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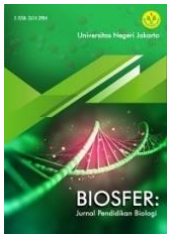

Integration PBL with RMS: Improving problem solving skills on environmental education

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ABSTRACT

The environmental education course currently does not integrate problem-solving problem skills. The purpose of this study was analyzing the results of applying integration on problem-based learning with the RMS (reading, mind mapping, and sharing) learning model. The research method was a quasi-experimental with pre-test-post-test control group design. The study was conducted on 56 students who took an environmental education course in Natural Science Education Universitas Tidar. Data analysis used an Anacova test with a pretest as its covariate. The study results stated that 1) developed learning model integrates PBL with RMS learning model consisting of identifying problems, finding relevant information about problems through reading activities, analyzing problem: group discussion through mind mapping, providing solutions, and sharing results of mind mapping. 2) The integration of PBL with the RMS learning model indicated by an average score of post-test in the integration of PBL with the RMS learning model class of 68.46, and the traditional class of 48.92. 3) the learning process that occurs in the integration of PBL with the RMS learning model class shows that learning is run well, which is indicated by students' average evaluation score of the lecturer learning process. The integration of PBL and RMS model can be utilized by teachers and lecturers in Biology learning to have thinking skills and solve daily problems.

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INTRODUCTION

Education is a process to develop the human mindset to solve problems found in everyday life. The current era is called the industrial revolution 4.0 period, which requires thinking skills such as critical thinking and problem-solving skills in everyday life. Problem-solving skills and critical thinking skills must be integrated into every learning because it is important for self-existence in everyday life (Lamb, 2017; Schooner et al., 2017; Muhlisin et al., 2018).

Learning biology ideally has a basic goal to educate individuals who can research, investigate, and build correlations between daily lives (Djamahar et al., 2019). Science subjects using scientific methods are expected to develop skills to solve problems faced in everyday life and have an attitude towards life from a scientists' point of view (Celik et al., 2011; Ozrecberoglu et al., 2018). Problem-solving skills are an important skill in science because they are used to solve phenomena in everyday life.

Problem-solving skills start from understanding the problem, choosing a strategy that will be used, overcoming the problem, and examining the solution to the problem that has been given (Saygih, 2017). Problem-solving skills should be integrated into the learning process to improve students' problem learning skills. Problem-based learning is based on learning about new information using previous knowledge and skills and eliminating ignorance by individuals or groups' workings. This learning also enhances active learning, increases factual information, and is based on understanding and solving the problem to improve problem-solving skills (Celik et al., 2011; Ulger, 2018; Bilgin et al., 2019).

The development of problem-solving skills can be integrated or can be implemented in the learning process. The learning process that can develop problem-solving is problem-based learning because the learning process focuses on understanding the problem and providing alternative solutions to the problems that occur. The integrated problem-solving skills in education can improve learning outcomes and problem-solving skills (Phungsuk et al., 2017). The steps of the learning process that integrates problem-solving skills consist of 1) identifying the problem; 2) defining the problem; 3) providing solutions; 4) organizing problem information; 5) allocating resources to solve problems; 6) observing progress; and 7) evaluating the solution to be accurate (Widiasih et al., 2018).

The observation analysis of student activities during the learning process shows the low problem-solving skills of students, such as students having difficulty recognizing a problem, less able to find the truth of the solutions that have been delivered. They have difficulty in explaining in detail the solutions that have been offered in overcoming the given problems. These results are supported, which states that many students have difficulty solving problems if faced with problems encountered in everyday life. One of the factors that cause students' low problem-solving skills is the lack of learning process opportunities for students to develop problem-solving skills, and learning is less confronted with problems in daily life (Ogilve, 2009; Etherington, 2011).

