



## The Effect of Contextual Problem-Based Learning Model on Students' Environmental Literacy in Environmental Education Course

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### ABSTRACT

**Objective:** The 21st century is characterized by transformation and advancement across multiple domains. These modifications encompass requirements within the educational sector. This essay seeks to analyze the opportunities and obstacles of environmental literacy and awareness in 21st-century schooling. This study sought to determine the impact of contextual problem-based learning on students' environmental literacy. The research employed a posttest-only approach and constituted a quasi-experimental study. The control group underwent conventional training, while the experimental group engaged in contextual problem-based learning. The environmental literacy of students was the dependent variable in this study. The independent variable in this study was contextual problem-based learning. Sixty pre-service biology educators from two complete courses participated in the research during their first semester. The assessments of recent environmental literacy competencies were utilized as study instruments. The research findings indicate a disparity in students' environmental literacy between those subjected to contextual problem-based learning and those who undergo traditional education. The experimental group exhibited superior environmental literacy compared to the control group. Consequently, contextual problem-based learning is a viable approach for augmenting students' environmental knowledge.

### INTRODUCTION

Environmental literacy refers to students' awareness, knowledge, attitudes, skills, and inclinations to address environmental issues (Lee et al., 2020). Environmental literacy is a skill required at all levels of education and a crucial element for achieving success in 21st-century skills (Farida et al., 2023). The importance of recognizing environmental literacy as a human and social issue (Guerrero & Sjöström, 2025). The application of environmental science and environmental literacy to address environmental issues is a crucial need (Suherman & Vidákovich, 2025). Community involvement is increasing environmental literacy among current stakeholders and future generations regarding lake management, ecology, and eutrophication (Armstrong et al., 2021). The implications for education require educators to adopt innovative learning strategies to foster environmental literacy and prepare them for future challenges in sustainable living and decision-making (Agustira). The advancement of science and technology in the 21st century is becoming increasingly inevitable (Andrews et al., 2019). This is due to the absence of boundaries between nations for communication and collaboration, necessitating that all sectors prepare accordingly. In the realm of education, modifications in learning paradigms are essential to accommodate advancements of the 21st century (Kennedy & Odell, 2014), which demands the ability and proficiency in 21st-century skills (Kwan, 2019). The demands of the 21st century lead to the formation of quality individuals who are in accordance with the demands of the times (Mak et al., 2025). Adapting to the needs of the times is essential to avoid being left behind and maintain one's existence (Reinke, 2020).



The National Education Standards Agency emphasized the significance of acquiring 21st-century skills in 2010. The declaration asserts that 21st-century national education seeks to fulfill the nation's ideals, including a prosperous society and an equal and respected position among other nations globally, based on the formation of quality human resources, namely independent figures, and the desire to realize the nation's ideals. It can be said that the demands of this change are aimed at preparing individuals who are qualified and can adapt to the developments of the current century.

This aligns with Buchori (Wiltbank et al., 2019), who stated that in facing 21st-century life, mastery of three key understandings is necessary, including cultural understanding (cultural literacy), understanding of knowledge (scientific literacy), and understanding of the environment (environmental literacy). Environmental literacy has become an important understanding or ability that needs to be mastered in the 21st century (Mcneal et al., 2020). This is also stated in the P21 framework for 21st-century learning, which identifies environmental literacy as one of the key themes in 21st-century learning (Driessen et al., 2020). Environmental literacy comprises three components: attitudes, knowledge, and behavior towards the environment. Environmental awareness is one of the components of environmental literacy (Corwin et al., 2019).

A person's environmental awareness is said to stem from their environmental knowledge. A person with good environmental literacy is considered to possess good environmental awareness (Clements et al., 2022). This is crucial in this century, not only because of the demands of progress and paradigm shift, but also because it helps solve existing problems and instill a disciplined and wise attitude towards the environment (Dulai et al., 2022). In practice, both environmental literacy and environmental awareness certainly face challenges (Mcdaniel et al., 2022). However, both skills also hold significant potential for application in the 21st century (Qu et al., 2024). Contextual problem-based learning and teamwork can increase student interest in a topic (Yang & Hardy, 2015), contextual problems to enhance students' creative thinking skills (Satriawan et al., 2020), and Contextual problem-based learning (CPBL) to improve problem-solving skills (Agustoni et al., 2021). The purpose of this article is to examine the impact of using contextual problems in learning on students' environmental literacy in 21st-century education.

## RESEARCH METHOD

The research methodology employed was quasi-experimental. The way participants are classified is the main distinction between this study and real experimental research. Participants were chosen at random in order to lessen bias in experimental studies. Quasi-experimental research is the best choice if individual selection is thought to be challenging or impossible. Because a quasi-experimental approach does not offer total control, researchers must take into account aspects that affect internal and external validity when interpreting their research findings (Shortlidge et al., 2019).

