



Analysis of Student Environmental Literacy: PjBL-Based Learning that is Integrated STEM

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Abstract: This study aims to analyze student environmental literacy from the aspect of physical and ecological systems, social, cultural, and political systems, environmental Issues, multiple solutions to environmental issues, and citizen participation and action strategies. The research subjects were 70 students of chemistry education and physics education at Malikussaleh University which is taught by learning Project Based Learning (PjBL) integrated with STEM. Research results in the overall average environmental literacy ability of students are 74 by category good, there are 14 students with very good environmental literacy skills, 50 students in the good category, and 6 students in the sufficient category. If viewed from environmental literacy indicators obtain the average value of students who answer correctly different questions, namely physical and ecological systems by 80%, social, cultural, and political systems by 70%, environmental issues by 68.1%, multiple solutions to environmental issues of 58.58%, and citizen participation and action strategies namely 86.1%.

Keywords: Environmental literacy; PjBL; STEM

Introduction

The era of globalization has had an impact wide enough in various aspects of life, including claims for maintenance education (Karimova et al., 2022; Lin et al., 2020; Stofkova et al., 2020) College is responsible for producing graduates competent. Graduates must have competence based on demands that have knowledge, attitudes, skills, character, and emotional maturity (Arsanti et al., 2021; Bancin, 2017; Ginting et al., 2020). The learning model is very influential on the final ability of students. The use of learning models is useful to generate enthusiasm for learning, as well as increase student motivation to play an active role in the learning process (Fajri et al., 2021; Islam et al., 2018).

The 2013 curriculum has provided a reference in the selection of appropriate learning models with a scientific approach and prepared students to face the challenges of the times. Model One of the intended learning is project-based learning (PjBL). PjBL implementation can increase student creativity (Oktaviani et al., 2021; Putri et al., 2020). PjBL is learning student-centered and

innovative teacher as a motivator, students have the opportunity to work autonomously to construct their learning (P. D. Anggraini et al., 2021). The advantages of PjBL between others are group working, social interaction, and problems solving skills as well as learning how to use equipment or programs (Aksela et al., 2019; Muliaman et al., 2020). Thus, PjBL isn't limited in terms of knowledge and information, but rather with their teacher's help, it provides students with the opportunity to transform themselves during the learning process. Knowing how to solve problems, working collaboratively, and thinking innovatively are considered to be 21st-century essential skills. Therefore, PjBL is generally accepted as an effective method for teaching processes, such as problem-solving and decision-making (Efstratia, 2014; Muliaman et al., 2020).

To remain competitive globally, a lot of the state calls for increased studies in the field of Science, Technology, Engineering, and Mathematics (STEM) at all levels of education. Based learning STEM is alternative learning that could potentially be used for building 21st-century skills (Anggraini et al., 2021;

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Beswick et al., 2019; Permanasari, 2016; Stehle et al., 2019; Badlisyah et al., 2022).

STEM can be a determining factor and economic development, educational programs, and strong protection for a country (Aninda et al., 2020). STEM in learning can encourage students to design, develop and utilize technology, sharpening cognitive, manipulative, and effective, and apply knowledge (Jannah et al., 2021; Kapila et al., 2014). Many studies have been conducted related to STEM implementation. Proven STEM implementation improves students' mastery of concepts (Aldi et al., 2022; Hariyanto et al., 2019; Ningkaula et al., 2021), problem-solving skills (Huang et al., 2016; Traphagen et al., 2014) critical thinking (Dywan et al., 2020; Wahono et al., 2020; Widiyawati et al., 2020), reasoning (Alfieri et al., 2015; Ding et al., 2016), elementary level students' scientific literacy (Afriana et al., 2016; Mellyzar et al., 2022) and medium (Ismail et al., 2016).

