



## Contribution of metacognition awareness to critical thinking skills with pbl model and hpc strategy: A food digestion system study

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### ABSTRACT

Students are agents of future leaders who need to be prepared from now on to think at a high level. Through PBL models with HPC strategies, elementary science learning can potentially train high-level thinking, including metacognitive awareness and critical thinking skills. This study aims to reveal the contribution of metacognitive awareness to critical thinking skills with PBL models and HPC strategies. Various studies report that PBL has shortcomings in fostering metacognition and critical thinking. Therefore, PBL needs to be implemented with the homogeneity psycho cognition (HPC) strategy so that students can rise in organizing metacognitive awareness and critical thinking. This correlational study examined the relationship between metacognitive awareness and students' critical thinking skills. The predictor and criterion variables in the study were metacognitive awareness and critical thinking skills, respectively. Data analysis was conducted with linear regression. The results showed a correlation between metacognitive awareness and critical thinking skills in learning with PBL. There is a moderate relationship between the two variables. The predictor variables contributed 28.4% to the criterion variable. This study recommends that PBL with HPC is very important to be familiarized with learning in elementary schools to encourage students' metacognition and critical thinking skills.



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## INTRODUCTION

The educational paradigm shift in the 21st century demands more of students and teachers than usual and requires extensive knowledge and application of life skills to meet these standards. Today, it is imperative for students to use self-regulation and metacognitive skills to cope with the changes that are happening around the world (Mendoza & Elepaño, 2023). Metacognition refers to a person's knowledge of their cognitive processes, products, or anything related. Metacognition has been reported to influence students' academic performance (Stanton et al., 2015). Some educational researchers argue that metacognition significantly correlates with students' academic performance or achievement (Abdellah, 2015). Others view that explicit metacognitive training can improve students' metacognition. Metacognition can help people understand and control their cognitive performance, allowing them to take charge of their learning (Abdelrahman, 2020).

John Flavell introduced the term 'Metacognition' as early as 1970, describing it as knowledge and cognition about cognitive phenomena (Yore & Treagust, 2006). Flavell was the first to use the term 'Metamemory' and stated that people can store and retrieve information in their memory. Metacognition refers to the knowledge of one's cognitive processes or anything related to them (Flavell, 1979). Metacognition occurs when individuals plan, monitor, and evaluate their cognitive behavior in a learning environment (Sandi-Urena et al., 2011; Siegesmund, 2016). Metacognition plays an important role in learning as it helps students be more engaged in the learning process, thus leading to academic success (Sonowal & Kalita, 2019). It can be seen from the learning curriculum implemented in Pakistan that metacognition is very important for learners' success (Hussain, 2019).

In science learning, many studies have revealed a positive relationship between metacognitive awareness and student achievement (Oyelekan et al., 2019). The analysis shows the importance of metacognitive awareness as a supporting factor for an effective science-learning process. This is because metacognition is a predictor of successful learning. A better understanding of the factors behind thinking performance allows students to learn the material more easily (Handayani, 2020). Students with poor metacognition can benefit from metacognitive training to improve their metacognition and cognitive performance (Bogdanović et al., 2015). Metacognition is also associated with improved problem-solving and reflective thinking skills (Chen et al., 2018; Antonio, 2020). Other findings explain that if metacognitive training is conducted continuously over a semester, it will likely improve students' ability to assess their test scores (Casselmann & Atwood, 2017). In addition, high-achieving students have significantly higher metacognitive awareness levels than their low-achieving peers. Science educators must explore ways to support students' metacognition (Al-Balushi et al., 2022).

