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Enhancing Environmental Literacy Using EMKONTAN Learning for Biology Teacher Candidates

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Abstract

This study aims to analyze the effectiveness of the EMKONTAN learning model in improving environmental literacy for prospective biology teacher students. EMKONTAN is a student-centered learning model (students active learning), oriented to creative learning, problem-based learning, collaborative learning and provides opportunities for students to improve environmental literacy. This research was conducted in the event semester of the 2020/2021 academic year at IKIP Budi Utomo Malang (IBU) and FTTE Universitas Muhammadiyah Malang (UMM), involving 150 second semester students through total sampling. Data obtained through observation, questionnaires and tests. The research used a pretest-posttest non-equivalent control group design. The experiment was conducted from March to July 2021. Data collection in this study was carried out using Google Form, Google Classroom, Google Meet, and WhatsApp. Data analysis using SPSS software version 23. The ANCOVA analysis results showed that EMKONTAN, PBL affected students' creativity, collaboration skill and environmental literacy on biology teachers candidate students with a value of $p<0.005$. The LSD result was significantly different in improving students' environmental literacy. The EMKONTAN class gained the highest posttest score. Therefore, EMKONTAN could be applicable to improve environmental literacy outcomes in environmental learning.

Keywords: *EMKONTAN; Environmental literacy; Teacher candidate*

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INTRODUCTION

The whole world has just been gripped by the COVID-19 pandemic which has killed more than 6.29 million people worldwide and until now there is still no sign of stopping (Agarwal et al., 2022). This pandemic is essentially an Acute Respiratory Infection (ARI) disease problem based on environmental problems and human lifestyles, especially in terms of hygiene, environmental health and food (Murni et al., 2021). Some experts refer to this pandemic as a problem of disharmony in human relations with the environment, which has become a global problem where its distribution is closely related to the environment and a person's lifestyle as is generally an infectious disease (Hwang et al., 2020; Pinheiro & Luís, 2020; Saladino et al., 2020; Yoosefi Lebni et al., 2021).

After the COVID-19 pandemic, the world faces new threats related to environmental problems. Climate change is a long-term threat that scares the world's citizens (Agarwal et al., 2022; Filho et al., 2020; Hickman et al., 2021). Crucial environmental problems include pollution, global warming, population explosion, natural resource decline, waste disposal, climate change, biodiversity decline, deforestation, ocean acidification, ozone layer depletion,

water pollution, air pollution, uncontrolled urban expansion, environmental health and genetic engineering (Adla et al., 2022; Manisalidis et al., 2020; Zhang et al., 2022). These problems arise as a result of human activities triggered by population explosions, economic development, technological advances and changes in political and economic institutions.

Environmental problems and education in Indonesia are problems that need to be addressed and require sustainable development (Husamah et al., 2017, 2022; Rahardjanto et al., 2022). Indonesia needs to improve the quality of the environment and education to become a developed country and create a glorious "Golden Indonesia" according to the ideals of the Indonesian nation from time to time (Maryam et al., 2018; Permatasari & Murdiono, 2022). A beautiful, healthy and clean environment free from pollution is an important factor to support the development of quality human resources. Meanwhile, quality education is an important factor to create a golden Indonesia in the future (Kumar et al., 2021; Sudarwati, 2021). Progress from various sectors such as agriculture, fisheries, resources, technology, economy, culture, defense and others begins with the advancement of the quality of education in these fields.

Environmental literacy is an individual's ability to understand and interpret environmental conditions, from the results of such understanding and interpretation, the individual can decide on appropriate actions to maintain, restore and improve environmental conditions (Coyle, 2005; Karimzadegan & Meiboudia, 2012; Mardiani et al., 2021; Muhdhar et al., 2021). The most widely accepted meaning of environmental literacy is that environmental literacy consists of awareness and concern for the environment and its related problems, as well as knowledge, skills and motivation to work towards the solution of current problems and prevention of new problems (McBride et al., 2013; Wong et al., 2018; Wu et al., 2020). In line with that, (B. McBeth et al., 2011) states that environmental literacy has four domains, namely: (1) knowledge, (2) cognitive skills, (3) attitudes, (4) behavior. (Latifatur & Amalia, 2022) reports that the environmental literacy of prospective biology teacher students is in the medium category. The same category was also found for the environmental literacy component of environmental competence and environmental knowledge. Meanwhile, (Farwati, Permanasari, Friman, et al., 2017) reports that prospective chemistry teacher students at Sriwijaya University have a very good attitude towards the environment. This finding has the same tendency as the report from (Ozgurler & Cansaran, 2014) on environmental literacy of teacher-student students in Turkey.