PjBL and STEM have complementary advantages and disadvantages. In PjBL students understand concepts by making products, while in STEM learning there is a design and redesign process (engineering design process) that makes students produce their best products Indonesia is in the information age which is synonymous with the literacy era. The literacy era describes the ability to interact, communicate, and actualize which is expressed verbally and in writing (Irianto et al., 2017).

Many studies examine STEM-integrated PjBL abilities in scientific literacy, but there is still a lack of research that analyzes the ability of students' environmental literacy aspects. Environmental literacy includes awareness, knowledge, and behavior in protecting the environment (Komariah et al., 2020). Students with high environmental literacy values will also have high environmental care behavior which is manifested in the way they act in dealing with environmental issues (Pratama et al., 2020).

Environmental problems are becoming increasingly difficult and complex from time to time, humans tend to overuse natural resources without trying to regenerate them. Humans use coastal land to build factories, ports, agricultural land, and coastal reclamation which worsens land conditions. This problem is mostly caused by people's behavior that threatens the environment badly. This is closely related to public education and the way humans acquire environmental literacy in educational units (Roshayanti et al., 2019). The goal of increasing environmental literacy is to prepare people to understand and overcome these problems (Komariah et al., 2020).

Environmental literacy is a skill that must be instilled to shape human character, the American Association of Colleges of Teacher Education (AACTE)

has raised environmental literacy to a crucial theme as part of 21st-century learning. The implementation of STEM in Physics courses opens opportunities for improving students' abilities to apply environmental, technological, and mathematical knowledge as well as being trained to be creative in designing solutions to environmental problems. So, from that, STEM implementation is strongly suspected of being able to actualize lecture goals. Environmental literacy serves to build students' understanding of the main concepts based on phenomena. Then this understanding becomes the capital for applying knowledge to solve environmental problems with unlimited sources through the use of technology (Adisendjaja et al., 2007; Haristy et al., 2013). This study aims to analyze students' environmental literacy from the aspects of physical and ecological systems, social, cultural, and political systems, environmental issues, multiple solutions to environmental issues, and citizen participation and action strategies (Hollweg et al., 2011).

Method

This type of research is descriptive quantitative, to describe students' ability to environmental literacy. The capabilities analyzed correspond to aspects of environmental literacy, namely aspects of physical and ecological systems, social, cultural, and political systems, environmental issues, multiple solutions to environmental issues, and citizen participation and action strategies. The first step is carried out by developing environmental literacy questions and carrying out PjBL-based learning that is integrated with STEM. In measuring students' environmental literacy abilities, the approach used is quantitative. Data collection uses environmental literacy questions that are valid and reliable. The research sample was 70 students of Physics Education and Chemistry Education at Universitas Malikussaleh in the Odd Semester of the 2022/2023 Academic Year. The environmental literacy scores are calculated using the average percentage technique for each aspect, then the results obtained are interpreted using a table of criteria as follows.

Table 1. Interpretation Criteria Score (Djaali et al., 2008)

Interval Percentage (%)	Criteria
86 < N ≤ 100	Very Good
72 < N ≤ 86	Good
58 < N ≤ 72	Enough
43 < N ≤ 58	Low
N ≤ 43	Very Low

Result and Discussion

The initial stage of the research was to develop environmental literacy instruments that were validated.

The questions developed amounted to 15 questions. Results the instrument developed was an environmental literacy assessment instrument on environmental pollution. The product is validated theoretically this validity using the content validity coefficient. Theoretical validity is carried out to get an assessment from the expert. The final product obtained consists of 15 questions which have been validated by 6 experts. Analysis of the theoretical validity score used the Aiken

formula adjusted for the Aiken index. Based on the analysis using the Aiken index, the items are valid and appropriate to use if the value of $V \geq 0.78$ for six raters (Aiken, 1985). The results of the validation score analysis with the Aiken formula for environmental literacy assessment instruments on environmental pollution material with an average of ≥ 0.80 are in the high category. In detail, it can be seen in Table 2.

