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THE EFFECTIVENESS OF PROJECT-BASED LEARNING MODEL WITH RAHMA SYNTAX TO IMPROVE PROSPECTIVE BIOLOGY TEACHERS' CRITICAL THINKING SKILLS

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ABSTRACT

This research aims to measure the effectiveness of the Project-Based Learning Model with RAHMA Syntax (PjBL-RAHMA) in improving prospective biology teachers' critical thinking skills. RAHMA is an acronym for Recognizing Problems, Analyzing Problems, Handling Projects, Monitoring Progress, and Assessing Results. This research was quasi-experimental with a posttest-only control group design. This research involved 223 prospective biology teachers from three well-accredited public universities in Sumatra, Indonesia. Data from the critical thinking skills test results were analyzed using JASP software. Prospective biology teachers' achievement of critical thinking skills after learning using the PjBL-RAHMA model showed that the experimental class was better than the control class. This research concludes that PjBL-RAHMA effectively improves prospective biology teachers' critical thinking skills. This research also explains the contribution of each PjBL-RAHMA syntax in improving prospective biology teachers' critical thinking skills. The PjBL-RAHMA syntax has increased prospective biology teachers' ability to understand and analyze real-life problems, providing good reasons, logical thinking, and creating solutions to problems, especially in pedagogy.

Keywords: project-based learning; RAHMA syntax; critical thinking skills; prospective biology teachers

INTRODUCTION

Critical thinking skills are one of the key competencies emphasized in 21st-century skills (Kim et al., 2019; Silviariza et al., 2021; Bielik & Krüger, 2024), essential competencies for professional (Parra-González et al., 2023; Rivas et al., 2023), and sustainable development goals (Martin et al., 2021). Individuals with critical thinking skills can overcome various obstacles and challenges in the future (Ennis, 2015) and become an essential aspect of achieving academic performance in higher education (Guamanga et al., 2024; Rivas et al., 2023). Critical thinking skills are crucial to the industrial revolution era, characterized by rapid and continuous change (Hidayati et al., 2020; Razak et al., 2022).

This change also impacts the education field, where teachers must be able to quickly adapt to it (Kapasheva et al., 2024). As a result, this ability becomes crucial for teachers in this era to improve their students' critical thinking skills (Silviariza et al., 2021). Developing critical thinking skills has been recognized as one of the most important goals (Jatmiko et al., 2018). Critical thinking skills are necessary for all educators, including prospective biology teachers. They will educate students with biology material that continues to develop along with advances in science and technology (Arsih, 2020). Therefore,

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prospective biology teachers must develop ways to manage and solve problems critically (Poonputta, 2023).

However, the critical thinking skills of prospective teachers in Indonesia are still low. As reported in previous studies, prospective teachers' critical thinking skills are still inadequate (Maguna et al., 2016; Farcis, 2016; Suwono et al., 2017; Irwanto et al., 2018; Jirana et al., 2019). A study on prospective biology teachers also shows that their critical thinking skills are still lacking (Amin et al., 2017). Another study by Arsih et al. (2020) on prospective biology teachers at a well-accredited university in West Sumatra, Indonesia, shows that 88.06% have low critical thinking skills. These findings highlight the need to improve critical thinking skills, which are essential in higher education (Stupple et al., 2017).

Efforts to improve prospective teachers' critical thinking skills have been implemented in various ways, such as through contextual learning (Nasution & Rezeqi, 2015), writing assignments (Li et al., 2024; Reed et al., 2024), debate, cooperative works (Saldıray & Doğanay, 2024), metacognition-based learning (Puger et al., 2024), inquiry-based learning (Sapriati et al., 2024), and various other learning approaches and activities (Bielik & Krüger, 2024; Blessing, 2024; Reffhaug et al., 2024). The dominant effort of educators to improve critical thinking skills is implementing the Project-Based Learning (PjBL) model (Bezanilla et al., 2019; Guo et al., 2020; Balleisen et al., 2024; Shi & Li, 2024; Sonnenberg-Klein & Coyle, 2024; Wibowo et al., 2024; You, 2024).

