Comparing Metacognitive Skill between Problem-based Learning Combine Question Student Have and Problem-based Learning Combine Learning Journal

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Keywords: Metacognitive skill, problem-based learning, question student have, learning journal.

Abstract: Metacognitive skills is a very important skill possessed by students regarding the ability for planning, monitoring and evaluating the cognition process in order to achieve its learning objectives. This research aimed to determine comparing metacognitive skill between Problem-Based Learning combine Question Student Have and Problem-Based Learning combine Learning Journal. The research methods used Pretest-Postest Nonequivalent Control Group Design with ninety-six senior high school students in South Tangerang. The Anova Test result shows there are significant differences on metacognitive skill ($F = 9{,}388$, $p < 0{,}05$) with the intervention of PBL (control), PBL combine QSH (first experiment), and PBL combine LJ (second experiment). Tukey Test results showed there are significance difference on metacognitive skills with PBL versus PBL-QSH ($p=0{,}000 < \alpha = 0{,}05$) and PBL versus PBL-LJ ($p=0{,}010 < \alpha\ 0{,}05$). There was no significance difference on metacognitive skills between treatment PBL-QSH versus PBL-LJ ($p=0{,}520 > \alpha = 0{,}00$). The three aspects of metacognitive skills, planning, monitoring and evaluation have significant differences in the overall treatment.

1 INTRODUCTION

In this 21st century, people are being pushed and demand to master various skills. Thus, on this case, education is expected to prepare students mastering these various skills in order to be a successful individual in their life. Important skills in the 21st century are still relevant to the four pillars of life which include learning to know, learning to do, learning to be and learning to live together. Each of the four pillars consist of special skills that need to be empowered in learning activities. For example, critical thinking skills, problem solving, metacognition skills, communication skills, collaboration skills, innovation and creation skills, information literacy skill and many other (Zubaidah 2017). This is affirmed by (Ozturk 2017) that teaching metacognitive to individuals is the main goal of education since the 21st century, students must be able to build strong content knowledge with response to various audiences, tasks, goals, critical disciplines by synthesizing from various sources. Metacognitive skills also needed more than ever in order to aid individuals and groups in becoming more adaptable and flexible (Hogan et al. 2015).

One of the skills that students must have is the metacognitive skills. John Flavell defined metacognitive in the end of 1970's as "*cognition about cognition phenomena*" or in short "*thinking about thinking*" (Lai 2011). Metacognitive refers to high-level thinking skills that enable active control regarding the relationship of cognitive processes in learning (Livingston 2003).

Metacognition is a person's knowledge and awareness about his cognition and ability to regulate his cognition process. Metacognition knowledge includes declarative, procedural and conditional knowledge. The process of cognition has three essential functions, namely planning, monitoring and evaluating the process of cognition in order to achieve the goals (Boekaerts 1999). And its strengthened by (Balcikanli 2011), that there are three skill categories that have an important role in regulating student skills related to the learning process, namely the skills of planning, monitoring and evaluating.

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Table 1 : Pretest and Posttest Metacognitive Skill.

Learning Model	*Instrument*	N	$\bar{x}$	SDV	Min.	Max.
PBL (X1)	*Pretest*	34	26,69	11,20	3.70	40,47
	Posttest	34	50,44	10,24	25.93	70,37
PBL – QSH (X2)	*Pretest*	32	29,40	15,31	0.00	48,15
	Posttest	32	63,54	12,59	37,04	85,19
PBL – LJ (X3)	*Pretest*	30	24,44	9,41	11,11	40,74
	Posttest	30	60,00	15,21	33.33	96,30

Based on the observation and interview in high schools located in South Tangerang, biology teachers stated that metacognitive skills are new, assessment for metacognitive skills is still small, and there is no specific learning model to improve students' metacognitive skills.

Students begin learning when faced with problems, at that time the conditions creates stimulus in student's metacognitive experience. Skilled problem solvers reflect the metacognitive skills used during the problem solving process (Delvecchio 2011). Thus, we need a problem-oriented learning model.

Problem-based learning is an effective approach in teaching high-level thinking processes. Problem-based teaching is a learning approach where students work on authentic problems with the intention of compiling knowledge, developing inquiry, high-level thinking skills, developing independence and confidence (Trianto 2009). Problem-based Learning (PBL) is the leading method among student-centered methods that provides individuals with developing their metacognitive skills. In order to do planning, to provide alternative solutions, to analyze and synthesize, to present the alternative solutions provided, and to evaluate the process when a new problem is faced, a person should be able to use metacognitive skills successfully (Tosun and Senocak 2013).