Table 2. Validation Score Analysis of the Aiken Index

Aspects of Environmental Literacy	Item	Indicator	Aiken Index	Average
Physical and ecological systems	1	Knowing the relationship between ecosystem balance systems	0.83	0.87
	2	Knowing the relationship between ecosystem balance systems	0.83	
	3	Know the impact of human activities on climate change	0.94	
Social, cultural, and political systems	4	Know the system of laws or laws that regulate the environment	0.83	0.87
	5	Know the system of laws or laws that regulate the environment	0.89	
	6	Knowing community beliefs and customary laws that affect the maintenance of ecosystems	0.89	
Environmental Issue	7	Know the causes of various environmental problems that arise due to natural biophysical impacts	0.94	0.89
	8	Know the causes of various environmental problems that arise due to human conflicts	0.83	
	9	Know the causes of various environmental problems that arise due to human conflicts	0.89	
Multiple solutions to environmental issues	10	Know solutions to environmental problems including efforts that have been or are being made	0.83	0.83
	11	Know solutions or alternatives to overcome environmental problems in the future	0.83	
Citizen participation and action strategies	12	Know what actions can positively improve and maintain the environmental	1.00	0.92
	13	Know any actions that can negatively reduce the quality of the environment	0.83	
	14	Know any actions that can negatively reduce the quality of the environment	0.89	
	15	Know any actions that can negatively reduce the quality of the environment	0.94	
Average Aiken Index				0.88

Environmental literacy questions that have been developed were tested on 70 students in Chemistry Education and Physics Education at Malikussaleh University. The percentage of student answers as a whole can be seen in Figure 1.

Overall, the average environmental literacy ability of students is 74 in the good category, there were 14 students with very good environmental literacy skills, 50 students in the good category, and 6 students in the sufficient category.

The results of environmental literacy skills in the good category are obtained from a combination of all aspects of environmental literacy. With the student literacy scores obtained, it can be said that students who are taught with STEM-integrated PjBL learning are already literate with environmental literacy, namely being able to apply concepts or facts obtained from natural phenomena that occur in everyday life. Good environmental literacy skills mean that students have awareness and concern for the environment. In line with

the opinion (Nasution, 2021) environmental education can increase the attitude toward loving the environment.

