Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

The Effect of Spatial Problem Based Learning Models on Critical Thinking Skills as Seen from the Eco-Literacy of High School Students

Reka Nonda Andini*, Sugeng Utaya, Yusuf Suharto
Geography Education, Universitas Negeri Malang, Malang, 65145, Indonesia

ARTICLE INFO

Article history:

Received: 09 Nov 2025
Revised: 12 Nov 2025
Accepted: 06 Dec 2025
Published online: 10 Dec 2025

Keywords:

Spatial Problem Based Learning,
Critical Thinking,
Environmental Literacy

** Corresponding author:*

E-mail:
reka.nonda.2407218@students.um.ac.id

Article Doi:

https://doi.org/10.31258/jes.9.6.p.6394-6413

This is an open access article under the CC BY-SA license.

A B S T R A C T

Students' critical thinking skills in geography learning are relatively low because learning is still conventional and does not emphasize spatial analysis and active student involvement (student center). This study highlights students' environmental literacy as an important factor contributing to the success of the learning process. The purpose of this study is to determine the significance of the Spatial Problem Based Learning model on critical thinking skills in terms of students' environmental literacy. The research used a quasi-experimental method with a pretest-posttest control group design with 62 students consisting of an experimental class and a control class as research subjects. Data were collected through critical thinking ability tests and environmental literacy questionnaires. Data analysis used the Independent Sample t-test and Two Way ANOVA. The results showed that the SPBL model had a significant effect on improving critical thinking skills in terms of students' environmental literacy. Students with high environmental literacy demonstrated better critical thinking skills. These findings indicate that the SPBL model is effective in developing critical thinking skills, especially in students with high levels of environmental literacy, thus providing an alternative innovative learning strategy in geography education.

1. Introduction

21st century skills are essential abilities that students need to master in order to keep up with the times. These skills refer to those relevant to the demands of the digital age and are grouped into four main competencies or 4Cs, namely critical thinking, collaboration, communication, and creativity (Asiah et al., 2023; Prayogi & Estetika, 2019). These skills are intended to enable students to not only understand the concepts of the material but also understand how to build cooperation or collaboration among students. The application of 21st-century skills enables students to be more adaptive and responsive to environmental dynamics, while also being able to find solutions to various problems that arise (Sukmawati & Ghofur,

2023; Zubaidah, 2019). Of the various skills that students must master, critical thinking is one of the most crucial abilities.

Critical thinking is a basic skill that falls under the category of higher order thinking skills and plays an important role in the learning process. This skill involves deep thinking, analyzing the truth of information for problem solving, thereby producing rational and systematic decisions (Astuti, 2020; Vera & Wardani, 2018). Students who possess critical thinking skills tend to be able to seek the truth, evaluate ideas rationally, think openly, be independent, and be skilled at solving problems and providing reasons for various phenomena they encounter (Puspita Sari et al., 2017; Selegi, 2019).

In geography learning, critical thinking skills are needed so that students are sensitive to environmental issues. This is because geography is closely related to geosphere phenomena in the students' surroundings and their interactions, which can help them understand issues that arise in geography material (A. N. Aini et al., 2022; Mellita & Rosita, 2019). In line with Hayati (2016), geography learning integrates critical thinking through all geography material with solving environmental problems around students. Students are able to convey ideas or thoughts to solve geographical problems contextually (Ervina et al., 2023; Setiawan et al., 2023). Critical thinking enables students to understand environmental issues more deeply, analyze their causes, and the possible impacts. In addition, critical thinking allows students to provide appropriate solutions based on the truth or logically based on actual facts and to make decisions (Sanusi & Hamzan, 2023; Sholihah et al., 2016).

Examining environmental issues in geography education requires not only critical thinking skills, but also environmental literacy. This is in line with Binasdevi's (2022) opinion that students' critical thinking skills in reading and understanding their surrounding environment are closely related to their environmental literacy skills. Environmental literacy is the ability to understand, analyze, and respond to environmental issues wisely, which plays an important role in shaping attitudes of care, responsibility, and awareness of the environment (Anggraini & Nazip, 2022; Febriasari & Supriatna, 2017; Fitri & Hadiyanto, 2022). An attitude of caring for the environment can begin with the intention to learn about environmental issues. A person is said to be environmentally literate if they are able to identify the actions that need to be taken and how to do them to preserve nature (Rokhmah et al., 2021). Good environmental literacy will improve students' ability to read environmental conditions, foster positive attitudes, and encourage active participation in solving environmental problems (Binasdevi, 2022). Thus, environmental literacy not only supports learning outcomes but also strengthens students' critical thinking skills in providing solutions to various environmental problems.

Understanding critical thinking skills in learning needs to be based on clear indicators. Students are said to think critically if they are able to analyze problems through the process of formulating problems, providing arguments, deducing, inducing, evaluating, and determining the right solution (Andini et al., 2024; Gastama et al., 2023). These indicators show that critical thinking skills are

important to develop in order to face the challenges of information advancement and global competition, which demand high-level thinking skills in problem solving (Hayati et al., 2016). Through mastery of these skills, students can analyze phenomena and problems in their surroundings more sensitively, find appropriate solutions, and balance their skills and understanding as preparation for their future lives (Nurlaeli, 2022; Sholihah et al., 2016; Wulandari et al., 2020).

In reality, field observations show that students' critical thinking skills are still relatively low. One of the causes is inappropriate teaching strategies, which result in students tending to only understand theories and concepts without being able to apply them in problem solving (Gastama et al., 2023; Munsarikha et al., 2023). This low ability is evident in students' lack of creativity in identifying, discussing, and solving problems, as well as their weak ability to monitor and control their own learning process (Puspita Sari et al., 2017; Ratnawati et al., 2020). A similar condition was also found at SMAN 2 Probolinggo, based on observations and interviews with geography teachers. Students' critical thinking skills are not yet optimal because the learning model used is still conventional, with lectures as the main method, and teachers as the main source of information (teacher-centered). This has resulted in low student participation, both in asking questions, responding to questions, and answering analysis questions. The learning process focuses more on textbook material and is less contextual to the factual issues surrounding students.

The geography lessons taught by teachers do not yet reflect real-life situations or contextual material, making it difficult for students to solve problems. Students' knowledge is still limited to the ability to classify and identify the core of a problem without linking it to cause and effect or spatial concepts. This is evident when students encounter environmental issues, where they only provide brief answers from books without conducting a more in-depth analysis of the causes and effects. In fact, environmental issues have inter-spatial connections that require critical analysis to find the right solutions (Amin, 2017; Silviariza et al., 2021). This condition poses a challenge for teachers to encourage students to think critically through the application of contextual, student-centered learning models that are able to relate the material to real life while still considering spatial aspects.