Several studies suggest that practice can enhance metacognition, especially during peer interactions (Ruiz de Zarobe & Smala, 2020). Metacognitive awareness is critical to learners' success as it allows individuals to organize their cognitive skills better and correct their weaknesses in building new cognitive skills (Ajayi & Achor, 2021). Metacognitive awareness can also influence individual conceptual understanding and problem-solving (Pozas et al., 2020). In addition, metacognitive awareness is a person's knowledge and awareness of his own processes and thinking strategies and the ability to evaluate and regulate his thinking process (Goren & Kaya, 2022). Metacognitive awareness is knowledge and control of cognitive processes (Ferreira et al., 2015; Xie et al., 2023). In other words, it is knowledge of cognition and control of cognition. Metacognitive awareness is not only thinking skills but also organizing and executing cognition (Alkan & Erdem, 2014; Choi & Son, 2023).

Metacognitive awareness is referred to as thinking about one's thoughts and cognition. Metacognitive awareness is generally further categorized into two aspects of the concept: cognitive knowledge and cognitive regulation (Schraw, 1998). Metacognition awareness has a big role for teachers. Teachers know what they teach and can understand the whole learning process. The results showed the influence of metacognitive awareness on the regulation of cognition, as metacognitive awareness does not stop at clarifying cognition and increasing students' self-awareness. It is worth using this awareness and organizing it to enrich the teaching process (Haddad et al., 2022). Metacognition awareness in schools is underdeveloped in internalizing their learning strategies, such as connecting prior knowledge with new knowledge, planning, monitoring, and evaluating. As a result, it impacts student learning outcomes that need to be revised (Wardoyo et al., 2021). In addition, students' lack of metacognitive awareness is often associated with students' need for more attention to the problem-solving and critical thinking processes (Awdah et al., 2017). Japanese learning informs that science teachers successfully encourage students in critical thinking (Kinoshita, 2022). Critical thinking

ability deserves to be examined as one of the ultimate missions of education in the 21st century. In this case, critical thinking is a process that requires the use of higher levels of cognitive skills in processing information. As an influential factor in developing critical thinking skills, metacognition requires deploying higher-order thinking skills. Similarly, critical thinking is a higher-order thinking activity requiring cognitive skills (Cakici, 2018).

Critical thinking is an indispensable part of building metacognition. Metacognition plays a key role in developing critical thinking skills (Amin et al., 2023). It is because it involves awareness of one's own thinking and reflection on one's own and others' thinking as objects of cognition. It is already perceived that critical thinking involves higher levels of metacognitive abilities or requires the use of higher levels of metacognitive abilities, such as cognitive skills in information processing (Choy, 2009; Nizlel et al., 2022). Furthermore, critical thinking is likely to be developed through metacognition (Zhan et al., 2023). Critical thinking skills and metacognition are closely linked to developing active participation at all levels of knowledge. Critical thinking skills requires an active process of questioning and analyzing information to gain knowledge. Metacognition awareness is required of what is known and not known at different levels of cognition and strategies to control the learning process. How and why questions make students realize and understand the learning materials. Teachers easily and efficiently decide what learning strategies they will use to create learning instruments in the form of higher-order questions (Mohseni et al., 2020). In other words, metacognition helps learners adjust plans and strategies appropriately during the critical thinking process (Saleh et al., 2023). In this case, metacognition is very significant for developing one's critical thinking because it can provide incentives for developing critical thinking.

In biological science subjects, some materials are very challenging for students, one of which is the food digestion system. Digestion is a very important process in the life of an individual. However, digestion is physically hidden in the body, making it challenging to understand and difficult for students to learn in class (Sensoy, 2021; Mack et al., 2023). In this case, teachers must be creative in designing teaching by using a combination of visuals and laboratories to simulate food digestion so that students understand the material presented. Various science methods can increase student activity (Vivante & Vedder-Weiss, 2022). In introducing metacognitive awareness, problem-based learning is reported as an appropriate method for students to improve their higher-order thinking skills (Sutarto et al., 2022). The reason is that problem-based learning encourages students to develop their ability to think critically about problems and potentially increase metacognitive knowledge. When individuals face problems, metacognitive strategies are important in achieving successful outcomes. By using metacognitive strategies, individuals can evaluate whether they will be successful and then decide on the steps to complete the task, observe, and transfer their experience to the next process (Tosun & Senocak, 2013); (Cer, 2019). In addition, they can develop their metacognitive awareness and help them find alternative solutions to the problems they face/possible problems they face daily (Kuvac & Koc, 2019). One important aspect of metacognitive awareness is the problem-solving process. Atmatzidou et al. (2018) confirmed that cognition is critical to student learning because it influences how students apply what they have learned to address a given problem.