Research from (Danial 2010) and (Arifah 2017) that Problem-based Learning (PBL) strategy has a very significant effect on student metacognition skills. Meanwhile (Yeyendra 2017) and (Fathinah, Ibnu, and Suharti 2016) research results revealed that the effect of using Learning Journals (LJ) with the Problem Based Learning method can increase the average metacognitive ability of students. Another fact, in a study by (Kristiani 2015) revealed that there is a positive relationship between metacognitive skills and cognitive learning outcomes of students in the use of scientific learning in the 2013 biology learning high school curriculum. Therefore, (Kurnia E and Sulistyo 2015) research shows that the question strategy has asignificant influence on learning outcomes; it is in accordance with research that the Question Student Have (QSH) strategy has an influence on learning outcomes.

However, information related to the effectiveness of learning journals and student have questions integrated with problem solving models of metacognitive skills is still minimal. Hence, this paper presents the findings of student's metacognitive skills towards the integrated QSH PBL model and LJ's integrated PBL model.

2 RESEARCH METHOD

2.1 Purpose of the Research

This research is a comparational research to determine which one are better between the class used PBL integrated with QSH or PBL integrated with LJ.

2.2 Method Samples

This research was conducted at state senior high school at Tangerang Selatan in the 2017/2018 academic year for ± 2 months. The sample were selected by using random sampling technique.

This research used *quasi experiment* with *nonequivalent pretest-posttest control group* (Cohen, Manion, and Morrison 2005). There are a total of 96 students involved with this research, consisting of 35 male and 61 females with 32 students in the PBL experiment QSH integrated, 30 students PBL integrated learning journals and 34 students in control class. Metacognitive skill instruments are given before and after treatment in formal classroom

learning settings to 10th grade high school students in South Tangerang.

2.3 Instrument

The research instrument is in a form of description test. The instrument used refers to the instrument of metacognitive skills that have been developed by (Zulfiani et al. 2018) on the development of metacognitive skill instruments includes cognitive questions on open ended problem solving forms accompanied by questions that refer to metacognitive skills.

The metacognitive test instruments skills are calibrated in advance through several test stages such as validity, reliability, differentiation and level of difficulty. Based on the calibration test results, the number of instrument questions consisted of 9 metacognitive skill questions and 3 cognitive description questions with a Cronbach Alpha value of 0.746 (high category).

The non-test instrument used in this research is lesson plan, student's worksheet, learning journal, and observation checklist.

2.4 Data Analysis

The data analysis used is a prerequisite test and hypothesis testing with the help of SPSS22. Prerequisite test uses normality test (Kolmogorov-Smirnov test) and homogeneity (Levene test). While testing the hypothesis using Anova test and Tukey test (parametric) and Kruskal Willis test (nonparametric).

3 RESULT AND DISCUSSION

3.1 Metacognitive Skil

Table 1 and Figure 1 summarizes the descriptive statistics of pretest and posttest metacognitive skills in each group with PBL as the control class. All of the data were then tested statistically with the normality test. Based on the results on Table 2 of the normality test in class X1 (0.092), X2 (0.200), and X3 (0.200)> 0.05, it can be concluded that when the class has a value of metacognitive skills that are normally distributed. Thus the homogeneity test results obtained 0.152> 0.05. So it is concluded that the three classes have the same variant of values.

Furthermore, because the data of the three classes are normally distributed and homogeneous the hypothesis tests used are parametric tests (Anova and tukey tests). Table 3 shows the results of the Anova test to prove the hypothesis whether there are mean differences between treatments.