One effective learning model for developing students' critical thinking skills is Spatial Problem Based Learning (SPBL). SPBL is a spatial problem-based geography learning model developed in line with 21st-century needs and created from the integration of the Problem Based Learning (PBL) model with Spatial Based Learning (SBL) (Silviariza & Handoyo, 2020). PBL emphasizes problem-solving skills, while SBL focuses on understanding geosphere phenomena spatially, making learning more concrete and contextual (Manek et al., 2019; Pambudi et al., 2021). In studying natural and cultural phenomena in depth, students are required to understand the location, reasons for occurrence, and development of these phenomena (Manek, 2023). Through SPBL, students are given the opportunity to actively and scientifically examine problems and solve them using a spatial approach, which is characteristic of geography (Silviariza et al., 2021). SPBL is also in line with the Scientific Approach because it encourages students to solve

problems scientifically. The scientific process carried out continuously can accustom students to think critically (Adilah, 2023; Silviariza & Handoyo, 2020). The SPBL model is able to motivate students to learn through group learning to find spatial solutions to problems. In line with Alhidayah's (2020) research, students will think more critically by providing solutions to problems given by teachers through individual and group discussions. Thus, SPBL is believed to be able to foster students' critical thinking skills in solving spatial geography problems.

The SPBL learning model has five stages or syntax in its application, namely (1) spatial problem orientation, (2) spatial problem formulation, (3) collecting and organizing spatial data and information, (4) analyzing and discussing spatial data, and (5) communicating (Silviariza & Handoyo, 2020). These five syntaxes are the advantages of SPBL because they are able to maximize students' critical thinking skills through direct experience and spatial-based scientific investigation. This systematic scientific process can stimulate critical thinking skills (Fetricia et al., 2023). The advantages of this model include training students to work in teams, helping students identify and formulate spatial problems through observation using a scientific approach, encouraging students to think critically about spatial problems in a contextual and factual manner so that learning is more meaningful (Afriani, 2018; Sri Utami et al., 2016). SPBL trains students to describe the relationships between spatial phenomena and accustoms them to making decisions about spatial problems using scientific methods. In addition, SPBL can also develop spatial thinking skills (Nursa'Ban et al., 2020; Silviariza & Handoyo, 2020).

A number of studies examining the SPBL model, such as those conducted by Silviariza (2021) and Itsnaini (2024), show that the SPBL model influences students' critical and creative thinking skills. The SPBL model provides students with scientific learning experiences in solving critical spatial problems (Silviariza et al., 2021). The SPBL model can also enhance students' creative thinking if the use of this model is habitualized in the geography learning process (Itsnaini et al., 2024). However, studies that specifically integrate SPBL with environmental literacy skills, especially in geography learning on environmental material, have not been widely studied. In fact, environmental literacy is an important competency for students to be able to read, understand, and respond to environmental issues wisely. Integrating environmental literacy into the application of the SPBL model not only encourages students to be more sensitive to real issues around them, but also requires critical thinking skills in analyzing environmental issues spatially, assessing the accuracy of information, and determining appropriate solutions. Thus, the application of the SPBL model in line with environmental literacy has the potential to develop students' critical thinking skills while shaping their concern for environmental sustainability.

Based on the description of the background of the problem, this study aims to determine the effect of the Spatial Problem-Based Learning model on thinking skills as viewed from students' environmental literacy in geography.

2. Methodology

This study used a quasi-experimental method through a pretest-posttest control group design involving two classes, namely the experimental and control classes. Both classes took a pretest to measure their initial critical thinking skills before the treatment was given. The experimental class used the SPBL model, while the control class used the classical or conventional learning model with lectures and question-and-answer sessions as usually applied at SMAN 2 Probolinggo. After the treatment, both classes took a posttest to measure students' critical thinking skills. The material used was from the chapter on the Environment and Population. The research design is shown in Table 1.

Table 1. Research Design

Group	***Pretest***	**Treatment**	***Posttest***
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Description:
O1: Pre-test of the experimental group
O2: Post-test of the experimental group
X: Learning using the Spatial Problem Based Learning model
O3: Pre-test of the control group
O4: Post-test of the control group

The study was conducted at SMAN 2 Probolinggo in the odd semester of 2025/2026, involving students of SMAN 2 Probolinggo in grade XI who were selected using purposive sampling based on previous equivalent cognitive assessment results. Based on these results, it was determined that the subjects of the study were classes XI-G and XI-H. The determination of the experimental and control classes was done using a spinner, with the results showing that the experimental class was class XI-H with 31 students and the control class was class XI-G with 31 students.

Data collection techniques were carried out using two instruments, namely critical thinking essay questions and environmental literacy questionnaires. The first instrument consisted of six essay questions based on critical thinking indicators, namely students' ability to formulate problems, provide arguments, deduce, induce, evaluate, and determine solutions (Andini et al., 2024). Before being tested in the study, the essay questions were tested for validity and reliability on 37 students in class XII-G. The basis for determining validity was that the questions were considered valid if the sig. value was ≤ 0.05. The results of the test instrument showed that all items were ≤ 0.05, which means they were valid. Meanwhile, the basis for determining reliability was that an item was considered reliable if Cronbach's alpha was ≥ 0.60. The results of the test instrument showed that $0.861 \geq 0.60$, which means it had consistency. The second instrument was an environmental literacy questionnaire consisting of 15 items and adapted to environmental literacy indicators, including (1) interest and understanding of the environment, (2) love and care for the environment, (3) sense of responsibility for

the environment, (4) managing and preserving the environment (Purnomo et al., 2024). The environmental literacy questionnaire uses a Likert scale with four answer options, namely strongly agree (SS), agree (S), disagree (TS), and strongly disagree (STS). The questionnaire has been validated by expert lecturers to ensure the suitability of the content and clarity of the statements.

Data analysis techniques use quantitative analysis with the help of SPSS Statistics 25 for Windows with prerequisite tests and hypothesis tests with a significance level of 5%. Prerequisite tests were conducted to prove that the data were normally distributed and homogeneous. Normality was tested using the Shapiro Wilk test with a sig. value ≥ 0.05 for normally distributed data, and homogeneity was tested using Levene's Test for Equality of Variances with a sig. value ≥ 0.05 for homogeneous data. Hypothesis testing was conducted using the Independent sample t-test for the first hypothesis and the two-way ANOVA test for the second hypothesis, which used three variables. If both hypotheses had a sig. value ≤ 0.05, then H0 was rejected and H1 was accepted, meaning that there was an influence between the three variables.

3. Results and Discussion

This experimental study was conducted at SMA Negeri 2 Probolinggo, involving 62 students divided into an experimental class and a control class. Each class consisted of 31 students with the same gender composition, namely 11 male students and 20 female students. This gender equality indicates that both classes had a balanced population. In addition, based on the average geography scores in the previous semester, the academic abilities of students in both classes showed a high level of homogeneity. This homogeneity was important because it ensured that the initial conditions of both classes were at a relatively similar level of ability, so that any differences in learning outcomes that emerged could be more closely related to the learning treatment applied, namely the Spatial Problem Based Learning (SPBL) model in the experimental class.