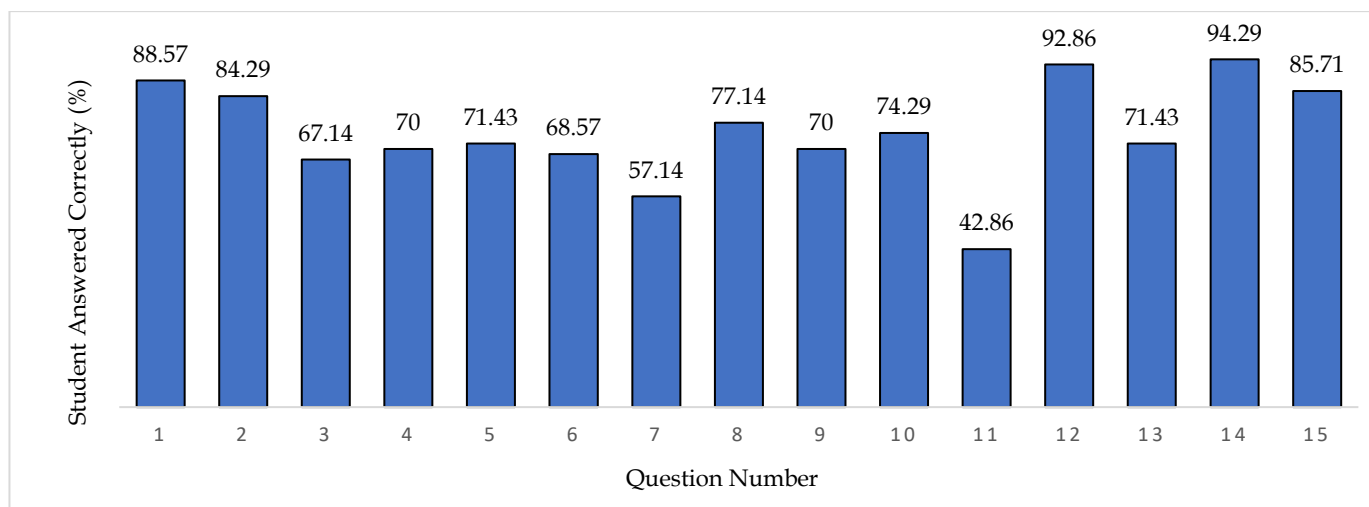


Figure 1. Environmental literacy value of students with STEM-integrated PjBL

This good student environmental literacy is also influenced by the student's habits. Most of the Physics and Chemistry Education students at Malikussaleh University come from areas that still have strong interaction with the environment, are more sensitive to environmental conditions, and solve many environmental problems. Research (N. Anggraini et al., 2021) says that students that come from rural areas usually have an attitude that cares more about the environment. In detail, the categories and number of students can be seen in Table 3.

Table 3. The Criteria for Environmental Literacy Values

Percentage Interval (%)	Criteria	Students
86 < N ≤ 100	Very Good	14
72 < N ≤ 86	Good	50
58 < N ≤ 72	Enough	6

From Figure 1 questions number 1, 12, 14, and 15 questions the most correctly answered, more than 85% of students can answer them correctly. The highest percentage in question number 14 is 94.29% or 66 students out of 70 students can answer correctly. This question measures aspects of environmental literacy, namely citizen participation and action strategies with achievement indicators. Knowing what actions can positively improve and maintain the environment. While the question with the least percentage of students, namely 42.86%, could answer question number 11 with the aspect of environmental literacy being measured as multiple solutions to environmental issues with indicators of knowing solutions or alternatives to address future environmental problems.

The percentage is based on environmental literacy aspects which can be seen in Figure 2.

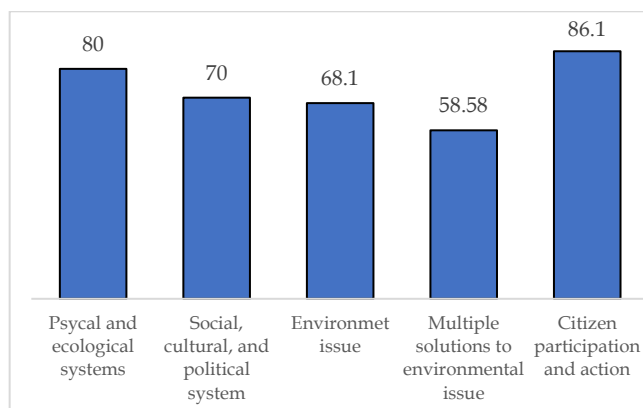


Figure 2. Percentage of student abilities based on aspects of environmental literacy

Based on a comparison of the average aspect of environmental literacy, the smallest proportion is 58.58% in several aspects of environmental problem solutions with indicators of the ability to have knowledge about solutions to environmental problems including efforts that have been or are being carried out and have knowledge of solutions or alternatives to overcome problems future environment. The low proportion can be caused by the lack of experience of students related to solving environmental problems This is in line with research (Ozsoy et al., 2012) which states that students' low environmental literacy is due to the lack of direct experience for students to interact with the environment.

Conclusion

Based on existing data, it can be concluded that the overall average score of students' environmental literacy is 74 in the good category. Out of 70 students, 14

students with environmental literacy skills were in the very good category, 50 students were in a good category, and 6 students were in the sufficient category. If viewed from environmental literacy indicators, the average score of students who correctly answered different questions was 80% physical and ecological systems, 70% social, cultural, and political systems, 68.1% environmental issues, multiple solutions to environmental issues 58.58%, and citizen participation and action strategies, namely 86.1%. From these data, student environmental literacy is classified as good with PjBL learning integrated with STEM.

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