Project-based learning (PjBL) is an organized learning model that allows students to participate in open-ended real-life challenges through collaborative efforts actively (Sasson et al., 2018; Usher & Barak, 2020; Barak & Yuan, 2021), creating student-centered learning that fosters critical thinking skills (Baines et al., 2021). Educational experts have suggested various PjBL syntaxes (Lucas, 2007; Mulyasa, 2014; Supardan, 2015; Jalinus et al., 2017; and Yudiono et al., 2019). The most widely used by researchers is Lucas' syntax (2007). In general, Lucas' syntax (2007) consists of six stages: (1) determining basic questions, (2) creating project designs, (3) scheduling, (4) monitoring project progress, (5) evaluating results, and (6) evaluating experiences. This syntax has been widely studied in science, engineering, and language learning programs (Guo et al., 2020), but no PjBL syntax design is specific to the pedagogical aspect. Accordingly, it is important to adjust the PjBL syntax by Lucas (2007) for use in pedagogical courses that focus on designing, implementing, and evaluating learning based on field findings, especially the Biology Learning Evaluation course. Furthermore, Lucas's (2007) version of the PjBL learning model has been used since 2019. However, after three years, the results have not been satisfactory, as it has failed to enhance the critical thinking skills of prospective biology teachers. According to preliminary research, the prospective biology teachers' poor performance on the Biology Learning Evaluation course was determined by their final semester exam results, which are displayed in Table 1.

Table 1. Final Semester Exam Achievement

Aspect	2020	2021	2022
Amount	132	144	142
Lowest score	16.00	16.00	19.00
Highest score	77.00	79.00	61.00
Average	53.59 (Low)	51.29 (Low)	39.78 (Low)

As a result, the PjBL syntax, as defined by Lucas (2007), cannot be applied directly in educational courses that concentrate on planning, carrying out, and assessing learning based on research findings. Therefore, the PjBL stages must be modified to make them appropriate for teaching pedagogical courses to prospective teachers, particularly in the Biology Learning Evaluation course.

The adjustments as the unique steps made in this study were to develop the PjBL-RAHMA model, an acronym for Recognize the problem, Analyze the problem, Handle a project, Monitor the progress, and Assess the result. Several adjustments need to be made from the PjBL model syntax version of Lucas (2007) so that it is relevant to train prospective teacher students' critical and creative thinking skills in pedagogy courses and formulate them in the PjBL-RAHMA syntax. First, while identifying fundamental questions, giving the context of actual difficulties in the field is helpful because this will draw students' attention to addressing the issues as they are directly encountered (Hung, 2016).

Second, modifications are made by operationalizing the project design's phases, whereby the creation of the question instrument for the Biology Learning Evaluation course necessitates peer and lecturer review and analysis to ensure that students are proficient in creating quality question instruments. As a result, modifications are performed during the project handling phase, further defined as scenario, scheduling, review, revision, and trial.

Third, adjustments are made by combining syntax five and six versions of Lucas (2007) because they can be implemented in one activity unit. In the PjBL-RAHMA, the Assess the result phase is named, in which students assess the results of their projects and draw conclusions from a series of project tasks that have been completed. Designing a logical conclusion based on the tasks given is essential to critical thinking skills (Lv et al., 2024).

The Biology Learning Evaluation course presents its challenges for prospective biology teachers. The essential aspect of this course is designing assessments in terms of cognitive, affective, and psychomotor (Darussyamsu et al., 2023). However, Poonputta (2023) reports that prospective teachers have limited knowledge and experience in developing various types of measurements and assessments in the lecture curriculum. Ramadhan et al. (2019) stated that designing questions in learning evaluation is challenging for prospective teachers. A preliminary study was conducted by interviewing the prospective biology teachers selected from low, moderate, and high competence achievements after studying the Biology Learning Evaluation course. This study reported that one of the essential problems is the lack of feedback received by prospective teachers from lecturers and the absence of collaboration with experienced teachers to help prospective teachers better understand what they should develop in lectures (Darussyamsu, 2024).