Before the implementation of the learning model, the geography learning process in both classes tended to be conventional, using lecture, question and answer, and discussion methods. The geography lessons conducted by teachers did not show real-life problems or contextual material, making it difficult for students to solve problems. The use of spatial-based learning media such as Google Earth was also not maximized, so students were rarely involved in spatial analysis activities. This condition limited students' opportunities to practice critical thinking and environmental literacy skills. The application of the Spatial Problem-Based Learning model in the experimental class was highly relevant because it provided a more challenging and contextual learning experience and guided students to actively identify, analyze, and solve problems from a spatial perspective.

During the research process, learning in the experimental class was carried out through the SPBL stages, namely spatial problem orientation, spatial problem formulation, spatial data collection and organization, spatial data analysis and

discussion of results, and communication. Meanwhile, the control class used conventional learning methods, such as lectures, question and answer sessions, and discussions. Data collection was carried out by administering a pretest to measure students' initial critical thinking skills before the treatment and a posttest after the treatment to see the improvement in students' critical thinking skills. An environmental literacy instrument was also administered to assess the extent to which students' understanding of environmental issues played a role in the learning process.

Students' critical thinking skills were measured through pre-tests and post-tests in the experimental class and control class. The results of the analysis showed a significant difference, with the experimental class using the SPBL model having a higher post-test average than the control class using conventional learning. A comparison of the average pre-test and post-test scores for both classes can be seen in Figure 1.

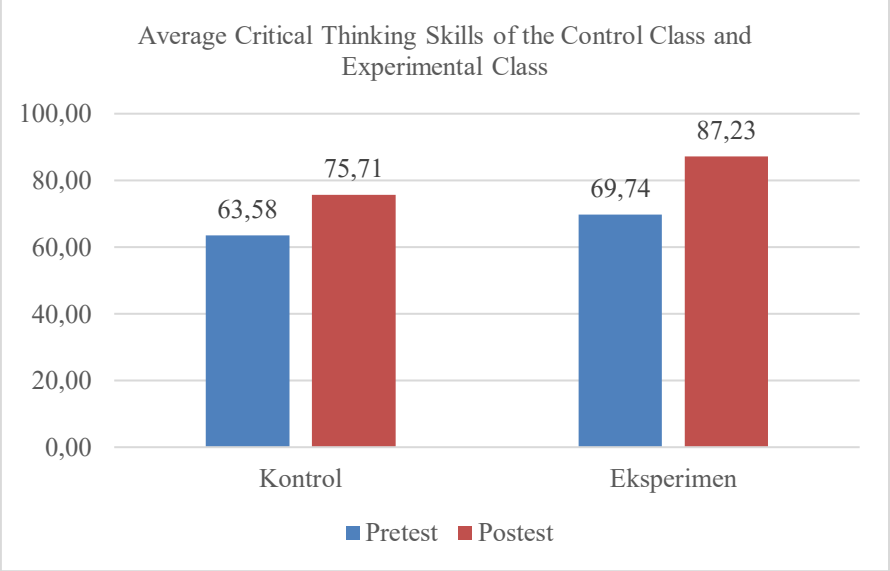

Figure 1. Comparison Chart of Average Scores for the Experimental Class and Control Class

Based on Figure 1, both classes experienced an increase in critical thinking skills after receiving their respective treatments. The control class increased from 63.58 to 75.71. The experimental class experienced a higher increase, from 69.74 to 87.23. The increase can also be seen from the comparison of N-Gain scores in both classes, see Table 2.

Table 2. Comparison of Average N-Gain Values for the Experimental Class and Control Class

Class	Pretest	Posttest	N Gain	N Gain (%)
Experiment	69,74	87,23	0,58	57,78
Control	63,58	75,71	0,33	33,30

Table 2 shows that the average scores of both classes increased. In the experimental class, there was an increase of 0.58 (moderate increase) or 57.78%, which is categorized as quite effective. In the control class, there was an increase of 0.33 (low increase) or 33.30%, which is classified as ineffective. These findings prove that the application of SPBL is quite effective in improving critical thinking compared to conventional learning. See Table 3 for the frequency distribution data for both classes.

Table 3. Frequency Distribution of Pretest and Posttest Critical Thinking Skills in the Experimental and Control Classes

Value Range	Qualifications	Experiment				Control			
		Pretest		Postest		Pretest		Postest	
		F	%	F	%	F	%	F	%
85-100	Verry Good	0	0%	20	65%	0	0%	2	6%
70-84	Good	18	58%	11	35%	6	19%	22	71%
55-69	Fair	13	42%	0	0%	23	74%	7	23%
50-54	Poor	0	0%	0	0%	2	6%	0	0%
≤49	Very Poor	0	0%	0	0%	0	0%	0	0%
Total		31	100%	31	100%	31	100%	31	100%

Table 3 shows a more significant improvement in the experimental class. In the experimental class, most students were in the good (58%) and fair (42%) categories, and after being given treatment with the SPBL model, 65% of students reached the very good category and 35% were in the good category. In the control class, the majority of students were in the adequate (74%) and good (19%) categories, and after conventional learning was applied, 71% reached the good category and only 6% reached the very good category. The increase in each critical thinking ability indicator in both classes is shown in Figure 2.

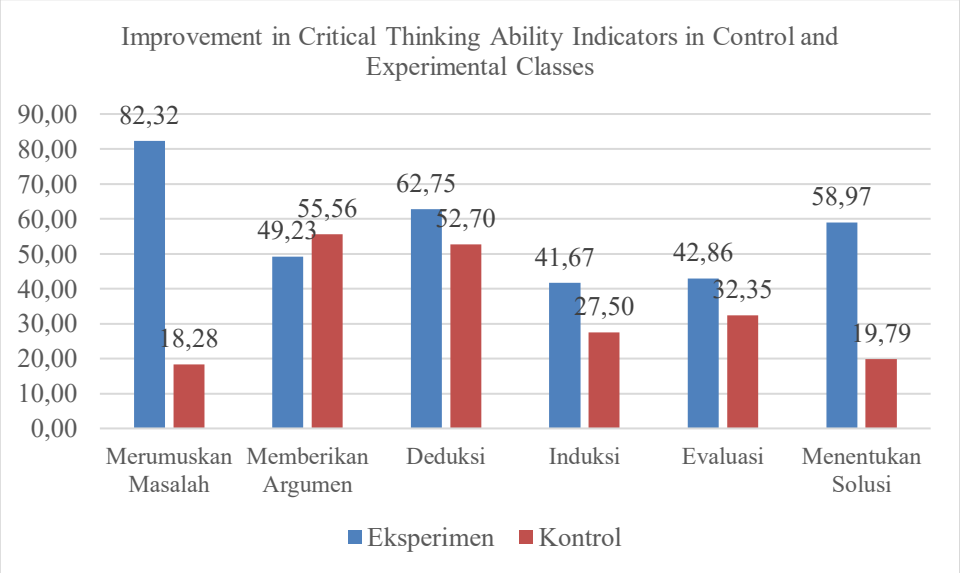

Figure 2. Improvement in Critical Thinking Ability Indicators in Control and Experimental Classes

In Figure 2, each critical thinking indicator in the experimental class experienced a higher increase than the control class. In the experimental class, the indicator with the highest increase was problem formulation with an N-Gain of 0.82 (82.32%) and the lowest increase was in the inducing indicator with an N-Gain of 0.42 (41.67%). In the control class, the highest indicator was providing arguments with an N-Gain of 0.56 (55.56%), and the lowest increase was in the problem formulation indicator with an N-Gain of 0.18 (18.28%). The results of the students' environmental literacy levels are shown in Table 4.