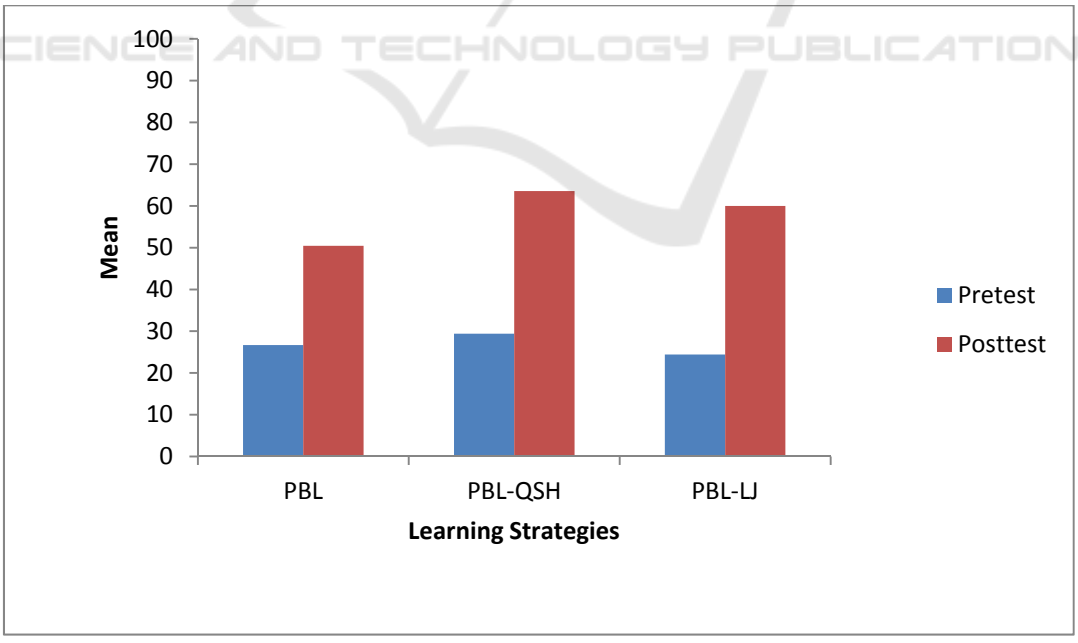

Figure 1 : Metacognitive Skill's Mean based Learning Strategies.

Table 2: Result of Prerequisite Test.

Learning Model	Prerequisite Test	
	Normality Test	Homogenity Test
PBL (X1)	0.092	0.152
PBL – QSH (X2)	0.200	
PBL – LJ (X3)	0.200	
Conclution	Normally Distributed (>0.05)	Homogenous (>0.05)

ANOVA test result obtained a probability value <0.05, so it can be concluded that the average of the three classes have significant differences in average, further test are carried out by the Tukey test.

Based on the data on Table 4, it was concluded that there were two classes that had significant average differences, namely between the integrated PBL classes with QSH and PBL, and between the integrated PBL classes with LJ and PBL. Whereas the class that does not have a significant difference is between the integrated PBL class with QSH and the integrated PBL with LJ. The result below show that integrated PBL class with QSH will obtain better metacognitive skill than without QSH. The QSH strategy is integrated in the PBL model at the stage of guiding individual investigation in groups. The QSH technique in this study gives students the opportunity to ask question directly to the teacher in writing. The strategy allows students to actively participate with indirectly maintain their self-regulatory to ensure the question they ask get answers. Self-regulatory activities are related to the metacognitive skill that include planning, monitoring, and evaluation. Metacognitive refers to high-level thinking skill that include active control regarding the relationship of cognitive process in learning (Livingston 2003).

PBL integration with LJ proved to have a better effect than PBL alone. According to (Sabilu 2008), metacognitive skills can be developed one of them by applying learning journals because learning journals are a method that can improve the ability to write and reflect on them. The application of learning journals to improve metacognitive skills will be better if done together with a learning strategy that is able to accommodate the empowerment of metacognitive skills, one of which is PBL (Setiawan and Susilo 2015).

By writing learning journals, students attempt to organize the previously presented information into a coherent whole and to integrate it into their prior knowledge. Learning journals were used as strategy activators to help students activate meta-strategic knowledge and to apply beneficial cognitive and metacognitive strategies during learning (Cazan 2012).

Tabel 3: Anova Test Result.

ANOVA

Metacognitive Skill

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3043,888	2	1521,944	9,388	,000
Within Groups	15076,642	93	162,114		
Total	18120,530	95			

Table 4: Tukey Test Result.

Dependent Variable: Metacognitive Skills

	(I) Learning Model	(J) Learning Model	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	PBL	QSH	-13,10570*	3,13594	,000	-20,5749	-5,6365
		LJ	-9,56382*	3,18934	,010	-17,1602	-1,9674
	QSH	PBL	13,10570*	3,13594	,000	5,6365	20,5749
		LJ	3,54187	3,23572	,520	-4,1650	11,2488
	LJ	PBL	9,56382*	3,18934	,010	1,9674	17,1602
		QSH	-3,54187	3,23572	,520	-11,2488	4,1650

*. The mean difference is significant at the 0.05 level.

3.1.1 Metacognitive Skills: Planning, Monitoring, and Evaluating

Based on the results of the normality test both aspects of planning, monitoring and evaluation have abnormal data results. Or p value <0.05. Then the statistical test carried out is the nonparamteric test, the Kruskal Wallis test. Table 4 describes the results of the Kruskal Wallis test in three aspects of metacognitive skills. Based on Table 4, test the hypothesis of the Kruskal Wallis test, p planning value (p = 0.002); monitoring (p = 0.023), evaluation (p = 0.010) where p <0.05 which concluded that there were significant differences in aspects of planning, monitoring, and evaluating between the control group and the integrated PBL-QSH group, and PBL integrated Learning Journal.

According to Flavell, when students are faced with problems, at that time students begin learning; these conditions include stimuli in students' metacognitive experience. Skilled problem solvers reflect the metacognitive skills used during the problem solving process (Delvecchio 2011).