The absence of collaboration between prospective and experienced teachers is overcome by implementing PjBL with RAHMA syntax (PjBL-RAHMA). At the Recognizing Problems stage, prospective biology teachers are asked to conduct interviews and discuss the development of assessments in schools with experienced teachers. The discussion provides prospective biology teachers with better experience and understanding in evaluating learning through PjBL (Abas et al., 2024; Balleisen et al., 2024). In the Analyzing Problems stage, prospective biology teachers collaborate in groups to discuss learning evaluation problems in schools and formulate problems.

After the problem is formulated, in the Handling Projects stage, prospective biology teachers design a project to solve the issues in the field and create a schedule of activities. In the Monitoring Progress stage, lecturers monitor the project's development and provide feedback. In the Assessing Results stage, prospective biology teachers collectively assess the success of solving biology learning evaluation problems through their projects. All stages of PjBL-RAHMA can overcome the lack of feedback for prospective biology teachers during lectures. With more structured feedback, prospective biology teachers' critical thinking skills will increase significantly in line with the lecturer's direction during lectures (Abas et al., 2024; Balleisen et al., 2024; Kim et al., 2019).

This research aims to measure the effectiveness of the PjBL-RAHMA model in improving prospective biology teachers' critical thinking skills. The critical thinking skills are assessed using FRISCO criteria, an acronym for focus, reason, inference, situation, clarity, and overview (Ennis, 2018). The targeted impact of this study is a contribution to the field of pedagogy by preparing prospective biology teachers with good critical thinking skills.

METHODS

This research was quasi-experimental with a posttest-only control group design (Bhattacherjee, 2012). The prospective biology teacher learned the Biology Learning Evaluation course for six meetings offline in the experimental class using PjBL-RAHMA, and in the control class, used PjBL Lucas, which has been used for three years in the course. After the treatment, all of the participants assessed their critical thinking skills using critical thinking skills instrument evaluation in the form of multiple choice and essay questions. The design is presented in Figure 1.

R	**X**	**O_1(Experimental Class)**
R		**O_2(Control Class)**

Figure 1. Research Design

This research involved 223 prospective biology teachers from three well-accredited public universities in Sumatra Island, Indonesia, as presented in Figure 2.

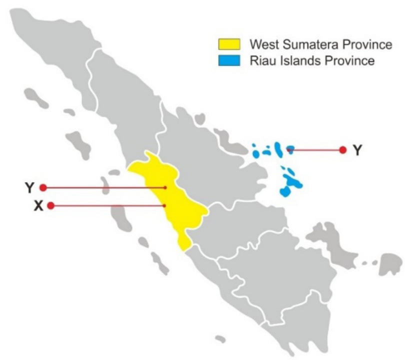

Figure 2. Research Location Map

Simple random sampling was used to obtain the sample. The population and sample in this research are described in Table 2.

Table 2. Population and Sample

University	Population	Sample	Experiment	Control
X	N = 144 Number of Class = 5	Classes B & C	Class B = 26	Class C = 27
Y	N = 39 Number of Class = 2	Classes A & B	Class A = 22	Class B = 17
Z	N = 40 Number of Class = 2	Classes A & B	Class B = 21	Class A = 19

Data were collected at the end of the Biology Learning Evaluation course. The ethics committee of Universitas Negeri Padang approved data collection per the Ethics Certificate Number 25.02/KEPKH-UNP/V/2024. The project completed in the Biology Learning Evaluation course is a higher-level thinking skills (HOTS) question instrument.

During the research, five face-to-face meetings were conducted under the guidance of lecturers. The control class learned using the PjBL model with syntax by Lucas (2007), as is usually done in the Biology Learning Evaluation course, while the experimental class learned using PjBL-RAHMA, whose syntax comparison is shown in Table 3.