Table 4. Environmental Literacy Results of Students in the Experimental Class and Control Class

Value Range	Qualifications	Experiment		Control	
		F	%	F	%
45-60	High	20	65 %	11	35 %
30-44	Medium	8	26 %	13	42 %
15-29	Low	3	10 %	7	23 %
Total		31	100 %	31	100 %

Table 4 shows that there are three categories, namely high, medium, and low, in terms of students' environmental literacy levels. In the experimental class, the majority achieved the high category (65%), medium category (26%), and low category (10%). In the control class, most achieved the medium category (42%), high category (35%), and low category (23%). Critical thinking skills were assessed based on students' environmental literacy, as shown in Table 5.

Table 5. Critical Thinking Ability Scores Based on Students' Environmental Literacy

Environmental Literacy	Average N-Gain Critical Thinking Skills	
	Experiment	Control
High	66,05	41,54
Medium	39,62	34,83
Low	49,12	17,38

Table 5 shows that in the experimental class, students with high environmental literacy had an N-Gain of (66.05), which was higher than students with moderate (39.62) and low (49.12) environmental literacy. In the control class, students with high literacy had an N-Gain of (41.54), moderate (34.83), and low (17.38). These findings indicate that good environmental literacy supports the improvement of critical thinking skills, and the application of the SPBL model is more effective in facilitating this connection than conventional learning.

Preliminary Test Results

The prerequisite tests conducted were normality and homogeneity tests. The normality test using the Kolmogorov-Smirnov test showed a significance value of $0.200 > 0.05$, which means that the data is normally distributed. Furthermore, the homogeneity test using Levene's Test for Equality of Variance based on mean showed a significance value of $0.217 > 0.05$, which means that it has a homogeneous variance.

Hypothesis Test Results

There are two hypotheses in this study. The first hypothesis uses the Independent Sample T-Test, and the second hypothesis uses the two-way ANOVA. See Table 6 for the results of the hypothesis testing.

Table 6. Hypothesis Testing

Source	*Sig.*
Corrected Model	.000
Intercept	.000
Perlakuan	.000
Literasi_Lingkungan	.000
Perlakuan Literasi_Lingkungan*	.010

Table 6 shows that the first hypothesis has a value (Sig.2-tailed) of 0.000 < 0.05, which means that the average score of the experimental class is higher than that of the control class. This means that the SPBL model has an effect on students' critical thinking skills. The second hypothesis has a significance of 0.000 < 0.05 for treatment, 0.000 < 0.05 for environmental literacy, and 0.010 < 0.05 for the interaction between treatment and environmental literacy. This means that the SPBL model has an effect on critical thinking skills in terms of students' environmental literacy.

The Effect of Spatial Problem-Based Learning Models on Critical Thinking Skills

Based on the results of data analysis, this study produced two main findings. First, the Spatial Problem Based Learning model was proven to have a significant effect on improving students' critical thinking skills. This was evidenced by the difference in the average scores between the experimental class and the control class on the pretest and posttest results, with a significance value of less than 0.05. Students who learned using the SPBL model showed a higher average critical thinking ability compared to students who followed conventional learning. The SPBL model in geography learning is scientific and interactive, as reflected in its syntax, which places students at the center of learning activities (student center). Therefore, the application of the SPBL model, which is characterized by a scientific approach, is more effective in improving critical thinking skills than conventional methods. These findings are in line with previous studies that confirm the superiority of scientific-based learning over conventional learning using lecture methods (Aliman et al., 2019; Farah et al., 2018; Sumarmi et al., 2020). The improvement in critical thinking skills is also influenced by interactive learning characteristics (Sri Utami et al., 2016), direct learning experiences through observation (Puspitasari et al., 2016), and the application of scientific processes in learning (Woa et al., 2018). In addition, the improvement of critical thinking skills is influenced by the advantages of the SPBL model, including encouraging teamwork, the ability to identify and formulate spatial problems, describe the interrelationships between spatial phenomena, and make scientific decisions on spatial issues.

The first advantage is that SPBL encourages cooperation among students through group-based learning activities. Active student involvement in discussions facilitates collaboration and the exchange of ideas during the learning process. Through group learning, students will think more critically by providing solutions to problems given by teachers through individual and group discussions (Safitri et al., 2019). Discussion activities encourage students to express their opinions, and through presentations, students learn to respond to and discuss solutions to these problems (Putri et al., 2021). The second advantage is that students are able to identify and formulate problems spatially through the scientific observation process. The scientific observation process trains students to think critically through the collection of factual data in the field and the analysis of relationships between geographical phenomena (Silviariza et al., 2021). The third advantage is that students can describe the relationships between spatial phenomena. This shows that every geographical phenomenon is interconnected and influences each other within a certain space. To that end, students are encouraged to actively seek information and build knowledge through their surroundings. Learning is student-centered with the teacher as a facilitator, so that students learn to think critically and solve problems independently (Lutfiah et al., 2021; Suliyati et al., 2018). The fourth advantage is that students can make decisions on spatial issues using scientific methods. Scientific problem solving can help develop critical thinking skills (Silviariza et al., 2020). The learning process with a scientific approach that is carried out continuously accustoms students to think critically and be more trained in making logical and appropriate decisions (Adilah, 2023; Purba, 2012).

The SPBL syntax guides students to solve problems from spatial experiences and scientific investigations (Silviariza & Handoyo, 2020). Scientific syntax can stimulate students' critical thinking skills (Shaughnessy et al., 2017; Silvia et al., 2019). Thus, the application of the SPBL model provides students with scientific learning experiences in solving critical problems spatially. In addition, the syntax or implementation stages in the Spatial Problem Based Learning model are in line with critical thinking indicators, so that students' critical thinking skills can be developed with this model. These findings are reinforced by Silviariza's (2021) research, which shows that the five syntaxes of the SPBL model can improve students' critical thinking skills. In the first syntax, namely spatial problem orientation, students and their groups identify and review various environmental issues related to the population around them. During the problem orientation stage, the teacher sparked the students' interest by showing images of environmental problems, such as marine pollution caused by waste in Probolinggo, using PowerPoint and Google Earth. These media were used to show the absolute and relative locations of the problems to be studied. The media used in the learning process in the experimental class are shown in Figure 3.