(Hmelo, Gotterer, and Bransford 1997) argue that problem-based learning is a different way of using knowledge to solve problems, and it is this 'functioning' knowledge that involves the metacognitive processes because problem-based learning uses real world cases or problems as the starting point, the processes involved in solving these problems should lead to the development of characteristics of metacognition. Problem-based learning require the successful student to monitor and direct the process of problem solving, bringing memory of concepts and processes learned earlier to bear upon the current problem, and the case is then reviewed, requires reflection upon declarative, procedural, and conditional knowledge. Therefore, problem-based learning should be ideally tailored to the rapid development of metacognition (Downing et al. 2009).

(Tas and Sungur 2012) also revealed that PBL provides students with opportunities for the development of various skills; students collaborate with each other to solve the problem, develop critical thinking skills, learn to apply the knowledge, and relate it with daily life experience. Students are expected to apply the knowledge and demonstrate metacognitive skills such as monitoring their own understanding.

Table 5: Kruskal Wallis Test Planning, Monitoring and Evaluation Aspects Results.

	Planning	Monitoring	Evaluating
Chi-Square	12,689	7,527	9,141
Df	2	2	2
Asymp. Sig.	,002	,023	,010

4 CONCLUSION

There are significant differences in metacognitive skills between PBL and QSH integrated PBL as well as between PBL and PBL integrated learning journals. But there is no significant difference between PBL-QSH and PBL-LJ. The three aspects of metacognitive skills, planning, monitoring and evaluation have significant differences between all treatments. This shows that the differences in interventions in each treatment affect all aspects of their metacognitive skills.

The 2013 Curriculum Recommendation recommends the PBL Model in Biology learning that allows students to be actively involved in learning and responsible for the learning process and its metacognitive skills. Teachers can try to apply the integrated PBL Model of integrated QSH and PBL-LJ.

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APPENDIX

Example of Metacognitive Skill Inventory

<table>
<tr><th>No</th><th>Content and Indicator</th><th colspan="4">Article for Question Number 1.1 - 1.3</th></tr>
<tr><td>1.</td><td>General characteristics of Fungi
/
Identifiy general characteristics of Fungi</td><td colspan="4">Read the article below carefully!

Is it dangerous to eat moldy bread?

When you see fungi/mushrooms on bread, you actually only see the tip of the iceberg. Do not ever eat the bread just by removing the moldy little parts. It can be said that fungi/mushrooms have long threads like roots embedded in food and "you may not know how far (fungus) has been removed," said Marianne H. Gravely, an educator from the Department of Agricultural Food Safety (USDA) and United States Supervision Services.
The USDA recommends removing bread and other baked food when moldy, because microscopic fungi can cause allergic reactions and respiratory problems in some people. Some fungi, under certain conditions, can produce harmful substances called mycotoxins. The worst impact of this substance is aflatoxin, which can cause liver cancer and is found mainly in nuts and corn when harvesting and storing in the granary. But, consumers in the US can be relieved because the fungus is monitored by government agencies. Quoted from the New York Times, Sunday (1/11/2015) afternoon, Gravely said again that if you want to maintain some bread, Gravely recommends cutting most of the area surrounding the fungus with a healthy margin to ensure you remove all parts of the fungi/mushrooms. However, check all parts of the bread carefully because there may be more invisible fungi. Fungi/mushrooms are an indication that bread may have been stored too long and passed from the consumption limit. Moldy foods may also have bacteria that are not visible to the naked eye.
USDA generally recommends removing most moldy foods, except for foods that are intentionally fermented, for example salami and cheese. But if the fungus appears later, not from the food ingredients, it should be discarded. Never sniff out the fungus you see in food, because it can cause breathing problems if the mold spores are inhaled. Wrap moldy food in a plastic bag before throwing it away, then throw it in the trash bin that has a lid. Clean the area where the food is stored and check other food nearby to see if they have been contaminated. The reason is, the fungus can spread easily through the air or contact with contaminated food.
Source : http://health.liputan6.com/read/2353547/bahayakah-makan-roti-berjamur
Problem : "According to you, what is the specific characteristic(s) between eatable mushroom and poisonous moshrooms?</td></tr>
<tr><td rowspan="3">2.</td><td>Content and Indicator</td><td>Metacognitive Skill's Indicator</td><td>Type of Question</td><td>Number Of Question</td><td>Question</td></tr>
<tr><td rowspan="2">General characteristics of Fungi</td><td>Planning

Designing step(s)/method(s) to solving a problem/task</td><td>Essay</td><td>1.1</td><td>Write down the step(s)/method(s) to solving a problem above!</td></tr>
<tr><td>Monitoring

Analyzing the important informations within</td><td>Essay</td><td>1.2</td><td>What information you needs to solve that problem?</td></tr>
</table>

No	Content and Indicator	Article for Question Number 1.1 - 1.3			
		solving a problem/task			
		Evaluation Assessing goals performance	**Essay**	**1.3**	According to you, is your step(s)/method(s) answering question number 1.2 appropriate? Give your reason!