Table 3. Comparison of PjBL Lucas and PjBL-RAHMA

Syntax	PjBL Lucas	PjBL RAHMA
1	Determining basic questions	Recognizing problems
2	Creating project designs	Analyzing problems
3	Scheduling	Handling projects Scenario Scheduling Review Revise Trial
4	Monitoring project progress	Monitoring project progress
5	Assessing results	Assessing results Assessing the item quality Conclusion
6	Evaluating experiences	

When prospective biology teachers demonstrate indicators of critical thinking, they will develop into critical thinkers (Facione, 2023). The indicators of critical thinking as the standard for this research are presented in Table 4 (Ennis, 2015) using critical thinking skills instruments from the final semester exam of Biology Learning Evaluation. Each indicator is elaborated into questions with the outline in Table 5.

Table 4. Indicators of Critical Thinking Skills

No	Critical Thinking Skills Aspects	Indicator
1	Focus	Understand the given problem
2	Reason	Explain the reasons based on relevant facts/evidence
3	Inference	Provide the right explanation
4	Situation	Use all information based on the problem
5	Clarity	Provide case examples that are relevant to the given problem
6	Overview	Reconfirm the conclusion thoroughly

Source: Ennis (2015)

The designed test consisted of ten objective questions with five answer choices and eight essay questions at the cognitive level C4-C6. Before being used, the test instrument was logically validated by three experts (with a validation value of 0.82, categorized as very valid) and tested on students in other classes that are not sample classes, with 48 test samples. The validity of each item had reached an acceptable level (IOC = 0.69-1.00), an appropriate level of difficulty (P = 0.31-0.70), discriminatory power (D = 0.53-0.92), and reliability of 0.84, as tested by Anates version 9 software.

Table 5. Outline of Critical Thinking Skill Instrument

Learning Outcomes	Type	Expected Competencies	Aspect	Item Number
Developing HOTS question instruments	Multiple choices	Analyze the principles of HOTS question preparation	Focus	1, 2
		Create HOTS question outlines.	Reason	3, 4
		Evaluate HOTS question items.	Inference	5, 6
			Situation	7, 8
			Clarity	9
			Overview	10
	Essay	Create instrument outlines based on the Kurikulum Merdeka	Focus	1b
			Reason	1a, 3a
			Inference	2b
		Create HOTS question stimuli from real-life problems	Situation	2a
			Clarity	3b
			Overview	4a, 4b

Data from the critical thinking skills test results were analyzed using JASP software. The results of the experimental class and control class tests were compared using the independent sample t-test method. The reference criteria in Table 6 were used to categorize the average scores of critical thinking skills into various levels.

Table 6. Criteria of Critical Thinking Skills

Score Range	Category
90-100	Excellent
80-89	Good
70-79	Moderate
<70	Not Critical

Source: Nasution and Rezeqi (2015)

RESULTS AND DISCUSSION

Prospective biology teachers' achievement of critical thinking skills after learning using the PjBL-RAHMA model shows that the experimental class is better than the control class. The critical thinking skills of the experimental class at the three universities are moderate. In contrast, the control class is not yet able to think critically. These results are presented in Table 7.

Table 7. Prospective Biology Teachers' Achievement of Critical Thinking Skills

University	Class	N	Min	Max	SD	Mean	Interpretation
X	Control	27	43.21	95.68	13.08	69.17	Not critical
	Experiment	26	53.40	98.77	12.41	77.52	Moderate
Y	Control	17	11.63	72.67	15.47	54.49	Not critical
	Experiment	22	36.92	97.97	14.63	76.67	Moderate
Z	Control	19	10.20	64.63	17.91	37.63	Not critical
	Experiment	21	23.47	99.32	20.54	71.25	Moderate

This finding shows that PjBL-RAHMA is more appropriate in elevating prospective biology teachers' thinking skills because the syntax facilitates critical thinking. Furthermore, prospective biology teachers' achievement of critical thinking skills has been analyzed using assumption tests. Data assumption tests are conducted using the Shapiro-Wilk test for normality (Table 8) and Levene's test for homogeneity of variances (Table 9).