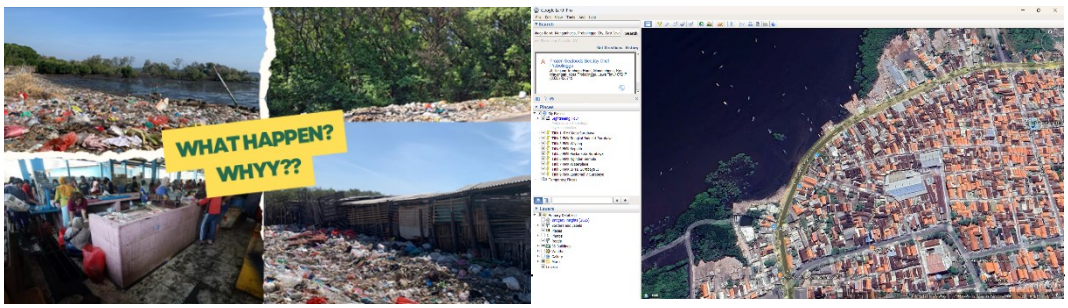

Figure 3. Learning Media in the Experimental Classroom

Teachers facilitate students in recognizing absolute and relative locations using Google Earth Pro and examining spatial factors through various relevant sources before conducting field observations. A properly conducted problem orientation must present issues that are interesting, challenging, and contextual, so that students have a high level of curiosity about the issues and are motivated to solve them (Andini et al., 2024). In addition, problems that arise from students' own identification tend to be more meaningful and relevant, encouraging them to find the right solutions (Lestari et al., 2017).

The second syntax is formulating spatial problems. At this stage, students are encouraged to formulate questions from the problems identified in the previous step. This stage can be called the questioning stage. The questioning stage is the beginning of students' ability to think critically about a problem. At this stage, students are trained to view problems spatially and formulate them. The third syntax is collecting and organizing spatial data and information. At this stage, students are directed to collect and organize spatial data. Students use worksheets designed by the teacher to collect and organize spatial data. Data collection is carried out from various sources, including Google Earth Pro, relevant literature reviews, and direct field observations. Field observations are conducted as a form of contextual learning that connects the material with the reality of the surrounding environment. At this stage, students are trained to think scientifically in accordance with investigative procedures so that they can analyze problems directly and provide solutions to problems accompanied by relevant evidence (A. N. Aini et al., 2022; Herzon et al., 2018).

The fourth syntax is analyzing spatial data and discussing the results. At this stage, students work with their groups to process the data that has been collected for further analysis. The analysis is carried out by looking at patterns, relationships, and trends in spatial data, such as the relationship between environmental conditions and human activities or the distribution of geographical phenomena in a particular space. After that, the analysis results are discussed in groups so that students can exchange opinions and test the validity of the arguments that arise. The process of searching for and confirming arguments encourages students to think critically in understanding and solving problems (Ennis, 2011). The fifth syntax is communicating. At this stage, students and their groups present their findings to other groups using PowerPoint to clarify the analysis results. Other groups are given

the opportunity to ask questions and respond to the issues. This is done to obtain different perspectives on the issue being studied. This stage is the final step in determining a decision in independent problem solving. Independent problem solving involves students in determining the appropriate solution to the issue being studied (Andini et al., 2024; Herzon et al., 2018).

The results of this study also reveal variations and improvements in each indicator of students' critical thinking skills. Each indicator of critical thinking skills in the experimental class that applied the SPBL model showed a more significant improvement compared to the control class that received conventional learning through the lecture method. In the experimental class, the highest indicator was problem formulation. This is related to the first and second syntaxes in the SPBL model, namely orientation and spatial problem formulation, in which students identify environmental issues studied through Google Earth to determine absolute and relative locations and the real environment through direct observation in the field. Thus, students are able to formulate relevant research questions. According to Ennis (2011), the skill of formulating problems is the main foundation of critical thinking skills, as it is the basis for individuals to construct arguments, perform deductive and inductive reasoning, evaluate, and make rational decisions (Andini et al., 2024). These findings confirm that the syntax stage in the SPBL model, which focuses on the process of identifying and formulating spatial problems, plays an important role in developing students' critical thinking skills.

Meanwhile, the lowest indicator in the experimental class was induction or drawing conclusions. These findings indicate that students still face difficulties in drawing generalizations from the data or information that has been collected. According to Facione (2015), critical thinking includes several cognitive skills such as interpretation, analysis, evaluation, inference, and explanation; the ability to infer (induction) is the stage where students draw conclusions based on the evidence that has been analyzed, and is often the most difficult part to master because it requires the ability to connect specific findings to general conclusions. This is in line with Mastuti's (2022) research, which found that evaluation and conclusion indicators are the skills that students master the least compared to analysis and interpretation. This shows that even though students are able to collect and analyze data, they still have difficulty making logical and valid conclusions from the data (Mastuti et al., 2022). In the context of SPBL learning, students often focus more on the initial stages, such as problem identification and formulation, while the conclusion-drawing stage requires intensive guidance from teachers so that students are able to interpret the results of their analysis logically and systematically. Therefore, the low achievement on this indicator reflects the need to strengthen the stages of reflection and interpretation of results so that students are able to draw valid and evidence-based conclusions.

The Effect of Spatial Problem-Based Learning Models on Students' Critical Thinking Skills in Terms of Environmental Literacy

The second finding shows that the Spatial Problem Based Learning model has a significant effect on critical thinking skills in terms of students' environmental

literacy. The results of the study show that students who learn using the SPBL model have significantly higher critical thinking skills than students in conventional classes. This is due to the interaction between the learning model and the level of environmental literacy. Based on the research findings, there are three categories of environmental literacy, namely high, medium, and low. Students with high environmental literacy levels tend to demonstrate higher critical thinking skills than students with medium or low environmental literacy levels.

Environmental literacy is the ability to understand environmental conditions based on a sense of concern and motivation to behave positively towards nature conservation. Students with a high level of environmental literacy tend to be able to think critically in analyzing various environmental issues and produce solutions to the problems faced (N. Aini et al., 2020; Purnomo et al., 2024). In dealing with environmental issues, critical thinking skills are needed to develop relevant ideas and concepts in finding alternative solutions to problems (Binasdevi, 2022). Critical thinking skills and environmental literacy are closely related in shaping individuals who are aware, caring, and responsible for their environment. This is in line with the findings of Binasdevi (2022), who asserts that students' ability to understand and interpret the surrounding environmental conditions cannot be separated from their level of environmental literacy. Critical thinking helps individuals analyze, evaluate, and make rational decisions on environmental issues, while environmental literacy plays a role in building knowledge, awareness, and skills to preserve nature. Thus, critical thinking is an important foundation in efforts to maintain environmental sustainability (Puspitasari et al., 2016). The higher the level of environmental literacy among students, the better their critical thinking skills in assessing and finding solutions to various environmental problems.