The dependent variable in this study is environmental literacy, whereas the independent variable is contextual problem-based learning. This study employed a posttest-only design without a comparable group as the foundation for the quasi-experimental methodology. The experimental and control classes were selected from two classes with similar characteristics. The same lecturer taught both classes, followed the same curriculum, and had equivalent class hours and campus facilities. Furthermore, based on previous academic records, the average scores of both classes on the college

entrance exam were relatively similar. Under these conditions, the two classes could be considered equivalent before the treatment and, therefore, suitable for comparison in a post-test-only design.

$$\begin{matrix} \text{NR} \times \text{O}_1 \\ \text{NR} \quad \text{O}_2 \end{matrix}$$

Notes:

There is not any : Non-random  
X : Contextual problem-based learning  
O<sub>1</sub> = O<sub>2</sub> : Environmental literacy

The experimental and control sample classes are delineated by a dotted line, signifying that they were not established through random assignment of individuals or research participants to the sample classes (Claramita et al., 2019). Sixty biology student instructors from two complete classes participated in the study during the second semester. Contextual problem-based learning was implemented to instruct students in the experimental classes. The control group, however, delivered conventional teaching to the participants in the study. The teacher provided contextual problem-based learning services with more clarity (Stanley, 2021). Following the instructional session, students in both sample classrooms underwent an assessment (O<sub>1</sub> = O<sub>2</sub>) to evaluate their environmental literacy.

## RESULTS AND DISCUSSION

### Results

Literacy is examined in environmental education courses involving first-semester pre-service biology educators for two complete courses. The mean and standard deviation offer a summary of students' environmental literacy competencies. Three basic levels of environmental literacy are presented, along with two treatment groups. Table 1 illustrates students' environmental literacy.

**Table 1.** Description of Students' Environmental Literacy

Treatment	Average	Standard Deviation	N
CPBL	70.53	8,653	30
Control	53.03	8,656	30

The control class comprised 30 students, while the Contextual Problem-Based Learning (CPBL) session also included 30 students. The students in the CPBL class achieved an average environmental literacy score of 70.53, accompanied by a standard deviation of 8.653. In the control class, the average environmental literacy score of pupils was 53.03, with a standard deviation of 8.656. The standard deviation was 15.880, while the mean for both groups was 66.28. The environmental literacy skills of pupils varied from 0 to 100, with the means indicating high literacy levels in the experimental/CPBL class and significantly low literacy levels in the control/traditional class.

The Kolmogorov-Smirnov test indicates that both the CPBL and standard models yield p-values less than 0.05 in the assessment of data normality for learning techniques. Likewise, according to the Shapiro-Wilk test, both the CPBL and control groups have p-values less than 0.05. Considering these two parameters, the data has a non-normal distribution. The p-value exceeding 0.05 obtained from the homogeneity of variance test

between the two groups signifies the equivalence of variances. Consequently, according to the learning model, it may be inferred that the students' environmental literacy data does not originate from a regularly distributed population, yet exhibits comparable variations (Udeozor et al., 2021).

The Mann-Whitney test was used in non-parametric statistical tests (non-normal distribution found using the Kolmogorov-Smirnov and Shapiro-Wilk tests) to examine whether there were similarities/relationships/differences between the environmental literacy skills of students in the experimental and control classes (Gopalan et al., 2020). Table 2 displays the results of this test. Although the data had a non-normal distribution (confirmed by Kolmogorov-Smirnov and Shapiro-Wilk tests), the homogeneity of variance test showed equivalence between the groups, justifying the use of the non-parametric Mann-Whitney test.

**Table 2.** Mann-Whitney test

<b>Test Statistics a</b>	
	EL
Mann-Whitney University	3,000
Wilcoxon W	468,000
Z	-6,627
Asymp. Sig. (2-tailed)	.000
a. Grouping Variables: Treatment	

### **Discussion**

Factors related to the model (learning approaches) with a p-value less than 0.05 are presented in Table 2. The contextual problem-solving learning (CPBL) model influences students' environmental literacy. This study aimed to ascertain if CPBL exerts a more significant impact on biology education compared to traditional teaching methods and to evaluate its effect on students' environmental literacy competencies. This is evidenced by the enhancement of students' academic performance, their fervor for biology, and their engagement in class activities.

Environmental literacy is crucial for cultivating committed future leaders and is a fundamental component of 21st-century skills, alongside creative thinking, critical thinking, communication, and cooperation (Bauer et al., 2020). The selection of environmental literacy as the primary focus of this study is grounded in the research conducted by Nuraini Sirajudin et al., who examined environmental literacy through the development of instruments spanning from elementary to tertiary education over a two-year period, specifically in 2001 and 2022. This aligns with the assertions of (Shortlidge et al., 2019), which emphasize that environmental literacy is a crucial criterion for cultivating committed leaders in the future (Riggs et al., 2020). Furthermore, Sukma, Aditya, and (Rodríguez et al., 2019) assert that literacy skills are among the most vital competencies in the 21st century. This research indicates that environmental literacy necessitates greater focus than other factors, as it is inferior to other cognitive elements (Sirajudin, 2019a, 2019b).