Table 8. Normality Test Result

University	Class	W	p
X	Control	0.967	0.533
	Experimental	0.967	0.546
Y	Control	0.882	0.034
	Experimental	0.914	0.057
Z	Control	0.901	0.051
	Experimental	0.955	0.426

The normality test results show that all data are normally distributed because they meet the criteria of $p > 0.05$, except for the control class at University Y ($p = 0.034$). Thus, data from Universities X and Z are analyzed using parametric statistics. In contrast, data from University Y are analyzed using nonparametric statistics.

Table 9. Homogeneity Test Result

University	F	df_1	df_2	p
X	0.022	1	51	0.883
Y	0.000	1	37	0.992
Z	0.176	1	38	0.677

For the homogeneity test, all data meet the homogeneity criteria suitable for parametric statistical tests ($p > 0.05$). The hypothesis test results are presented in Table 10. Based on the hypothesis test using the independent sample t-test in Table 10, all data in the three universities show $p < 0.05$. Thus, the null hypothesis is rejected. This result indicates that the PjBL-RAHMA significantly improves prospective biology teachers' critical thinking skills.

Table 10. Hypothesis Test Results

University	Test	Statistic	df	p	Location Parameter	SE Difference
X	Student	-2.381	51	0.021*	-8.347	3.505
Y	Mann-Whitney	43.000		< .001*	-21.912	
Z	Student	-5.490	38	< .001*	-33.621	6.124

*Significance value: 0.05

The analysis of aspects of FRISCO critical thinking also proves that prospective biology teachers' critical thinking skills in the experimental class are better than those in the control class. These results are displayed in Figure 3.

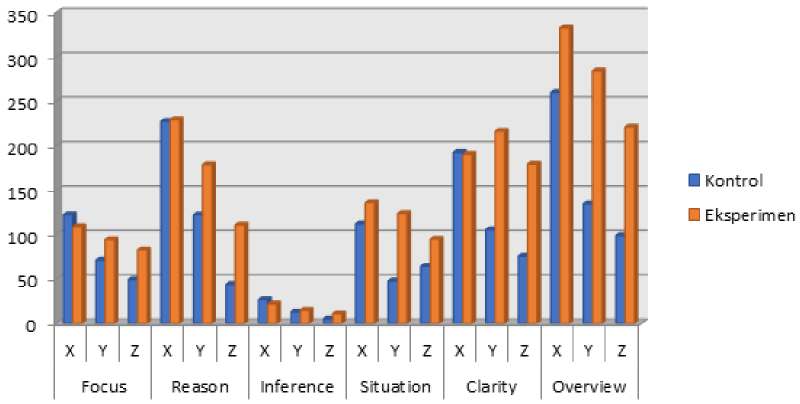

Figure 3. Critical Thinking Skills Achievement Based on FRISCO Aspects

The novelty of this research is the innovation of PjBL-RAHMA, an acronym for Recognizing Problems, Analyzing Problems, Handling Projects, Monitoring Progress, and Assessing Results. The main research results show that implementing PjBL-RAHMA improves prospective biology teachers' critical thinking skills. These results are in line with Wibowo et al. (2024) that the stages of PjBL syntax can enhance critical thinking skills because project work provides solutions to problems that are thought through critical analysis (Balleisen et al., 2024; Shi & Li, 2024). Furthermore, the achievement of critical thinking skills of prospective biology teachers also increases from the not critical to moderate category based on the criteria from Nasution and Rezeqi (2015). These results are in line with Suwono et al. (2017) that prospective biology teachers' critical thinking skills will increase if the learning process facilitates analyzing cases and processing information so that they learn to think, as implemented in the PjBL-RAHMA model (Trisdiono et al., 2019). Hung (2016) states that problems connect knowledge and real life, as trained to prospective biology teachers in the first syntax of PjBL-RAHMA (Recognizing Problems) by finding real issues in the field and analyzing them further in the second syntax (Analyzing Problems).