Problem-based learning (PBL) is a teaching approach that can meet these needs. PBL is proven to create an active learning environment and is one of the student-centered learning models. PBL is widely used in many university courses worldwide and is growing rapidly in Asia (Kwan, 2019). This is because PBL trains students to become independent learners and activates students' prior knowledge skills (Dolmans et al., 2016). PBL is an appropriate teaching and has a favorable influence on students' teamwork skills progress. Several studies reveal that students who learn with PBL methods experience an increased ability to work in teams (Abdullah et al., 2019). PBL presents authentic things in fostering students' curiosity to investigate and train higher-order thinking skills such as problem-solving and critical and creative thinking. Therefore, teachers are also expected to have these skills (Hursen, 2021). PBL presents students with a problem in order to acquire new knowledge. It will help students build their knowledge concepts and integrate their basic knowledge (Chang et al., 2020). To gain skills in problem-solving, students are expected to understand the process of problem-solving and become skilled in selecting and identifying relevant conditions and concepts, searching for generalizations, formulating a solution plan, and organizing what they have before (Atmatzidou et al., 2018). Metacognition will also encourage students' ability to solve problems and develop higher thinking skills

(Rivas et al., 2022). Therefore, another learning strategy is expected to overcome the shortcomings of PBL, such as the *Homogeneity Psycho Cognition* (HPC) learning strategy.

HPC is based on the homogeneous grouping of students, especially regarding cognition, thus helping students improve each other's confidence, emotions, and cognition. HPC is considered to cover the weaknesses of PBL by encouraging students to work in homogeneous groups with more enthusiasm. HPC refers to group learning. The HPC learning strategy prioritizes cooperation between students in groups to achieve learning objectives, but grouping is done with target homogeneity or similarity of students' cognitive abilities. The purpose of forming homogeneous groups is to provide opportunities for students to be actively involved in the process of thinking and expressing themselves in learning activities without feeling burdened by the characteristics of other students who are smarter or more aggressive. It makes them appreciate each other. HPC is based on student-centered learning in problem-solving in discussion groups. Students are divided into small groups and directed to learn a predetermined subject matter. The HPC learning strategy prioritizes group work and cooperative learning (Fenanlampir et al., 2021). It uses relevant and more humanistic strategies in learning so that more severe problems do not occur in learning (Batlolona & Klean, 2023). Through HPC, students' metacognition is expected to increase because students are highly valued, respected, and treated humanistically in learning in HPC. HPC is expected to have an impact on students' learning pleasure and comfort so as to encourage a better learning process. It also has an impact on the development of their critical thinking skills. Based on the existing problems, this study aimed to explore the relationship between metacognitive awareness and elementary school students' critical thinking skills by applying the PBL learning model with the HPC strategy.

## **METHODS**

### **Research Design**

This correlational study explored the contribution of metacognitive awareness to elementary school students' critical thinking skills in applying the PBL learning model with the HPC strategy. Metacognitive awareness is a predictor variable, and critical thinking skills are a criterion variable.

### **Participants**

This study was conducted on 5th-grade elementary school students in 2 clusters in Nusaniwe Subdistrict, Ambon City, totaling 15 elementary schools. Of the 15 elementary schools, 3 elementary schools were drawn that met the equality data obtained from the equality test results, namely Public Elementary School 72 Ambon, Public Elementary School 78 Ambon, and Public Elementary School 2 Latihan SPG. This study was conducted in the odd semester of the 2022/2023 academic year concerning the 2013 Curriculum. Initially, 71 students were involved, but only 46 students consistently followed all stages of PBL learning with the HPC strategy 4 times and took the metacognitive awareness and critical thinking skills test namely pretest dan posttest.