The SPBL model and environmental literacy play a strategic role in developing students' critical thinking skills, particularly in understanding, analyzing, and solving various environmental issues. This is in line with the essence of geography as a science that studies the relationship between humans and their environment in the context of space and time. Geography does not only focus on the physical aspects of the earth's surface, but also on how humans interact, adapt, and influence their environment (A. N. Aini et al., 2022). Geography covers various environmental issues such as climate change, land degradation, urbanization, and environmental pollution, which require critical thinking skills to find appropriate solutions to these problems. Through critical thinking skills, students can analyze environmental issues more deeply and produce relevant solutions based on empirical facts (Hayati et al., 2016; Sholihah et al., 2016).

In the context of developing critical thinking skills, the SPBL model provides an effective learning approach because it encourages students to understand and analyze various geographical issues based on a spatial perspective (Silviariza et al., 2021). Through this model, students are trained to solve problems by considering aspects of location, distribution, and interrelationships between phenomena, which are characteristic of geographical studies. The implementation of SPBL in geography learning aims to enable students to find solutions to various geosphere problems in their surroundings spatially (Buana & Putra, 2023). In examining

natural and socio-cultural phenomena, students need to understand where the phenomena occur, why they occur in that location, and how they develop over time (Manek, 2023). Furthermore, problem-based learning has been proven to have a positive effect on improving critical thinking skills and environmental awareness (Handoyo et al., 2024). Thus, the application of PBL provides a learning experience that emphasizes in-depth spatial problem solving, while environmental literacy equips students with knowledge, awareness, and responsibility for environmental sustainability. The combination of the two not only strengthens students' critical thinking skills but also fosters reflective and solution-oriented attitudes in understanding and addressing various environmental issues around them.

4. Conclusion

Based on the analysis and discussion, it can be concluded that the application of the Spatial Problem Based Learning model has a significant effect on students' critical thinking skills. Students who learn using the SPBL model demonstrate higher levels of critical thinking skills compared to students who learn through classical or conventional models. This shows that SPBL is effective because of its scientific, interactive, and student-centered learning characteristics, which enable it to stimulate active participation in problem identification, data collection, information analysis, and decision-making on spatial problems. In addition, the research findings also show a close relationship between critical thinking skills and environmental literacy. Students with high levels of environmental literacy tend to have better critical thinking skills. Environmental literacy helps students understand the relationship between humans and the environment scientifically, so that they are better able to analyze, evaluate, and make decisions on environmental issues responsibly. Thus, the application of the Spatial Problem-Based Learning model, supported by good environmental literacy, can create meaningful geography learning. This model not only improves students' critical thinking skills but also fosters awareness and concern for environmental sustainability.

References

Adilah, P. G. (2023). Peningkatan Kemampuan Berpikir Kritis Geografi: Model Pembelajaran Berbasis Masalah Berbantuan Microlearning di MAN 1 Malang. *Al Qalam: Jurnal Ilmiah Keagamaan Dan Kemasyarakatan*, *18*(1), 466–483.

Afriani, A. (2018). Pembelajaran Kontekstual (Contextual Teaching and Learning) dan Pemahaman Konsep Siswa. *Jurnal Al-Muta'aliyah STAI Darul Kamal NW Kembang Kerang*, *1*(3), 80–88. http://dx.doi.org/10.1016/j.regsciurbeco.2008.06.005%0

Aini, A. N., Wirahayu, Y. A., & Budijanto, B. (2022). Pengaruh Model Problem Based Learning Berbantuan Google Classroom Terhadap Kemampuan Berpikir Kritis Siswa Pada Mata Pelajaran Geografi. *Jurnal Integrasi Dan Harmoni Inovatif Ilmu-Ilmu Sosial (JIHI3S)*, *2*(12), 1236–1248. https://doi.org/10.17977/um063v2i12p1236-1248

Aini, N., Al Muhdhar, M. H. I., Rochman, F., Sumberartha, I. W., Mardiyanti, L., & Wardhani, W. (2020). Analisis Tingkat Literasi Lingkungan Siswa Pada Muatan Lokal Pendidikan Lingkungan Hidup. *Jurnal Pendidikan Biologi*, *12*(1), 40–44.

Alhidayah, Y., Yushardi, Mujib, M. A., Astutik, S., & Apriyanto, B. (2020). Pengaruh Model Spatial Based Learning (SBL) Terhadap Kemampuan Berpikir Spasial Siawa SMA/MA. *Jurnal Geografi*, *9*(2), 1–11.

Aliman, M., Budijanto, Sumarmi, & Astina, I. K. (2019). Improving Environmental Awareness of High School Students' in Malang city Through Earthcomm Learning in the Geography Class. *International Journal of Instruction*, *12*(4), 79–94. https://doi.org/10.29333/iji.2019.1246a

Amin, S. (2017). Pengaruh Model Pembelajaran Problem Based Learning Terhadap Kemampuan Berpikir Kritis dan Hasil Belajar Geografi. *Jurnal Pendidikan Geografi*, *4*(3), 25–36. https://doi.org/10.23887/jurnal_pendas.v7i1.1967

Andini, N. R., An, S., Putra, K. A., & Mu'tashimbillah. (2024). Application of Problem Based Learning Model on the Study of Land and Sea Waters to Improve Students' Critical Thinking Skills. *Future Space Studies in Geo-Education FSSGE*, *01*(04), 422–437. http://www.futurespaceleaders.org/#the-event

Anggraini, N., & Nazip, K. (2022). Kemampuan Literasi Lingkungan Mahasiswa Pendidikan Biologi Menggunakan Skor Nela. *Journal of Education Action Research*, *6*(4), 552–557. https://doi.org/10.23887/jear.v6i4.46975

Asiah, S., Habibah, R., Asrizal, & Fauzi, A. (2023). Meta-Analisis Pengaruh Model Problem Based Learning Terhadap Keterampilan Abad 21 Siswa. *Jurnal Ilmiah Multidisiplin*, *2*(9), 2. https://jurnal.arkainstitute.co.id/index.php/nautical/index

Astuti, D. W. (2020). Penerapan Model Inkuiri Sosial terhadap Keterampilan Berpikir Kritis Mata Pelajaran IPS di Sekolah Dasar. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, *12*(1), 35–42. https://doi.org/10.37640/jip.v12i1.271

Binasdevi, M. (2022). Pengaruh Model Problem Based Learning Berorientasi Literasi Lingkungan Terhadap Keterampilan Berpikir Kritis Siswa Madrasah Ibtidaiyah. *Indonesian Journal of Islamic Elementary Education*, *2*(1), 81–90.