The purpose of the initial activity of PjBL-RAHMA syntax is to provide prospective biology teachers with the opportunity to recognize fundamental problems in the classroom by requesting data related to the implementation of biology learning evaluation to teachers in schools. This activity trains prospective biology teachers to apply their critical thinking skills in analyzing problems encountered and making learning meaningful (Lufri et al., 2020; Marnewick, 2023). Along with providing prospective biology teachers with practical experience, this activity also allows them to work with experienced teachers, providing them with a platform for practicing communication in social situations (Hu et al., 2016; Poonputta, 2023).

Analyzing Problems is the second syntax. In this syntax, prospective biology teachers analyze the problems they get in the first syntax to further discuss the solutions in groups. In addition to training critical thinking skills in analysis, syntax strengthens team collaboration and thinking habits. Farcis (2016) states that thinking skills must be trained consistently during the learning process to become habits and make students innovative (Barak & Yuan, 2021).

Prospective biology teachers are guided to design a project to produce a higher-order thinking skills (HOTS) evaluation instrument to overcome the problems encountered in the first syntax and the results of its analysis in the second syntax. HOTS must be trained in students (Yerimadesi et al., 2023). Efforts to overcome these problems are carried out in the third syntax, Handle Projects. This syntax includes five activities: scenario, scheduling, review, revise, and trial. During the Scenario activity, prospective biology teachers collaborate in their groups to design a project to be implemented. Prospective biology teachers also complete the individual design of HOTS instruments to be commented on by their group members in the Review activity. This Scenario activity is essential for prospective teachers in designing the project plans they develop and is one of the critical factors in the success of PjBL (Balleisen et al., 2024; Shi & Li, 2024).

Furthermore, in the scheduling activity, the design made in the scenario activity is elaborated on as time allocation and implementation schedule. Scheduling is crucial to train prospective biology teachers to become advanced organizers (Shi & Li, 2024). A well-planned schedule will facilitate prospective biology teachers in understanding the knowledge (Abas et al., 2024; Balleisen et al., 2024). In addition, providing appropriate allocation is one of the determining factors for the success of critical thinking in a project (Purwanto et al., 2022).

After the Scenario and Scheduling activities are completed, the next activity is the Review, which involves exchanging HOTS questions with group members. The last activity in the third syntax is the Trial or HOTS question trial that prospective biology teachers make for first-year students in general biology courses. The trial results are analyzed to determine empirical validity, reliability, discriminatory power, and difficulty level. Thus, prospective biology teachers know which questions have and have not met the criteria for good questions. Prospective biology teachers in this syntax carry out reflection, assessment, and evaluation, which are a means of building critical thinking skills (Yang & Choi, 2023). Based on the review results, prospective biology teachers further revised and discussed the HOTS instrument in small groups. Learning in small groups is a social context that facilitates learning, especially in building sharing (Slavin, 2012). In line with that statement, Sonnenberg-Klein and Coyle (2024) explain that teamwork performance will be good when the group is small, so in this study, prospective teachers worked in groups of 3-4 people.

The fourth syntax is Monitoring Progress, where prospective biology teachers report the development and progress of the project in their group. Furthermore, the lecturer evaluates the implementation and completeness of the project. The last syntax is Assessing Results, which directs prospective teachers to consider the trial results in the previous stage. Based on the assessment, prospective biology teachers conclude the questions from their group project that meet the criteria to be collected as a final project report in a question card. This stage is relevant to the FRISCO aspect of critical thinking skills from Ennis (2015), which has been investigated for its application to improve critical thinking skills in other studies (Lim, 2021; Jiang et al., 2024).

In each syntax, prospective biology teachers upload their assignments in the learning management system (LMS) to get further feedback from lecturers. This activity is essential because the information is obtained well with appropriate and immediate feedback (Arends, 2012; You, 2024). Knowledge is gained when there is specific and direct feedback. Feedback helps prospective biology teachers improve their assignments' quality, competence, and motivation to complete the process and product of the tasks (Garn & Stenling, 2024; Marnewick, 2023). Prospective biology teachers' critical thinking skills can be developed by providing structured and systematic feedback (Kim et al., 2019; Sapriati et al., 2024) and become a catalyst for improving learning (Kasch et al., 2022; Nicol & Selvaretnam, 2022). Feedback from lecturers has an extraordinary effect on improving students' abilities and the achievement of assigned tasks (Ibarra-Sáiz et al., 2021). In addition, academic pressure on students from assignments and exams can also be overcome with good communication between lecturers and students through learning feedback (Vaessen et al., 2017).