Environmental science courses are multidisciplinary subjects that are closely related to everyday life (Nugraheni, 2014). Some environmentally unfriendly behaviors in the community are closely related to the understanding and concepts of environmental science, for example cleanliness ranging from the household environment, schools, markets, public facilities due to littering. The increase in electronic waste due to the massive use of mobile phones and computers contributes to environmental problems. For example, cleanliness starts from the household environment, schools, markets, public facilities due to littering (Ferronato & Torretta, 2019; Needhidasan et al., 2014).

The implementation of the Environmental Science learning process so far has shown a lack of encouragement to improve students' creativity, collaboration skills and environmental literacy. Preliminary research has been conducted at seven universities in Java and Sumatra with a sample consisting of fourteen (14) lecturers and fifty (50) students supporting this indication (Nurwidodo et al., 2019). Some of the results obtained are that students tend to memorize concepts because of the application of lecturer-centered learning and the absence of learning models that encourage student creativity both in providing opportunities and creating Environmental Science products that are beneficial to life (Farwati, Permanasari, Firman, et al., 2017). In addition, the absence of exploration activities for environmental problems in the field and the opportunity to solve them causes students to lack mastery of environmental problems and minimal contribution to solving environmental problems (Torkar, 2014).

As an effort to improve the quality of learning, research and development efforts are needed by experts or lecturers (Adam, 2022; Arifin et al., 2022; Ermila et al., 2022; Muhlasin et al., 2022; Nur et al., 2022; Nurhayatus et al., 2022; Prasetyo et al., 2022; Varisa & Fikri, 2022). One of the products resulting from the development is the EMKONTAN learning model. The development of the EMKONTAN learning model is oriented towards the involvement of students in observing environmental problems, identifying and analyzing environmental problems, preparing action plans and possible integration into natural resource conservation , implementing actions to solve environmental problems, monitoring and evaluation and follow-up plans. This development needs to be done to facilitate lecturers in lectures. We have developed this model before, and it meets validity, reliability and practicality. The EMKONTAN Learning Model has a very valid status with a validity level of 0.85%. The EMKONTAN learning model has a reliable status with the reliability level according to the validator reaching 0.87%. The EMKONTAN Learning Model has a practical status with the level of practicality according to lecturers reaching 0.86% and according to students reaching 0.88% (Nurwidodo et al., 2021).

Problems encountered in the field in learning environmental science and/or ecology are students' environmental literacy which is still low, requires a long time to explore problems, diverse student learning motivations and not everything is as expected, student awareness of the importance of environmental science is still low, MK Learning Environment and Ecology has been carried out using lecture, assignment and discussion methods and only one lecturer has used PjBL or PBL. So far, student learning outcomes are like the normal curve, some are lacking, some are good and some are very good.

Contributions to be able to solve environmental problems have been agreed upon by all respondents in environmental science and/or ecology lectures even though the achievements have not been as expected. Environmental literacy is considered as initial capital and very important role in efforts to solve environmental problems by all respondents. The ability to think creatively has been recognized by all respondents as a modality to solve environmental problems. Collaborative skills were agreed upon by all respondents as a modality for solving environmental problems. Creative thinking skills, collaborative skills and environmental literacy are recognized as important for students to be used as benchmarks for achieving environmental science and/or ecology learning outcomes, even though the facts on the ground are not as expected and therefore innovative efforts are needed to achieve them.

Learning models that are considered capable of generating creative thinking skills, collaborative skills and environmental literacy are learning models that are hands on activity, provide opportunities to identify problems, convey ideas/solutions, are able to invite students to think critically, and are contextual with real problems around them. The results of the needs analysis lead to the need to include creative thinking skills, collaborative skills and environmental literacy as competencies that should be achieved in Environmental Science and/or Ecology lectures. To achieve these competencies, innovative strategies or lecture models are needed (Wirzal et al., 2022), namely those that provide opportunities to solve environmental problems and make follow-up actions for the preservation of natural resources.

Based on the results of the needs analysis, it can be assumed that in this study EMKONTAN as a new model in learning Environmental Science courses that will be able to improve creative, collaborative thinking skills and environmental literacy that will contribute to better and sustainable environmental problem solving. Therefore, the problem in this research can be formulated as follows are there differences in environmental literacy in students who are taught EMKONTAN, PBL and conventional learning? This study aims to analyze the effectiveness of the EMKONTAN learning model in improving environmental literacy for prospective biology teacher students. Environmental literacy in this study consists of (1) knowledge (ecological knowledge), (2) attitude towards the environment (attitude) which consists of components of verbal commitment, sensitivity to the environment and

feelings towards the environment, (3) responsible behavior/ actual commitment (responsible environmental behavior) and (4) cognitive skills.