Based on the above analysis, the solution that can be given is applying the integration of problem-based learning with the RMS learning model (reading, mind mapping, and sharing). Problem-based learning can improve understanding of a concept and enhance problem-solving skills (Etherington, 2011). Several studies on the implementation of the RMS learning model that includes main steps of reading, mind mapping, and sharing in the study of science concepts have been proven to improve critical thinking, metacognitive, and concept understanding (Muhlisin et al., 2016; Muhlisin et al., 2018; & Muhlisin, 2019). An important finding in the RMS learning model study implemented in Biology learning includes the learning process that has not integrated problems in learning process activities; thus, finding relevant information about problems and skills to provide solutions is not yet evident in students' learning outcomes. Therefore, this research aims to develop and apply the RMS learning model that integrates problem-solving to improve problem-solving skills.

METHODS

Research Design

This research was conducted in the Natural Science Education of Universitas Tidar in the Environmental Education course. The study was conducted in August-November 2019. This research was conducted with a quasi-experimental approach with a pretest-posttest control group design (Sugiyono, 2010). The quasi-experimental research was intended to find out whether or not treatments on the research subject generate a result. The research design can be seen in table 1.

Table 1
Quasi Experiment Research Design

Scores	Treatment	Scores
Pretest	Integration of PBL with RMS learning models	Post-test
Pretest	Learning model with the presentation system	Post-test

Table 1 indicates the research design that compared pretest and post-test of the class group with the implementation of the Integration of PBL and RMS learning models and the pretest and post-test of the class group with the learning model's implementation using presentation system. The learning phase, steps for integrating PBL with the RMS learning model, can be seen in Table 2.

Table 2
Steps for Learning integration of PBL with RMS Learning Models

No	Learning Phase	Steps for Learning integration of PBL with RMS Learning Models	Examples of the implementation of learning
1.	Discussion	Identification of Problem.	Students identify problems about air pollution that occur in Indonesia by exposing news and YouTube videos about air pollution.
2.	Learning Phase	Finding relevant information about problems	Students read reference sources related to air pollution problems.
		Problem analysis: group discussion through making mind maps	Students in groups create mind mapping based on the problem of air pollution.
		Providing solutions.	Students develop solutions to problems that are integrated into the mind map.
3.	Reporting phase	Sharing the results of making mind maps.	Students share the results of making mind maps through presentations.

Source: Modified from Muhlisin et al., (2016); Muhlisin et al., (2018); Widiasih et al., (2018) & Muhlisin (2019)

Sampling

The research trial subjects included 56 students who were currently taking an Environmental Education course in the Department of Natural Science (IPA) of Universitas Tidar divided into two classes. Next, cluster random sampling was used to determine which class to be treated with the Integration of the PBL and RMS learning model and learning model with presentation system.

Instrument

The instrument used in this study was an evaluation sheet of essay tests in an environmental education course that was integrated with indicators of problem-solving skills, which included identification of problems, finding relevant information about problems,

providing solutions, and maintaining solutions. The instrument was tested for validity and reliability before being used, with a validity value of 0.969. The problem-solving skills rubric can be seen in table 3.

Table 3
Problem Solving Skills Rubric

Skill	4. Very good	3. Good	2. Fair	1. Low
Identification of Problem	Students can describe the problem clearly and are followed by supporting data relating to the topic of study.	Students can explain problems clearly and are followed by supporting data not relating to the subject of study.	Students can describe the problem clearly but not followed by supporting data.	Students cannot explain the problem clearly.
Finding relevant information about problems	Students conduct studies with at least four relevant sources of information.	Students conduct studies with at least three relevant sources of information.	Students conduct studies with at least two relevant sources of information.	Students conduct studies with at least one relevant source of information.
Providing solutions	Students have at least four viable solutions and describe relevant problem solutions.	Students have at least three viable solutions and describe relevant problem solutions.	Students have at least two viable solutions and describe relevant problem solutions.	Students have at least one viable solution and describe relevant problem solution.
Defending solution	Students are able to analyze all solutions and choose one that shows understanding about the problem being analyzed.	Students can evaluate solution and choose one solution looks reasonable.	Students can give simple explanation to one choice which is make sense.	Students unable to explain a solution.

Source: Modified from Zubaidah (2018)

One example of the essay questions used in this study can be seen in Table 4.