Buana, R. T., & Putra, A. K. (2023). Peningkatan Kemampuan Berpikir Spasial: Implementasi Model Problem Based Learning melalui Pendekatan Self Efficacy Berbantuan WebGIS Inarisk. *Journal of Education Action Research*, *7*(3), 310–319. https://doi.org/10.23887/jear.v7i3.63881

Ervina, A., Suharto, Y., & Rahmawati, R. (2023). Penerapan Model Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas X. *Journal of Geographical Sciences and Education*, *01*(2), 64–78. https://doi.org/10.29303/jcar.v2i1.395

Facione, P. a. (2015). Critical Thinking : What It Is and Why It Counts. *Insight Assessment*, *ISBN 13: 978-1-891557-07-1.*, 1–28. https://www.insightassessment.com/CT-Resources/Teaching-For-and-About-Critical-Thinking/Critical-Thinking-What-It-Is-and-Why-It-Counts/Critical-Thinking-What-It-Is-and-Why-It-Counts-PDF

Farah, F. A., Handoyo, B., & Bachri, S. (2018). Pengaruh Model Problem Based

Learning terhadap Keterampilan Geografi. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(10), 1391–1397. http://journal.um.ac.id/index.php/jptpp/

Febriasari, L. K., & Supriatna, N. (2017). Enhance Environmental Literacy through Problem Based Learning. *Journal of Physics: Conference Series*, *895*(1). https://doi.org/10.1088/1742-6596/895/1/012163

Fetricia, F., Soekamto, H., Soelistijo, D., & Utomo, D. H. (2023). Model Problem Based Learning Berbantuan Video Berita: Pengaruhnya Terhadap Kemampuan Berpikir Kritis Pada Siswa SMA. *Jurnal Integrasi Dan Harmoni Inovatif Ilmu-Ilmu Sosial*, *3*(7), 741–752. https://doi.org/10.17977/um063v3i7p741-752

Fitri, R. A., & Hadiyanto, H. (2022). Kepedulian Lingkungan melalui Literasi Lingkungan pada Anak Usia Dini. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(6), 6690–6700. https://doi.org/10.31004/obsesi.v6i6.3485

Gastama, A. N. F., Rosyida, F., Handoyo, B., & Soelistijo, D. (2023). The Effect of Group Investigation Model Assisted by Interactive Media Lectora Inspire on High School Students Critical Thinking Skills. *Jurnal Inovasi Teknologi Pendidikan*, *10*(3), 233–244. https://journal.uny.ac.id/index.php/jitp/article/view/59490

Handoyo, B., Purwanto, Ridha, S., & Tan, G. C. I. (2024). Effect of The Spatial Based Learning Using Quantum Geographic Information System on Students' Critical Thinking Skills. *Journal of Social Studies Education Research*, *15*(5), 328–379.

Hayati, W. I., Utaya, S., & Astina, I. K. (2016). Efektivitas Student Worksheet Berbasis Project Based Learning Dalam Menumbuhkan Kemampuan Berpikir Kritis Siswa Pada Mata Pelajaran Geografi. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *1*(3), 468–474.

Herzon, H. H., Budjianto, & Utomo, D. H. (2018). Pengaruh Problem-Based Learning (PBL) terhadap Keterampilan Berpikir Kritis. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(1), 42–46. http://journal.um.ac.id/index.php/jptpp/

Itsnaini, N., Purwanto, & Ujianto, D. A. (2024). *Classroom Innovation: A Study on the SPBL Model's Role in Fostering Creative Thinking among Humanities Students*. *1*(1), 31–45. http://www.futurespaceleaders.org/#the-event

Lestari, D. D., Ansori, I., & Karyadi, B. (2017). Penerapan Model PBM Untuk Meningkatkan Kinerja dan Kemampuan Berpikir Kritis Siswa SMA. *Diklabio: Jurnal Pendidikan Dan Pembelajaran Biologi*, *1*(1), 45–53. https://doi.org/10.33369/diklabio.1.1.45-53

Lutfiah, W., Anisa, & Hambali, H. (2021). Pengaruh Model Pembelajaran Problem Based Learning Terhadap Hasil Belajar Biologi. *Jurnal Ilmu Pendidikan*, *3*(4), 2092–2098.

Manek, A. H. (2023). Pengaruh Model Spasial Based Learning (SBL) Terhadap Kemampuan Berpikir Spasial Mahasiswa Pada Mata Kuliah Praktek Kerja Lapangan Geografi (PKLG). *Geoedusains: Jurnal Pendidikan Geografi*, *4*(1), 1–17. https://doi.org/10.30872/geoedusains.v4i1.2131

Manek, A. H., Utomo, D. H., & Handoyo, B. (2019). Pengaruh Model Spasial Based Learning terhadap Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *4*(4), 440.

https://doi.org/10.17977/jptpp.v4i4.12245

Mastuti, A. G., Abdillah, A., Sehuwaky, N., & Risahondua, R. (2022). Revealing students' critical thinking ability according to facione's theory. *Al-Jabar : Jurnal Pendidikan Matematika*, *13*(2), 261–272. https://doi.org/10.24042/ajpm.v13i2.13005

Mellita, S. A., & Rosita, L. (2019). Pengaruh Model Pembelajaran Inquiry Based Learning terhadap Kemampuan Berpikir Kritis Siswa pada Mata Pelajaran Geografi. *Geodika: Jurnal Kajian Ilmu Dan Pendidikan Geografi*, *3*(2), 70–79.

Munsarikha, N., Utomo, D. H., Budijanto, B., & Sumarmi, S. (2023). Pengaruh Model Hybrid-Problem Based Learning (PBL) Terhadap Kemampuan Berpikir Kritis Pada Mata Pelajaran Geografi Siswa Kelas XI SMA Negeri 1 Bangil. *Jurnal Integrasi Dan Harmoni Inovatif Ilmu-Ilmu Sosial (JIHI3S)*, *3*(5), 533–548. https://doi.org/10.17977/um063v3i5p533-548

Nurlaeli, J. S. (2022). Peningkatan Berpikir Kritis Siswa Melalu Model Pembelajaran Problem Based Learning dalam Pembelajaran IPS Kelas VII B di SMP Bakti Nusantara 666 Bandung. *Educatif Journal of Education Research*, *4*(3), 348–352. https://doi.org/10.36654/educatif.v4i3.265

Nursa'Ban, M., Kumaidi, K., & Mukminan, M. (2020). Factors of critical spatial thinking for a geography metacognition assessment in indonesian senior high schools. *Review of International Geographical Education Online*, *10*(2), 186–204. https://doi.org/10.33403/rigeo.686050

Pambudi, M. R., Handoyo, B., & Susilo, S. (2021). Pengaruh Model Pembelajaran Berbasis Spasial (PBS) Terhadap Kemampuan Berpikir Kreatif Dalam Presperktif Gaya Berpikir Siswa. *Jurnal Pendidikan: Riset & Konseptual*, *5*(2), 235–241.