### **Instrument**

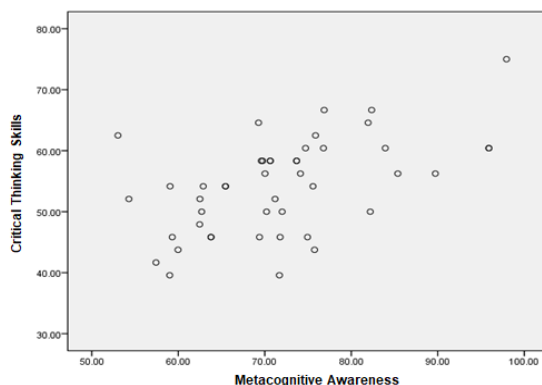
This research instrument is a metacognitive awareness questionnaire and a critical thinking skills test in the form of an essay. The subject matter refers only to animal and human food digestion. The test instrument was developed by referring to the core critical thinking skills by Facione (1990), which consist of interpretation, analysis, inference, explanation, evaluation, and self-regulation. The instrument has been validated, including construct validation and empirical testing. The critical thinking test consists of 12 items in the form of an essay. The time allocated to fill in each instrument ranged from 40-60 minutes. The critical thinking skills test was conducted twice, before treatment (pretest) and after treatment (posttest). Before being used, this question had been validated by three experts in the field of biology and biology learning from Pattimura University. This test instrument has also met the criteria for instrument feasibility from the aspects of validity and reliability, where the results of the trial of 43 students obtained a validity value of 0.65 and a reliability of 0.87.

## **Procedure**

This research was conducted following several procedures. These procedures include: 1) conducting research instrument trials and validation of learning tools, 2) conducting equality tests on six elementary schools that allow research to be carried out with PBL models with HPC strategies, 3) conducting ANOVA tests to find schools that have the same equality values, 4) providing assistance and simulations to teachers who would carry out PBL learning with HPC strategies, including learning tools, especially lesson plans and LKPD, 5) practicing PBL learning with HPC strategies assisted by teachers in sample schools four times for 4 weeks. The subject matter taught included food digestion of ruminant animals, food digestion in humans, food digestion disorders, and prevention of digestive system diseases. 6) After all learning was completed, a posttest of metacognitive awareness and critical thinking skills was conducted on students.

### Data Analysis Techniques

The data obtained from this study are metacognitive awareness data and critical thinking skills. Metacognitive awareness data is ordinal data, so it is necessary to transform it with MSI (Successive Interval Method). The same thing should have been done on critical thinking skills data, corresponding to the assessment format. Students' test results were corrected by referring to metacognitive awareness (score range 1-3) and critical thinking skills (Facione, 1990) with a score range of 1-4. The test data were then tabulated and analyzed using linear regression with the assistance of the SPSS 16.00 program after all data met the criteria of linearity, normality, and homoscedasticity. The results of the linearity test between the predictor and criterion variables showed that the two data had a linear relationship. As shown through the Scatter Plot in Figure 1.



**Figure 1.** Scatter Plot of Linearity between Metacognitive Awareness and Critical Thinking Skills

Normality test uses Kolmogorov-Smirnov and Shapiro-Wilk tests by utilizing residual data. The results of the normality test, as shown in Table 1, inform that the residual data are normally distributed ((KS(46) = 0.097,  $p = 0.200$ ) and (W(46) = 0.985,  $p = 0.798$ ).

**Table 1**

The test results of Residual Data normality

	Tests of Normality					
	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.097	46	.200*	.985	46	.798

a. Lilliefors Significance Correction

\*. This is a lower bound of the true significance.