METHOD

This research was conducted at IKIP Budi Utomo Malang and Universitas Muhammadiyah Malang on 150 second semester students. The sampling technique of the research is saturated sample, meaning that all of them become samples. Hypothesis testing was carried out on student learning outcomes in the form of description test scores on environmental literacy scores on the aspects of knowledge and cognitive skills were obtained through multiple choice tests. The environmental literacy questionnaire for the domain of attitudes and behavior towards the environment was first tested for the normality of the residual data using Kolmogorov Smirnov, with the criteria that if the probability value> level of significance (alpha = 5%) then the data was declared normal. Test the homogeneity of the data using the Levene Test, with the criteria if the probability value> level of significance (alpha = 5%) then the data is declared homogeneous. After that, the hypothesis was tested using Anacova with the test criteria stating that if the probability level of significance (alpha = 5%) then H0 is rejected.

The design of this study used a non-equevalent pretest posttest control group design. Tests were conducted at the beginning of learning (pretest) and at the end of learning (posttest) in the control and experimental groups using the same instrument. The research design is presented in Table 2. Tests were conducted at the beginning of learning (pretest) and at the end of learning (posttest) in the control and experimental groups using the same instrument. The research design is presented in Table 2. Tests were conducted at the beginning of learning (pretest) and at the end of learning (posttest) in the control and experimental groups using the same instrument. The research design is presented in Table 1.

Table 1. Research design

Group	Pretest	Treatment	Posttest
EMKONTAN Experiment	O1	X1	O2
Positive control (PBL)	O3	X2	O4
Negative control	O5	X3	O6

Information: O1, O3 and O5= pretest score; O2, O4 and O6= posttest score; X1= EMKONTAN learning model; X2= learning model PBL; and X3= conventional learning model.

The independent variables in this study were the EMKONTAN learning model, the Problem Based Learning and conventional (direct) learning models. The dependent variable in this study is student environmental literacy.

The environmental literacy assessment instrument was developed from the results of (Maulidya et al., 2014) research on Environmental Literacy of Fast Learner Middle School Students and (Rahmawati et al., 2017) on Environmental Literacy Assessment of Indonesia Student (ELAIS) which includes six domains, namely: (1) knowledge (ecological knowledge), (2) attitude towards the environment (attitude) which consists of components of verbal commitment, sensitivity to the environment and feelings towards the environment, (3) responsible behavior/actual commitment (responsible environmental behavior) and (4) cognitive skills which consist of identification of environmental issues, analysis of environmental issues and environmental action plans.. ELAIS in this research is the development and application of MSELI (Middle Student Environmental Literacy Instrument) which was developed by (W. McBeth & Volk, 2009) and adjusted by researchers with assessment standards for students in Indonesia.

The data in this study are test score data obtained through pretest and posttest. Before collecting post-test data, learning was carried out as an experimental activity in the class that was treated with the EMKONTAN learning model, the positive control class with the PBL learning model and the negative control class with the conventional learning model.

Observation progress is carried out at each meeting to get a value on the determined dependent variable.

The research data were analyzed using descriptive statistics to show the description of EMKONTAN learning in relation to the aspects of validity and implementation. Meanwhile, the effectiveness of the EMKONTAN model in improving students' environmental literacy analyzed using inferential statistics. Hypothesis testing was carried out using one-way ANCOVA. Previously done assumptions that are the requirements by using several tests of normality and homogeneity of the data.

The EMKONTAN model is a learning model used in Environmental Science lectures to improve students' creativity, collaboration skills and environmental literacy. This model was developed based on the analysis of needs, strengths and weaknesses of the model, as well as expectations of the objectives of the model development. The EMKONTAN model provides opportunities for students to participate in learning through appropriate steps in solving environmental problems that can provide unity of creative thinking skills, collaborative skills and environmental literacy for students.

The syntax (Table 2) in learning the EMKONTAN model is: socialization and environmental observation, identification and analysis of environmental problems, action planning and integration into natural resource conservation, carry out action to solve environmental problems and integrate into natural resource conservation, monitoring and evaluation, follow-up plans into student creativity programs. The syntax is structured by taking into account the characteristics of creative, collaborative learning, and environmental literacy. If the syntax of the EMKONTAN model is applied properly, the opportunities for creative thinking, collaborative skills and environmental literacy of students will increase.