The Biology Learning Evaluation course using the PjBL-RAHMA model is implemented in collaboration with face-to-face lectures and group collaboration in independent assignments outside the classroom. Collaborative assignments allow prospective biology teachers to manage their tasks and be responsible for achieving the set goals (Ali, 2015). This emphasis is a principle of self-directed learning and collaboration to improve critical thinking skills (Kopzhassarova & Eskazinova, 2016; Martin et al., 2021). It also aligns with You (2024) that teamwork contributes positively to students' task performance and critical thinking.

Specification of the finding has assessed that the PjBL-RAHMA effectively elevates prospective biology teachers' critical thinking skills in the Biology Learning Evaluation course. Therefore, lecturers should use this learning model to empower prospective teachers' critical thinking skills, especially for pedagogy and other relevant courses. Pedagogy courses emphasize aspects of the methods and things that teachers conduct with their students (Langsford, 2024) to teach and evaluate learning achievement (Setiasih et al., 2024). The characteristics of the material that can be applied to the PjBL-RAHMA model are materials with group work to produce products in the context of pedagogy, especially in developing learning devices that require further revision and testing. Further research is needed to implement the PjBL-RAHMA model in other pedagogical courses and universities to adjust the PjBL-RAHMA syntax for different courses. Furthermore, to obtain research results that empower students' critical thinking skills in subsequent studies, researchers must consider the advantages and disadvantages of the PjBL-RAHMA model.

The ability to provide good reasons, think logically, and express principles and scientific reasons for the basis of decision-making are needed in critical thinking skills (Razak et al., 2022; Rivas et al., 2023; Guamanga et al., 2024). It is relevant to critical thinking criteria called FRISCO by Ennis (2015). Prospective biology teachers obtained the highest score in the overview. This result shows that prospective biology teachers can describe a problem from various aspects found in the early phase, including focus, reason, inference, context, and clarity. Meanwhile, the inference aspect or providing a comprehensive explanation based on facts and findings obtained the lowest category and has not reached the good category. Therefore, further efforts are needed to overcome this problem.

The scope of this research is still limited to evaluating the PjBL-RAHMA model's effectiveness in improving prospective biology teachers' critical thinking skills. In contrast, its effect on other 21st-century skills, such as collaboration, communication, and creative thinking, has not been studied. Therefore, further studies are needed to determine the effect of the PjBL-RAHMA model on those skills. In addition, other effects can also be studied from psychological and affective aspects, such as interest, motivation, activity, self-confidence, and others, which are limitations of this study. Further research can measure these aspects with appropriate instruments. It can also be applied to different courses in the field of pedagogy.

CONCLUSION

This research aims to measure the effectiveness of the PjBL-RAHMA model in improving prospective biology teachers' critical thinking skills. This aim addresses the research gap from previous studies that use PjBL to improve critical thinking skills in science, engineering, and language learning but have not been implemented in the pedagogical aspect. This research shows that using the PjBL-RAHMA model helps prospective biology teachers improve their critical thinking skills. This model is designed for a biology learning evaluation course that is mandatory for prospective biology teachers. Based on the FRISCO critical thinking aspects, prospective biology teachers have been excellent in reason, clarity, and overview; they are good in focus and situation but need improvement in inference. Therefore, this model must be adjusted to drill the inference skill. This learning model positively impacts the prospective biology teachers' ability to analyze, reason, and solve problems. Educators should consider the PjBL-RAHMA model's characteristics and syntax details for effective implementation. The advantages and disadvantages of PjBL-RAHMA in the Biology Learning Evaluation course are described and considered for further research.

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