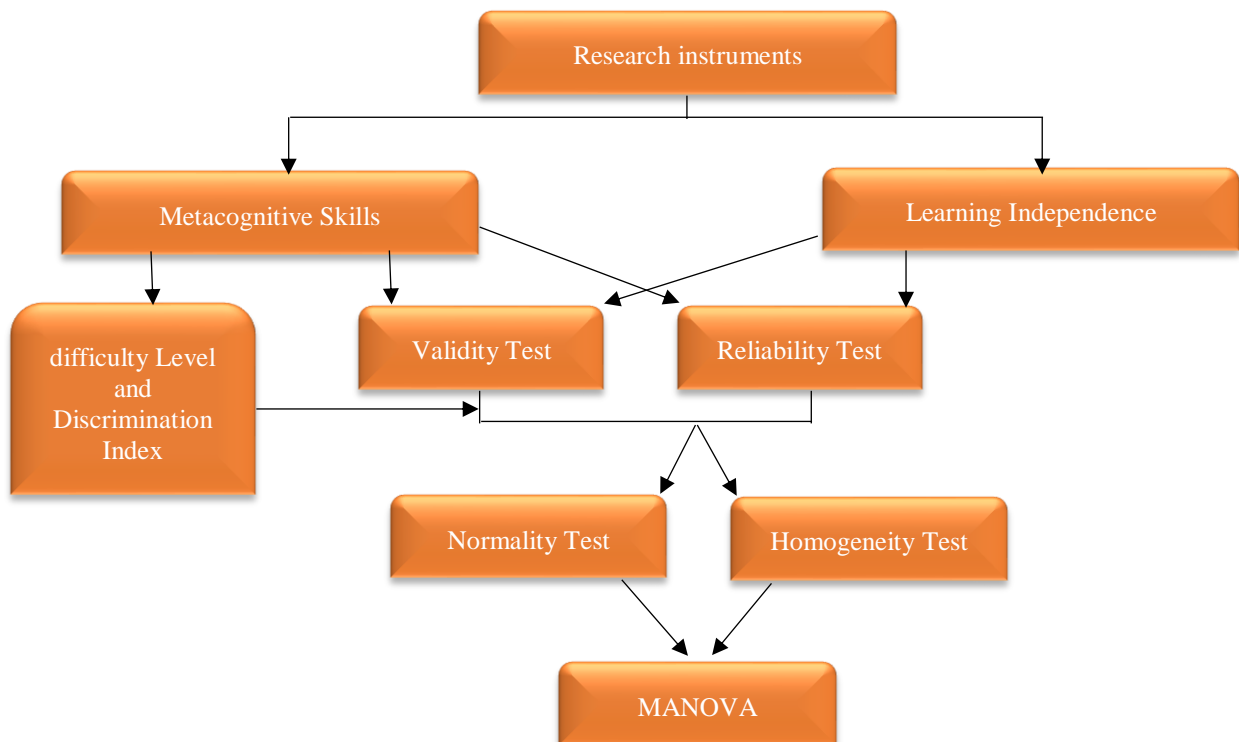
The PBL model requires students to construct their own knowledge, find solutions independently, and develop inquiry and higher-order thinking skills through collaboration (Andayani et al. 2017; Yusri 2018). PBL model's principle provides a problem as the first step in the learning process (Farisi, Hamid, and Melvina 2017). The problems are often encountered in everyday life and are relevant to the learning materials (Prasetyo and Kristin 2020). Educators act as facilitators who direct the participant to find the solutions needed. The PBL model is expected to improve students' metacognitive skills and learning independence.

The PBL model was selected based on several other relevant research results. The application of this learning model can improve concepts understanding, creative thinking, and critical thinking (Farisi et al. 2017; Prasetyo and Kristin 2020; Utomo, Wahyuni, and Hariyadi 2014). Besides, the PBL model presents positive effects on students' mathematical problem-solving abilities and learning outcomes (Amin 2017; Supiandi and Julung 2016; Yusri 2018). These relevant studies have not yet looked at the effect of the PBL model on students' metacognitive skills and learning independence. Therefore, that makes this research different compared to previously mentioned studies.

### METHOD

The quantitative research method was used in this study. The design of the research was quasi-experimental with a posttest-only control group design because not all variables and the experimental conditions can be regulated and controlled. The samples were divided into an experimental group or a control group taken by cluster random sampling. The posttest-only control group design in this research was used to determine the effect of treatment by only comparing the posttest mean values between the experimental group and the control group.

The instruments used were a description test for metacognitive skills and a questionnaire for learning independence. Both instruments had previously met the valid and reliable criteria. The metacognitive skills and learning independence data obtained were tested using normality and homogeneity tests and then continued with the MANOVA test. The following figure displays the research method:



**Figure 1. The Flowchart of the Research Method**

## RESULTS and DISCUSSION

The research data had been taken from the metacognitive skills post-test results and students' learning independence questionnaires. The following are the research data to determine the effect of the PBL learning model on metacognitive skills and student learning independence.

**Table 1. The Recapitulation of Metacognitive Skills**

Classes	Percentages
Experimental	81.15%
Control	70.10%

Based on table 1, the students in the experimental class had better metacognitive skills than the control class. Furthermore, the following is a recapitulation of learning independence data:

**Table 2. The Recapitulation of Learning Independence**

Classes	Percentages
Experimental	55.28%
Control	45.06%

Table 2 shows that the control class and the experimental class obtained different learning independence mean values. It appears that the mean value of the experimental class was greater than the control class.