Table 2. Syntax of EMKONTAN Model

Syntax	Phase Description	Student Activities
Phase 1: Socialization and Observation of Environmental Issues	Student orientation on the EMKONTAN step and observing environmental problems	- Listening to the purpose of the lecture and understanding the stages or steps of EMKONTAN delivered by the lecturer - Form a work/study group with 4 students per group - Observing and exploring environmental problems as the first step in the EMKONTAN model - Finding various environmental problems on a local, regional and global scale - Documenting the results of observations of environmental problems found
Phase 2: Problem Identification and Analysis	Taking an inventory of environmental problems and analyzing factors that affect environmental problems	- Together with group members, carry out an inventory of environmental problems encountered both from news sources and those directly encountered - Carry out investigations to analyze the factors that cause problems to arise - Classify the factors causing environmental problems, whether human factors or natural factors
Phase 3: Action Plan	Presenting an action plan to solve environmental problems	- Together with members in the group, prepare an action plan for solving environmental problems as directed by the lecturer. - Presenting an action plan for solving environmental problems by showing the stages of problem solving - Formulating the integration of solving environmental problems with conservation of natural resources
Phase 4:	Implementing an action	- Together with group members, take action to solve

Syntax	Phase Description	Student Activities
Implementation of the Action Plan	plan in the form of solving environmental problems	environmental problems as planned - Carry out every planned stage in solving environmental problems - Demonstrate an integrated formulation of solving environmental problems with conservation of natural resources
Phase 5: Monitoring and Evaluation	Monitoring and evaluating the process and results of problem solving	- Together with group members, monitoring the completion of each stage in solving environmental problems - Evaluate the process and results of solving environmental problems - Evaluating the integration of solving environmental problems with conservation of natural resources
Stage 6 Follow up plan	Make a follow-up plan (RTL) by compiling a proposal for the Student Creativity Program	- Together with group members, make a follow-up plan (RTL) on the process and results of solving environmental problems - Prepare PKM proposals based on environmental issues and conservation of natural resources as a form of RTL

RESULTS AND DISCUSSION

EMKOTAN and PBL learning have been carried out at the IBU campus, while conventional learning has been carried out at UMM. The level of implementation of the EMKONTAN learning model obtained very good results, as shown in the table of implementation of EMKONTAN learning in Table 3.

Table 3. Recapitulation of the implementation of EMKONTAN learning

Learning Syntax	Learning Activities By Lecturers	Average Score	Information
Socialization and Observation	• Lecturer introduces the background and stages of the EMKONTAN learning model (socialization)	5	Very well done Well
	• Lecturers present phenomena or facts related to environmental problems	4	Very well done Well
	• Lecturer divides students in several groups and each group consists of 4 to 5 students.	4	Very well done Well
	• This group of students then carries out the learning process according to the syntax of the EMKONTAN model	4	Very well done Well
	• Lecturers direct students to observe environmental problems encountered	4	Very well done Well
	• Lecturer directs students to	4	Very well done

Learning Syntax	Learning Activities By Lecturers	Average Score	Information
	document the results of observations		good
Problem Identification and Analysis	• Lecturers direct students to identify environmental problems in their working groups	4.3	Very well executed
	• Lecturers ask students to recapitulate environmental problems that are local, regional and global	5	Very well executed
	• The lecturer asks students to analyze the problem based on the cause	4.5	Very well executed
	• Lecturers direct students to analyze problems based on the impact it causes	4	Very well executed
	• Lecturers direct students to analyze possible solutions to environmental problems	3.2	Well done
	• Lecturers direct students so that the results of the identification and analysis of environmental problems are the product of collaboration in their working groups	3.2	Well done
Action plan	• The lecturer asks students to plan various alternative solutions to solve environmental problems	5	Very well executed
	• The lecturer directs that the planned project develops the integrated value of solving environmental problems with natural resource conservation	3.3	Pretty well done
	• Lecturers direct students so that action plans are prepared with relevant steps or stages of solution	4	Very well executed
	• Lecturers direct students so that action plans are prepared by considering their implementation	4.5	Very well executed
	• Lecturers direct students so that action plans are prepared with complete tools, materials and ways to do it	4.5	Very well executed
	• The lecturer directs students so that the action plan is equipped with an implementation schedule	5	Very well executed
Action Execution	• Lecturers direct students to	5	Very well executed