Table 4
Example of the essay questions

Example of problem
Data of *Sipongi Kebakaran Hutan dan Lahan* (forest and land fires) recorded fires covering an area of 328 thousand ha from January to September 15, 2019, in all Indonesia. The number reaches 64% of previous year forest and land fires area. The current forest and land fires occur in East Nusa Tenggara (NTT) of 108 thousand ha, Riau of 49 thousand ha, and Central Kalimantan of 45 thousand ha (https://databoks.katadata.co.id/). a. Explain factors influencing forest fires in Indonesia! b. Explain forest fires' impact! c. Explain solutions to reduce forest fires in Indonesia!

Research Procedure

The research procedure consisted of the following steps: 1) scope step that comprises survey research by observing the learning process and tools in environmental education course; 2) creation step (designing an RMS learning model with problem-based learning); 3)

user experience stage, which is submission to users, in this case, lecturers who teach the environmental education course; and 4) evaluation step by implementing the RMS learning model with problem-based learning through a quasi-experiment (Siemens, 2005). The research procedure is illustrated in Figure 1.

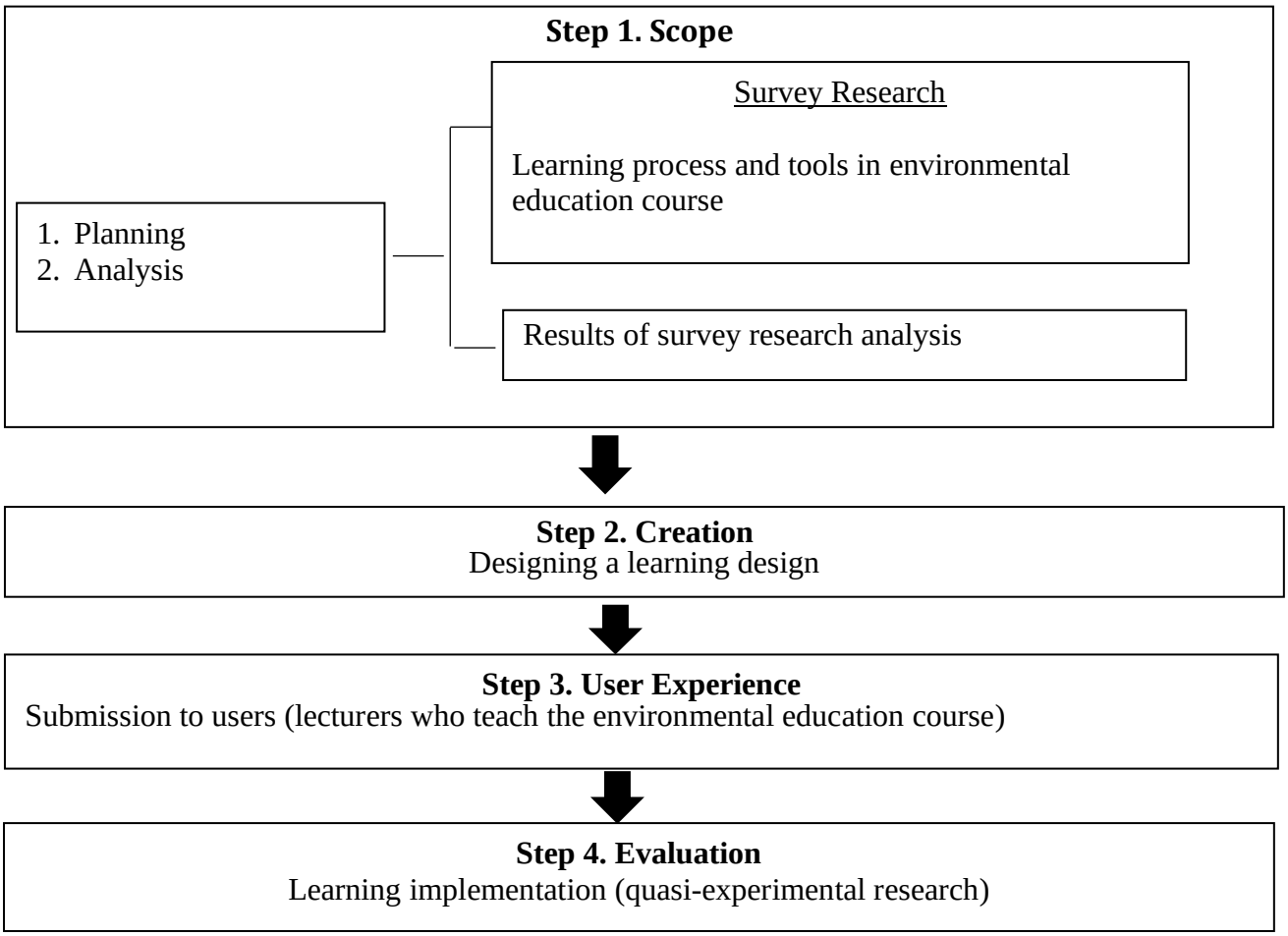

Figure 1 Research Procedure

Data Analysis Techniques

This study used the Anacova test (Analysis Covarian) with a pretest as a covariate. Before the data were analyzed with Anacova, normality, and homogeneity were tested. The results of normality and homogeneity tests can be seen in Table 5.

Table 5
Normality and Homogeneity Test

Test	df	P-value	Criteria	Conclusion
Test of Normality	56	0.200	P≥0.05	Normal
Test of Homogeneity of Variances	56	0.651	P≥0.05	Homogeneous

Based on Table 5, it can be concluded that the data are normally distributed and homogeneous. Anacova analysis was using SPSS 23 software.

RESULTS AND DISCUSSION

The results of problem-solving skills are obtained from the test scores that have been integrated indicators of problem-solving skills from the control class (conventional class) and

the experimental class (integration PBL with the RMS Learning Model) with 24 questions. Recapitulation of the average results of problem-solving skills can be seen in Figure 1.