The last requirement is the homoscedasticity test, which is analyzed using the Glejser Test. The results are as shown in Table 2: that the Sig value > alpha, then the variant value is homogeneous and vice versa. The information shows that the Sig value = 0.920, meaning that it is greater than alpha, then the variance of the residual value is homogeneous, indicating that the data homoscedasticity requirement is met.



**Table 2**  
homoscedasticity Test Results using the Glesjer Test

		Coefficients				
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.916	3.658		1.617	.113
	Metacognitive Awareness	-.005	.050	-.015	-.101	.920

a. Dependent Variable: Residual\_Positive

## RESULT AND DISCUSSION

Critical thinking skills can be significantly predicted by metacognitive awareness applying the PBL model with HPC strategy as shown in [Table 3](#).

**Table 3.**  
Anova results about relationship between metacognitive awareness and critical thinking skills.

ANOVA <sup>b</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	778.899	1	778.899	17.341	.000 <sup>a</sup>
	Residual	1976.328	44	44.917		
	Total	2755.227	45			

a. Predictors: (Constant), Metacognitive Awareness  
b. Dependent Variable: Critical Thinking

Information about the contribution of metacognitive awareness to critical thinking skills in learning with PBL with HPC strategy is shown in [Table 4](#).


**Table 4**  
The correlation coefficient between metacognitive awareness and critical thinking skills

Model Summary						
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson	
1	.532 <sup>a</sup>	.283	.266	6.70198	1.302	

a. Predictors: (Constant), Metacognitive Awareness  
b. Dependent Variable: Critical Thinking

From [Table 3 and 4](#) shows that a simple linear regression was conducted to predict students' critical thinking skills based on their metacognitive awareness scores. A significant regression equation that ( $F(1,44)=17.341, p < 0.001$ ), with  $R^2$  of 0.283 was obtained. Thus, metacognitive awareness in PBL learning with HPC strategy contributed 28.3% to the critical thinking skills, and other factors contributed 71.7%. The description of students' thinking skills, especially on the variables of students' problem-solving and critical thinking skills in solving the test questions, is shown in [Table 5](#).

**Table 5.**  
Results of students' answers for aspects of critical thinking skills

Indicator	Question	Students Answer	Category										
Analysis	Take a look at this picture of one of the stomachs of ruminants.	1. To chemically digest food, as well as to kill bad bacteria (S21)	Very critical (4)										
													
	What do you think is the main function of the stomach?												
Evaluation	Give two important reasons why cows should digest grass twice.	1. Because the grass is very hard 2. Because the cow's stomach is large and consists of 4 parts (S35)	Critical enough (3)										
Explanation	If an adult has most of their teeth missing, imagine the two things that happen during the mechanical digestion process in the mouth.	Unable to eat well (S5)	Less critical (2)										
Inference	Look closely at the data in the table below. Table 1. Meal intervals of some students	A person's mealtime depends on their hobbies (S15)	Very less critical (1)										
	<table border="1" data-bbox="472 1099 888 1323"> <thead> <tr> <th>Student Name</th> <th>Eating activities performed in a day every .... hour</th> </tr> </thead> <tbody> <tr> <td>1. Andi</td> <td>3-4</td> </tr> <tr> <td>2. John</td> <td>6-7</td> </tr> <tr> <td>3. Stella</td> <td>3-4</td> </tr> <tr> <td>4. Fanni</td> <td>6-7</td> </tr> </tbody> </table>	Student Name	Eating activities performed in a day every .... hour	1. Andi	3-4	2. John	6-7	3. Stella	3-4	4. Fanni	6-7		
Student Name	Eating activities performed in a day every .... hour												
1. Andi	3-4												
2. John	6-7												
3. Stella	3-4												
4. Fanni	6-7												
	What can you conclude from the table?												