Learning Syntax	Learning Activities By Lecturers	Average Score	Information
	implement plans into real actions to solve environmental problems		
	• Lecturer directs students to consider alternative plans that are most likely to be implemented	4	Very well executed
	• Lecturers direct students to work on solving environmental problems in the form of projects with planned stages and targets	5	Very well executed
	• The lecturer directs that the projects they work on produce integrated products from solutions to environmental problems with conservation of natural resources	4	Very well executed
	• Lecturers direct students to be able to complete projects according to the schedule they have prepared	5	Very well executed
Monitoring and Evaluation	• Lecturer directs students to document progress data on environmental problem solving actions (projects)	5	Very well executed
	• The lecturer directs students to report the progress of project activities	4	Very well executed
	• Lecturers direct students to present products as a result of project work	4	Very well executed
	• Lecturers direct students to self-evaluate the progress and results of the completion of environmental problem solving projects	4	Very well executed
	• Lecturer gives advice and motivation to groups who experience difficulties and obstacles in completing environmental problem solving projects	4	Very well executed
Follow Up Plan	• Lecturers and students reflect on the process and results of project work	4	Very well executed
	• The lecturer directs students to plan follow-up actions in the form of preparing a student creativity program based	4	Very well executed

Learning Syntax	Learning Activities By Lecturers	Average Score	Information
	on Environmental Problems and Conservation of Natural Resources		
	• The lecturer directs students to present the development of the preparation of student creativity program as follow up pland	4	Very well executed
	• Lecturers direct students to provide guidance to lecturers so that their proposals can be included in the Ministry of Research, Technology, and Higher Education of Indonesia (Students Creativity Program)	3.5	Pretty well done
Average Score		**4.6**	**Very well executed**

The results of the analysis of the variance of the effectiveness of the learning model on student environmental literacy are presented in Table 4.

Table 4. Results of ANCOVA Environmental Literacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13541.641	4	3385.410	28.848	.000
Intercept	27738.510	1	27738.510	236.367	.000
Environmental literacy	1156.820	1	1156.820	9.858	.002
class	12579.177	3	4193.059	35.730	.000
Error	15960.061	139	117.353		
Total	291761.000	144			
Corrected Total	29501.000	143			

R Squared = .459 (Adjusted R Squared = .443)

Table 4 shows the differences in learning models (F count = 117.353 with p value = 0.000 while $p < (\alpha = 0.05)$). Therefore, the hypothesis which states that the learning model affects environmental literacy is acceptable. Then the LSD test was performed, shows the significant differences between conventional, PBL, and EMKONTAN learning models. The average posttest score reflects this. EMKONTAN got the highest score (34.50), followed by PBL (39.44), and conventional learning (58.75).

Regarding the EMKONTAN model, which is stated to be oriented to students active learning (SAL), it is indeed structured with learning steps that require student learning activities as well as the syntax it developed. Starting with the socialization step to the follow-up plan, all of which involve the active participation of students. The student activities are in individual units and group units. In individual units, students make observations in their respective environments, in group units, students coordinate and discuss to choose which problems will be the representation for the next study, learning strategies as "instructional activities that involve students in do something and think about what they do." In Creating a significant learning experience, Bonwell and Eison describe a holistic view of active learning that includes all of the following components: Information Experience, Ideas, Dialogue and

Reflective. This framework can be a useful tool for considering how students learn actively (Nurwidodo et al., 2021).

The mean scores of EMKONTAN, PBL, and conventional learning are detailed in Figure 1.