Instructors must furnish educational tools/models that cultivate environmental literacy competencies. Practical learning tools will produce optimal outcomes when conveyed through suitable learning methods or models (Leupen et al., 2020). A learning strategy that allows students to devise multiple solutions to a problem can be utilized to

enhance environmental literacy (Riggs et al., 2020). A learning model that demonstrates this characteristic is the contextual problem-based learning model (Bassett et al., 2020). Research conducted by Sihaloho, Sahyar, and (Prochazkova et al., 2019) indicates that the contextual problem-based learning model significantly influences students' environmental literacy and problem-solving skills (Wahid & Talib, 2017). This finding aligns with (Wilton et al., 2019), who assert that the principal objective of advanced science education is to enhance students' competencies in environmental literacy and problem-solving.

This study aims to establish an environmental education learning model utilizing contextual problem-based learning to enhance students' environmental literacy skills (Taylor & Gavin, 2015). Goodwin & Goodwin (2016) assert that problem-based learning is effective in enhancing creative thinking skills. Researchers advocate for the implementation of a contextual problem-based learning (CPBL) approach in environmental education to enhance the environmental literacy competencies of biology education students. Research by Rambonilaza & Brahic (2016) has showed that this methodology is effective in enhancing students' environmental literacy skills. The findings of (Ndzimbomvu & Rampedi, 2021) demonstrate that the implementation of a contextual problem-based learning (PBL) model enhances student learning outcomes. This research corresponds with investigations carried out on alternative materials or topics. District et al., (2023) established an environmental education learning paradigm grounded in contextual problem-based learning, emphasizing the concept of environmental issues. A study determined that the contextual problem-based learning model enhances students' environmental literacy skills in science education. Lovren (2023) did research in several subjects. The study sought to assess the enhancement of students' mathematical representation skills and curiosity dispositions through the implementation of environmental education models utilizing contextual problem-based learning. The study concluded that the contextual problem-based learning model can improve students' mathematical representations and curiosity attitudes toward optical device material.

The study by Vasquez & Atwood (2023) demonstrated that the application of a contextual problem-based learning paradigm enhances students' academic performance in English. Moreover, the study conducted by Rasis & Kuswanto (2023) sought to establish a contextual problem-based learning paradigm suitable for mathematics education. The research conducted by Almarashdi & Jarrah (2022) sought to ascertain if contextual problem-based learning enhances elementary students' environmental literacy in scientific education. The research determined that the contextual problem-based learning paradigm enhances environmental literacy abilities in science education using digital media innovations, narratives, films, and practice questions .

The research conducted by Karamik (2023) created a pedagogical module utilizing the contextual problem-based learning model to enhance students' problem-solving abilities. The findings indicated that the contextual problem-based learning approach led to an enhancement in problem-solving abilities. Consequently, the contextual problem-based learning paradigm positively influences higher-order thinking skills (Hobbins et al., 2020). This indicates that the contextual problem-based learning model can function as a significant educational resource for students and educators to attain learning goals and fulfill the requirements of the 21st century (Almarashdi, 2023).

Based on the discussion above, it is clear that the contextual problem-based learning model used in this study has had a positive impact on the environmental literacy skills of biology education students. Good skill proficiency indicates strong knowledge. Therefore, the contextual problem-based learning model has contributed to helping students construct their knowledge. Environmental literacy is crucial for cultivating committed future leaders and is a fundamental component of 21st-century skills, alongside creative thinking, critical thinking, communication, and cooperation. Therefore, this study has addressed one of the weaknesses of problem-based learning.

## CONCLUSION

This study demonstrates how students' environmental literacy skills are influenced by the contextual problem-based learning (CPBL) model. Consequently, Contextual Problem-Based Learning (CPBL) can improve biology teaching by positively influencing students' environmental literacy competencies in environmental education courses.

Students' understanding of biological principles is significantly enhanced through critical analysis of the environment. To facilitate pupils' reflection and reasoning regarding their behaviors, an environment conducive to the study of biology might be established. Therefore, schools play a major role in mitigating environmental issues by improving the environmental literacy (knowledge, attitude, and behavior) of students. The knowledge domain includes information about the relationship between humans and natural systems, whereas the attitude domain includes personal beliefs, values, and feelings about nature. Environmental literacy is more than just awareness or personal knowledge; it is developed in a specific context, whereas behavior can change as a result of changing attitudes and knowledge. Environmental literacy is an important component of every human being's basic literacy. Homework can enhance students' capabilities and refine their environmental literacy skills.

This study illustrates the impact of students' past environmental literacy and their learning practices on their environmental literacy development. Moreover, the two parts do not engage with each other. Consequently, CPBL is an appropriate and distinctive method for addressing the subject of cognition and achieving educational objectives. Pupils in the experimental group appeared more proficient in establishing the strategy, cultivating essential skills, formulating conclusions, and delivering a clear explanation. It illustrated how Contextual Case Based Learning could enhance biology instruction by positively influencing students' environmental literacy in environmental education courses.

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