The regression equation analysis of the relationship between metacognitive awareness and critical thinking skills in learning with PBL with HPC strategy is shown in Table 6. Students' critical thinking skills can be predicted using the regression equation  $y = 25.980 + 0.394x$ . The regression coefficient ( $B = 0.394$ ) indicates that an increase in metacognitive awareness score by 1 number will increase students' critical thinking skills score by 0.394.

**Table 6**  
Regression coefficient between metacognitive awareness and critical thinking skills

Model	Coefficients				
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	25.980	6.873		3.780	.000
Metacognition	.394	.095	.532	4.164	.000

a. Dependent Variable: Achievement. Critical Thinking

The research findings reveal that through learning with PBL combined with the HPC strategy, there is a linear relationship between metacognitive awareness and critical thinking skills. The

relationship between the two variables is in the medium category ( $r$ -value = 0.532). It means that students' critical thinking skills can be predicted by metacognitive awareness. Students who are skilled in scientific argumentation show the ability to do critical thinking skills well. That is the contribution of metacognition to critical thinking skills. Learners who engage in more metacognitive activities, particularly higher-order planning, and higher-order strategies, have good critical thinking skills (Ku & Ho, 2010). Students' critical thinking is developed by challenging learners in such a way with learning activities based on problem-solving. All this information greatly helps students form critical thinking (Angelelli et al., 2023). The current work trends show that collaboration is essential for future success. For example, in the United States, pharmacists collaborate with other interprofessional healthcare team members to improve the quality of patient health, limit medication errors, and increase patient medication knowledge and adherence (Chisholm-Burns et al., 2010). It is, therefore, a challenge for schools to develop students' collaboration skills to prepare students for future challenges. Not doing this will adversely affect future learning and career opportunities (Borge & White, 2016). Thus, life skills in the form of metacognitive awareness and critical thinking skills are very important to equip students to understand, navigate, and ultimately be successful. Related to this, a more thorough identification of the problem is carried out to analyze and explore the problem (Leasa et al., 2021). Problems that are not well understood will lead to a solution that does not solve the problem but may create new problems. In this case, critical thinking focuses on recognizing and exploring the problems that must be solved.

Decision-making is at the core of critical thinking, but not all conditions suit it. Decision-making that has the potential to generate critical thinking is when it contains logic and is rational (Sellars et al., 2018). In order to produce a wise decision, a higher level of critical thinking is needed (Khoiriyah et al., 2015). The results of previous studies informed that with the PBL model, students' metacognition awareness increased to 81%. In PBL, the solutions are different, so students can develop creative ideas, prepare individuals to become more competitive, and become independent and responsible thinkers. Individuals with high metacognitive awareness will create a more positive learning environment (Markandan et al., 2022).

Metacognitive awareness plays an important role in student's learning process to be more independent and to do more effective learning. Students with high metacognitive awareness know where and when to use their knowledge (Siqueira et al., 2020). Knowledge of cognition plays a very important role at the beginning of learning when new study practices are being performed or when completing complex tasks. There is evidence that metacognitively aware students can set realistic goals for their learning, and they are also able to use effective strategies and make changes when necessary more successfully than unaware students (Tuononen et al., 2023). Metacognitive awareness of cognitive processes is more evident in individuals who excel in cognitive activities than those who perform less well. It includes intellectually gifted children, who show higher metacognitive knowledge than children of high average and low average intelligence (Song et al., 2021).

Empowering metacognitive awareness is an effort to improve the quality of learning (Miller, 2017). In addition to implementing various learning approaches in the form of PBL and HPC, teachers must also implement an assessment process that supports the improvement of student metacognition. To achieve these targets, teachers must correctly understand what, why, and how metacognition-based learning is applied (Hindun et al., 2020). Recent theoretical frameworks of the cultural origins of metacognition suggest that the culture-dependent aspects of metacognition are determined by the extent to which the culture emphasizes understanding the mental state of the self and others. With this framework, strong metacognitive skills benefit the individuals who possess them and the social groups that make decisions and work together (Heyes et al., 2020).