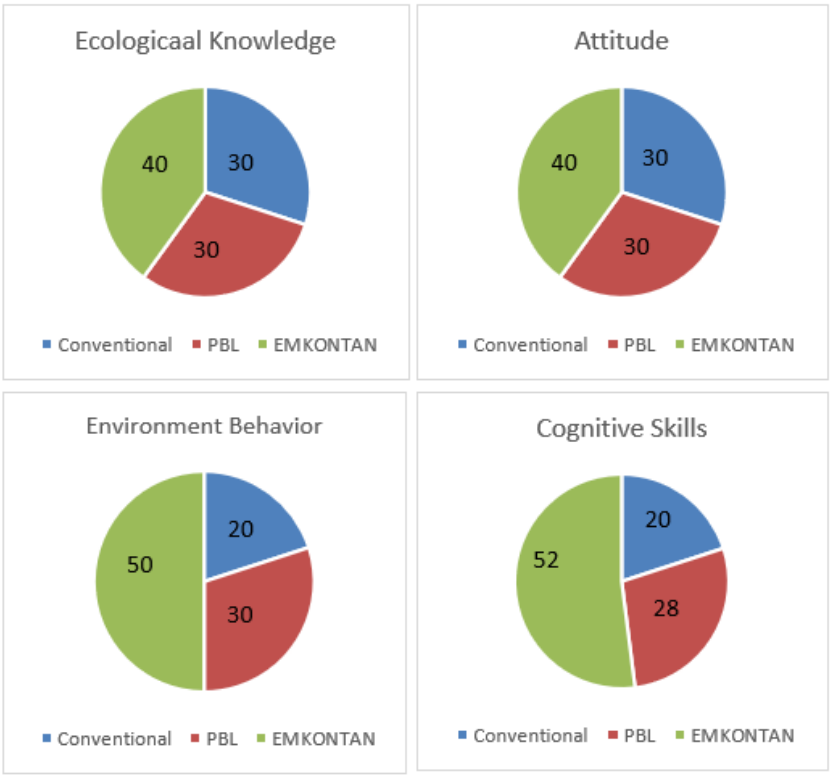

Figure 1. Average Score environmental literacy on Conventional Learning Models, PBL, and EMKONTAN on Environmental Literacy

Figure 1 shows the environmental literacy score of students with a maximum score of 100. Aspects of ecological knowledge in all classes reached the maximum score. The conventional class got the lowest score in the issue investigation aspect with a score of 50. Meanwhile, the PBL and EMKONTAN classes got the maximum score. The highest score in the analytical aspect was obtained by the EMKONTAN class which received a score of 75. While the lowest value was obtained by the conventional class which received a value of 31. The highest value in the sensitivity aspect to the environment was achieved by the EMKONTAN class which received a value of 63. The lowest value was obtained by the conventional class which obtained a value of 25. The highest score in the pro-environmental behavior aspect was achieved by the EMKONTAN class which received a score of 92. The conventional class got the lowest score of 42.

The results showed that the learning model had an effect on students' environmental literacy outcomes. The EMKONTAN learning model gives the highest contribution to student environmental literacy compared to PBL. EMKONTAN involves students to learn comprehensively, through the EMKONTAN stages. At this stage students are asked to identify and analyze environmental problems. (Danaher et al., 2020) said that collaborative problem formulation activities can help students to master environmental problems as a whole. In EMKONTAN learning, students are asked to identify and analyze relevant issues related to environmental issues and natural resource conservation.

The next stage is the identification and analysis of environmental problems. This stage trains students to involve conception, experience, and judgment or affection for the environmental conditions they face. Identification is able to stimulate students to ask questions, relate previous experiences, gather information, and find patterns of relationships

between events and objects (Oguz-Unver & Yurumezoglu, 2009). Developing the habit of identifying and analyzing environmental problems can increase students' understanding of environmental problems and conservation of natural resources. Action planning is an effort to implement his understanding of the problems that have been identified and analyzed for their causes and effects and should be addressed (Gherheş et al., 2022).

Environmental problems cannot be left unchecked, but must be addressed through properly planned actions. Planning for action requires creativity, collaboration and high environmental literacy. Taking action is an implementation step of an action plan that provides various alternative solutions to choose from and adapt to their capabilities, benefits and implementation. Completion of the implementation of solving environmental problems and their integration into natural resource conservation, followed by monitoring and evaluation stages, by which the implementation of the action can run smoothly as planned. At the follow-up stage, environmental literacy, creativity and collaboration are confirmed to produce works in the form of student creativity program, student creativity programs based on environmental problems and conservation of natural resources.

CONCLUSION

There is an effect of EMKONTAN learning on students' environmental literacy. This is indicated by the results of the ANCOVA hypothesis test with F count = 1.667 with p value = 0.000 while $p < (\alpha = 0.05)$. Then the LSD test showed a significant difference between conventional, PBL, and EMKONTAN learning models. This is reflected in the average posttest score. The highest EMKONTAN score (24.66), followed by PBL (23.81) and conventional learning (21.18). EMKONTAN could be applicable to improve environmental literacy outcomes in environmental learning.

RECOMMENDATION

This study is only focused on the effects of EMKONTAN learning on students' environmental literacy. Other aspects need to be looked at, for example creativity, communication, and collaboration.

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This section can be written in case there are certain parties need to be acknowledged, such as research sponsors. The acknowledgment must be written in brief and clear. In addition, avoid hyperbole acknowledgment.

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