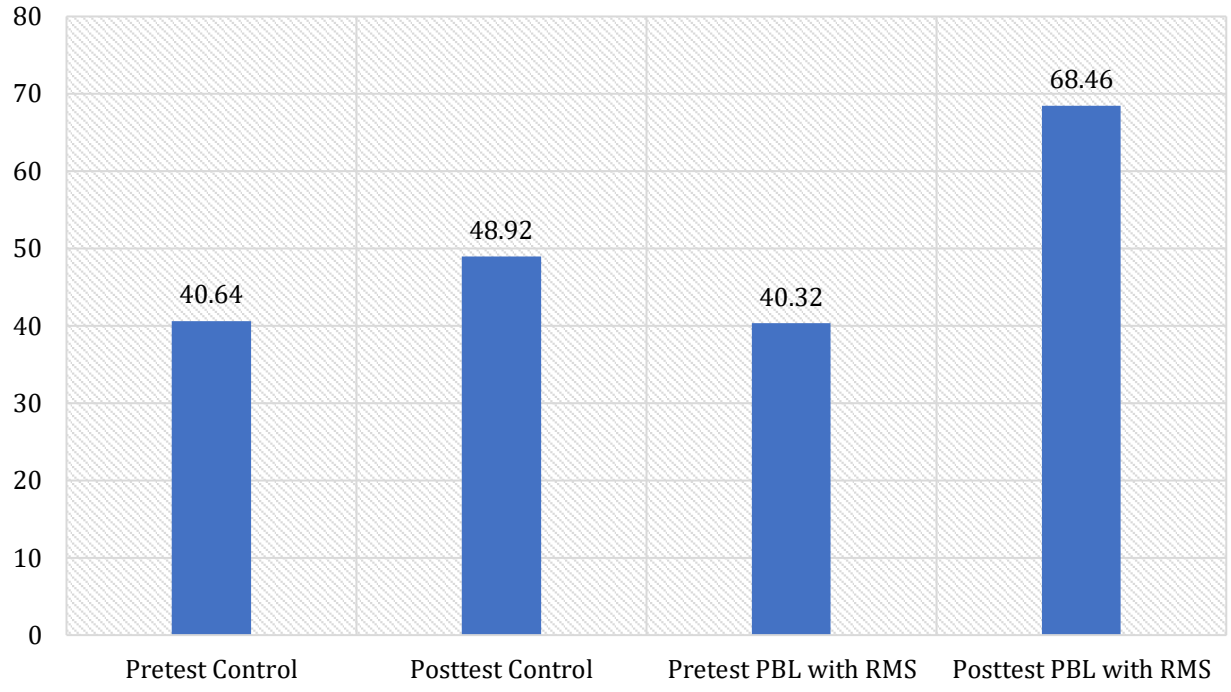

Figure 2
Average of Problem Solving Skills

Based on Figure 2, the results show that the pretest of conventional class and integration PBL with the RMS Learning Model class is not significantly different. In contrast, the average post-test result of the problem-solving skills in the integration of PBL with the RMS Learning Model class is higher with 48.92 and 68.46 on score. The value of problem-solving skills is grouped based on indicators of problem-solving skills. In detail, it is grouped by criteria scores 24 - 42 (Very low), 43 - 60 (Low), 61 - 78 (High), and 79 - 98 (Very high). A summary of data on problem-solving skills based on criteria can be seen in Table 6.

Table 6
Summary of Data on Problem Solving Skills

Indicator	Conventional Class		Improvement	Integration PBL with RMS Learning Model		Improvement
	Average of Pretest (Category)	Average of Post-test (Category)		Average of Pretest (Category)	Average of Post-test (Category)	
Identification of Problems	48,.20 (Low)	56.50 (Low)	8.30	48.20 (Low)	76.30 (High)	28.10
Finding relevant information about problems	47.00 (Low)	58.20 (Low)	11.20	48.67 (Low)	83.00 (Very High)	34.33
Providing solutions	46.20 (Low)	58.50 (low)	12.30	44.80 (Low)	81.70 (Very High)	36.90
Defending solution	48.30 (Low)	55.20 (Low)	6.90	47.00 (Low)	78.80 (high)	31.80

Table 6 explains that the results of problem-solving skills in the Integration of PBL with RMS Learning Model class increased from low to high and very high categories. The highest

change is in the indicator of providing solutions with an increase of 36.90, and the lowest is in the identification of problems of 28.10. This change shows that Integration PBL with RMS Learning Model as a whole can improve problem-solving skills.