Critical thinking as a specific higher-order thinking, has been considered a planned achievement in education by 2050 (International Commission on the Futures of Education, 2021), which, when taught effectively, will promote logical thinking, problem-solving and contribute to the improvement of education, especially in higher education and employment. PBL is a student-centered approach, emphasizing learning by solving problems, and has been suggested and used at the university level to develop critical thinking skills in undergraduate students. Most studies have shown it to have an overall positive impact, some negative (Liu & Pásztor, 2022). A successful PBL experience requires support for students, especially those new to PBL. PBL successfully develops metacognitive awareness (Tadesse et al., 2022). As a student-centered learning approach, PBL directs students' engagement in group learning



to solve problems using learning steps. Students acquire new knowledge and information through self-directed and group learning (Nagarajan & Overton, 2019).

In a PBL setting, students must use each other's opinions, ideas, and knowledge to formulate new ideas and concepts (Saqr & Alamro, 2019). In addition, interaction during PBL can increase participants' awareness of metacognitive knowledge and problem-solving. In problem-solving, students' metacognition skills also play a role so that students can think critically in problem-solving. Metacognition is also a process where a person thinks sequentially to develop problem-solving strategies (Siagian et al., 2019). Meanwhile, PBL and HPC strategies help low-ability students to encourage critical thinking. Critical thinking is recognized as one of the main indicators of the quality of student learning in schools and universities (Stephenson et al., 2019). They are slowly trained to build critical thinking. They use keywords to add a few words to complete the sentence structure to be complete in answering critical thinking skills questions. The results of a survey conducted by professors at one university for undergraduates showed that 5% of those tested showed proficient critical thinking skills, with more than 80% showing no proficiency (Goeden et al., 2015). If critical thinking is important for academic and professional preparation, higher education, i.e., lecturers, should use teaching methods to improve critical thinking skills. Therefore, PBL and HPC are some of the approaches that will answer global needs in the future. It is proven by various references and study results that show that PBL and HPC improve student skills and learning outcomes.

Some of the best universities in the world have implemented PBL in the curriculum. The University of Leicester tries to introduce first-year students to working in teams on open-ended problems, which helps them deepen and enhance the teaching content, connecting the different areas of the curriculum they will encounter (Williams, 2017). The University of Helsinki in Finland also made other modifications for first-year students; for example, PBL is applied in the first period, where students are allowed to work in research laboratories and participate in ongoing research work (Jonassen, 2000). In addition, Hakkari University in Turkey applied context and problem-based learning. They found that learning in contexts such as cultural problems (an event from a newspaper, a story, or an environmental problem from the learners' social environment).

In addition, the results of a study conducted by (Fenanlampir et al., 2021) on 15 elementary school students in Ambon City showed that HPC could improve student learning outcomes, learning skills, and critical thinking. The same findings align with Batlolona and Klean (2023), who stated that HPC is very effective in improving students' concept understanding compared to conventional learning. Event-oriented learning in real life makes lectures come alive and changes students' attitudinal views to be more motivated to learn (Baran & Sozbilir, 2018). With students' motivation and enthusiasm guaranteed with real cases and different curricula towards knowledge development, it will support students' high-level cognition knowledge to learn new things (Hu & Li, 2020).

## CONCLUSION

The conclusion drawn from this research shows a correlation between metacognitive awareness and critical thinking skills in learning using PBL models with HPC strategies. Thus, this study recommends that PBL with HPC strategy is important to be familiarized in learning in elementary school for students' metacognitive awareness and critical thinking skills. This research contributes 1) Using the PBL learning model with the HPC strategy, which is considered challenging to implement in science learning in elementary schools because of the assumption that elementary school students have weak metacognitive awareness and critical thinking skills. 2) Using PBL with HPC strategy to foster and familiarize elementary school students to think at a high level to live in the future. These two important competencies, namely metacognition awareness and critical thinking skills, are at the forefront of learning in the 21st century.

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