The metacognitive skills and learning independence data of the experimental class and the control class were then analyzed to determine whether the data distribution was normal and homogeneous or vice versa. The normality and homogeneity tests were performed as the prerequisite tests before performing the MANOVA analysis. Table 3 contains the results of the normality test.

**Table 3. The Results of the Normality Test**

Variable	Class	Sig level.	sig.	Information
Metacognitive Skills	Experimental	0.05	0.187	Normal Distribution
	Control		0.200	Normal Distribution
Learning Independence	Experimental		0.092	Normal Distribution
	Control		0.200	Normal Distribution

Table 3 displays that all groups came from a normally distributed population. The last prerequisite test was the variance-covariance test using Box's M test. This test was performed to see if the variances of the two data have the same or homogeneous covariates or vice versa. The Box's M test was performed using SPSS statistical software version 17 and the results can be seen in Table 4.

**Table 4. Homogeneity Test**

	Metacognitive Skills	Conclusion
Box's M	0.649	Homogeneous
F	0.209	
df1	3	
df2	691920,000	
Sig.	0.890	

Based on Table 4, the variances of the data on metacognitive skills and learning independence, both in the experimental and control classes were homogeneous.

After the two prerequisites had been met, the data analysis was performed using the Multivariate Analysis of Variance (MANOVA) test. The MANOVA test was used to determine whether or not the independent variable (PBL model) influenced the two dependent variables (metacognitive skills and learning independence). Table 5 contains the summary of the MANOVA test.

**Table 6. The Results of Multivariate MANOVA Analysis**

	Effect	Value	F	Hypothesis df	df error	Sig.
<b>Treatment</b>	Pillai's Trace	.524	33,611b	2,000	61,000	.000
	Wilks' Lambda	.476	33,611b	2,000	61,000	.000
	Hotelling's Trace	1,102	33,611b	2,000	61,000	.000
	Roy's Largest Root	1,102	33,611b	2,000	61,000	.000

Based on Table 6, the value of sig. was  $0.000 < 0.050$ , which means that there was an influence of the PBL model on metacognitive skills and students' learning independence. Furthermore, the univariate statistical test was used to determine whether the PBL model influenced the metacognitive skills and learning independence of each student. The results are described in Table 7.

**Table 7. The Results of Univariate MANOVA Analysis**

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
<b>Treatment</b>	Metacognitive Skills	1950,437	1	1950,437	31,991	.000
	Learning Independence	1670,766	1	1670,766	39,412	.000

The first row of Table 7 displays the variable sig. value obtained was  $0.000 < 0.05$ . It means that the PBL model influence students' metacognitive skills. Therefore, it can be concluded that the PBL model provided better metacognitive skills than conventional learning. Furthermore, in the second row of Table 7, the learning independence variable obtained a sig. value of  $0.000 < 0.05$ . It means that the PBL model influenced students' learning independence. Therefore, it can be concluded that the PBL learning model produced better learning independence than conventional learning.

## Discussion

The first meeting was held on March 1, 2021, in the experimental class by implementing the Problem-Based Learning model in the learning process. The first stage of the PBL model was providing a stimulus to students by providing a video about the human coordination system and directing them to observe the video. The second stage was identifying the problem where the students were directed to the problems around them. The third stage was collecting data where the students discussed things that must be done together with their groups. At this stage, the students constructed their own knowledge through discussion to seek or find solutions to problems. Then the last step was verification,

The second meeting was held on March 3, 2021, in the control class. The implementation of learning in this class was the same as the first meeting where the students were given a problem to discuss. After that, the students came forward to convey the results of their discussions and the teacher provided conclusions from the results of students' discussions. The students listened carefully and then they had a questions and answer session. At the end of the learning process, the teacher administered a posttest.

During the first meeting, the learning process was not conducive. However, at the second meeting, the learning process run smoothly. In the control class, the students listened and asked questions when something was not clear. At the end of the learning process, a posttest was also administered. Overall metacognitive skills increased as the results of the implementation of the PBL model based on students' average posttest score (81.15% in the excellent category).

The experimental class's average score on the learning independence questionnaire was 55.28%. at the same time, the control class obtained an average score of 45.06%. It can be said that the PBL model in the experimental class increased the learning independence compared to the control class which used the Discovery Learning model commonly used by biology teachers at SMA N 1 Bumi Agung.

The results showed that the PBL model provided better metacognitive skills and learning independence compared to the conventional learning model. The students were very enthusiastic during the application of the PBL model based on the number of questions and explanations given by students during the learning process. The results of this study complement several relevant studies that look at the positive impact of the PBL model (Amin 2017; Farisi et al. 2017; Suminar and Meilani 2016;

Supiandi and Julung 2016; Yusri 2018). The PBL model is one of the learning models that can improve necessary students' skills.

### CONCLUSION

Based on the results of the study, it can be concluded that there the Problem-Based Learning (PBL) model influences the 1) metacognitive skills; 2) learning independence; and 3) metacognitive skills and learning independence simultaneously. Students who were treated using the PBL model had better metacognitive skills and learning independence than students who were treated using a conventional learning model.

Based on the research results, the researchers suggest further research to use the PBL model in their research on other skills. For teachers, the research results could be used to enrich the selection of learning models that can be used in the classroom.

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