The learning process in Integrating PBL with the RMS Learning Model class is evaluated through students' lecturer evaluation instruments. The six aspects of being assessed are: 1) Apperception and motivation, 2) Mastery of the material, 3) Application of teaching and learning strategies, 4) Utilization of learning resources or media in learning, 5) Student involvement in learning, and 6) Closing learning. Each aspect is broken down into 20 assessment criteria. The scores used for each criterion are 1 (poor), 2 (Not good), 3 (fair), 4 (good), and 5 (Very good). The description of the evaluation of the learning process can be seen in Table 7.

Table 7
Description of Evaluation of Lecturer Learning Process by Students

No	Aspects of Evaluation of the Learning Process	Average
1.	Apperception and motivation	4.74
2.	Mastery of material	4.72
3.	Implementation of educated learning strategies	4.81
4.	Use of learning resources/media in learning	4.81
5.	Student involvement in learning and	4.75
6.	Closing learning	4.63

Table 7 indicates that the learning process in the integration of PBL with the RMS Learning Model class shows the average value of each aspect in the category is very good. It shows that the learning process from the beginning to the end can activate students to learn by predetermined learning goals. Anacova analyzed data on problem-solving skills with pretest as the covariate. The results of the analysis with Anacova can be seen in Table 8.

Table 8
Anacova Analysis Results Based on the Value of Problem-Solving Skills

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5392.926[a]	2	2696.463	26.718	.000
Intercept	1259.989	1	1259.989	12.485	.001
Learnng_Model	5260.343	1	5260.343	52.122	.000
Pretest	49.908	1	49.908	.495	.485
Error	5348.913	53	100.923		
Total	203677.000	56			
Corrected Total	10741.839	55			

The test results of Table 5 in the learning model's source obtained that p less than α 0.05 (p≤0.05) with sig. 0,000. There are differences in problem-solving skills between students who are learning with the integration of PBL with the RMS learning model, and students learning with conventional learning models. Based on this, it can be concluded that there is an effect of the integration of PBL with the RMS learning model on student problem-solving skills.

The analysis results show that the integration of PBL with the RMS learning model has a better impact than the application of conventional models in education courses on the problem-solving skills of students. It is influenced by several factors of the learning process that occurs in the two classes. The improvement of problem-solving skills in the class of integration PBL with the RMS learning model is influenced by the learning process that accommodates learning steps. Those steps include identifying problems, finding relevant information in supporting

problem-solving, discussing in mind mapping, providing various solutions, and sharing the results of group discussions.

The problem-based learning process triggers improved learning and problem-solving skills (Arikan & Unal, 2015). These learning activities use problems as a starting point in learning (Hemker et al., 2017). Problems are intended to achieve learning objectives by involving students in independent or group work so that it leads to new knowledge (Sockalingam et al., 2012). New knowledge will be more meaningful if it is learned by using problems in students' daily lives (Damopoli et al., 2018; Muhlisin et al., 2018).

Students' problem identification activities are carried out by identifying exposure to air pollution information and videos that show air pollution. Furthermore, students read the information that supports the problem-solving process. The reading process is an activity that encourages students to be curious (Muhlisin et al., 2016; Susiati et al., 2018; & Amin et al., 2019), supported by the use of realistic problems as a starting point for learning (Yusof et al., 2011; Hadiyanti et al., 2016). It has led students to be more motivated to look for what to learn to solve problems. This process helps build information and carry out meaningful activities for learning to develop problem-solving skills (Celik et al., 2011; Nabilah et al., 2019).

The knowledge that has been built by students through reading is then applied in mind mapping as a group. This activity encourages students to have skills in constructing their knowledge, working in groups, having thinking skills to express thoughts in the form of branched writing, and understanding concepts (Sartono et al., 2016; Muhlisin, 2019; Syahmani et al., 2020). It allows students to show more about their ideas in providing various kinds of problem-solving solutions. Using mind maps in the learning process can improve problem-solving skills (Hung et al., 2014; Indriani & Mercuriani, 2019).

Working in groups to create a mind map facilitates students in choosing solutions that are considered most relevant based on obtained data and information. It encourages students to make final decisions related to the various solutions that have been offered. Group work makes students exchange ideas and decide relevant decisions relating to problem-solving (Huang, 2005). This activity also allows students to take responsibility and control their learning to evaluate what students have done (Aziz et al., 2014; Pratama, 2018).

The last stage carried out in the class of integration PBL with the RMS learning model is sharing the results of making mind maps. The purpose of this activity is to exchange ideas between students and lecturers. Students in delivering results must maintain the reasons for the solutions that have been offered so that problem-solving skills in indicators of maintaining solutions can be improved. Group activities in analyzing problems, discussing options, making decisions, and reporting in front of the class in solving problems based on real learning situations will improve problem-solving skills (Simone, 2014; Ristiasari et al., 2012; Fatmawati, 2016; & Dewi, 2019). The research faced an obstacle: students' lack of skill in developing a solution to problems found. The obstacle could be surmounted by training students to make a timeline on what, why, when, where, and how to solve the problems.

CONCLUSION

Based on data analysis and discussion, it can be concluded that the developed learning model is the integration of PBL with the RMS learning model. It consists of identifying problems, finding relevant information about problems through reading activities, analyzing problems: group discussion through mind mapping, providing solutions, and sharing the results of making mind maps. The implementation of learning with the integration of PBL and the RMS learning model is better than conventional learning, as indicated by the average post-test score of the class with the integration of PBL and the RMS learning model of 68.46 and the traditional class of 48.92. The learning process in the class of integration PBL with the RMS learning model class

shows that learning is run well, which is indicated by the average evaluation score of the lecturer learning process by students.

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