Prayogi, R. D., & Estetika, R. (2019). Kecakapan Abad 21: Kompetensi Digital Pendidik Masa Depan. *Manajemen Pendidikan*, *14*(2), 144–151. https://doi.org/10.23917/jmp.v14i2.9486

Purba, J. P. (2012). *Pemecahan Masalah dan Penggunaan Strategi Pemecahan Masalah*. 1–8.

Purnomo, H., Utaya, S., & Mutia, T. (2024). Meningkatkan Kemampuan Berpikir Kritis Siswa melalui Model Geographical Inquiry Learning untuk Menumbuhkan Literasi Lingkungan. *Journal of Education Action Research*, *8*(4), 661–670.

Puspita Sari, N., Budijanto, & Amiruddin, A. (2017). Pengaruh Penerapan Model Pembelajaran Problem Based Learning Dipadu Numbered Heads Together Terhadap Keterampilan Metakognitif dan Kemampuan Berpikir Kritis Geografi Siswa SMA. *Jurnal Pendidikan : Teori, Penelitian, Dan Pengembangan*, *2*(3), 440–447. http://journal.um.ac.id/index.php/jptpp/

Puspitasari, E., Sumarni, & Amirudin, A. (2016). Integrasi Berpikir Kritis dan Peduli Lingkungan melalui Pembelajaran Geografi dalam Membentuk Karakter Peserta Didik SMA. *Jurnal Pendidikan*, *1*(2), 122–126.

Putri, H., Kurniawan, D. A., & Simanjuntak, E. (2021). Pengaruh Model Pembelajaran Berbasis Masalah (PBL) Terhadap Karakter Bersahabat/Komunikatif Siswa pada Pelajaran Fisika. *Prosiding Seminar Nasional Matematika Dan Sains*, 363–370.

Ratnawati, D., Handayani, I., & Hadi, W. (2020). Pengaruh Model Pembelajaran

PBL Berbantu Question Card Terhadap Kemampuan Berpikir Kritis Matematis Siswa SMP. *Edumatica : Jurnal Pendidikan Matematika*, *10*(01), 44–51. https://doi.org/10.22437/edumatica.v10i01.7683

Rokhmah, Z., Nuril, A., Fauziah, M., Ipa, J., Matematika, F., Ilmu, D., Alam, P., & Surabaya, U. N. (2021). Analisis Literasi Lingkungan Siswa Smp Pada Sekolah Berkurikulum Wawasan Lingkungan. *Pensa E-Jurnal : Pendidikan Sains*, *9*(2), 176–181. https://ejournal.unesa.ac.id/index.php/pensa/index

Safitri, E. M., Sari, Y., & Dewi, R. F. K. (2019). Pengaruh Model Pembelajaran Problem Based Learning terhadap Sikap Mandiri dan Kemampuan Komunikasi Matematika Siswa Kelas V SD Negeri Bakalrejo 1. *Square : Journal of Mathematics and Mathematics Education*, *1*(2), 83. https://doi.org/10.21580/square.2019.1.2.4063

Sanusi, A., & Hamzan. (2023). Peningkatan Kemampuan Berpikir Kritis Siswa Melalui Model Pembelajaran Berbasis Inkuiri Terbimbing Pada Muatan Pelajaran IPS di Kelas V SDI Babussalam Sangkawana Tahun Pelajaran 2023. *Walada: Journal of Primary Education*, *2*(2).

Selegi, S. F. (2019). Analisis Kemampuan Higher Order Thinking Skill (HOTS) Melalui Creative Problem Solving (CPS) Untuk Meningkatkan Kemampuan Kognitif Mahasiswa. *JURNAL SWARNABHUMI : Jurnal Geografi Dan Pembelajaran Geografi*, *4*(1). https://doi.org/10.31851/swarnabhumi.v4i1.2591

Setiawan, E. H., Wiwoho, B. S., & Abubakar, S. (2023). Upaya Peningkatkan Kemampuan Berpikir Divergen Peserta Didik SMAN 2 Batu Mata Pelajaran Geografi Melalui PBL Dipadu Diferensiasi Konten. *Jurnal Tinta: Jurnal Ilmu Keguruan Dan Pendidikan*, *5*(2), 136–145.

Shaughnessy, M. F., Varela, M., & Liu, Z. (2017). Critical Thinking in Science: What Are the Basics? *World Journal of Educational Research*, *4*(4), 585. https://doi.org/10.22158/wjer.v4n4p585

Sholihah, M., Utaya, S., & Susilo, S. (2016). Pengaruh Model Experiential Learning Terhadap Kemampuan Berpikir Siswa SMA. *Jurnal Pendidikan: Teori Penelitian, Dan Pengembangan*, *1*(11), 2096–2100. http://journal.um.ac.id/index.php/jptpp/article/view/7869

Silvia, M., Suyono, Roekhan, & Harsiati, T. (2019). Critical Thinking Patterns of First-Year Students in Argumentative Essay. *Journal for the Education of Gifted Young Scientists*, *7*(September), 683–697.

Silviariza, W. Y., & Handoyo, B. (2020). Spatial-Problem Based Learning (SPBL) Development (preliminary studies for geography learning). *Jurnal Pendidikan Geografi*, *25*(1), 69–79. https://doi.org/10.17977/um017v25i12020p069

Silviariza, W. Y., Sumarmi, & Handoyo, B. (2020). Using of Spatial Problem Based Learning (SPBL) Model in Geography Education for Developing Critical Thinking Skills. *Journal for the Education of Gifted Young Scientists*, *8*(3), 1045–1060. https://doi.org/10.17478/JEGYS.737219

Silviariza, W. Y., Sumarmi, & Handoyo, B. (2021). Improving Critical Thinking Skills of Geography Students with Spatial-Problem Based Learning (SPBL). *International Journal of Instruction*, *14*(3), 133–152. https://doi.org/10.29333/iji.2021.1438a

Sri Utami, W., Sumarmi, Nyoman Ruja, I., & Utaya, S. (2016). React (Relating,

Experiencing, Applying, Cooperative, Transferring) Strategy to Develop Geography Skills. *Journal of Education and Practice*, *7*(17), 100–104. www.iiste.org

Sukmawati, I., & Ghofur, M. A. (2023). Pengembangan E-LKPD Berbasis Problem Based Learning Terintegrasi Keterampilan 4C untuk Meningkatkan Kemampuan Berpikir Kritis Peserta Didik pada Mata Pelajaran Ekonomi. *Jurnal Paedagogy*, *10*(4), 1020. https://doi.org/10.33394/jp.v10i4.8626

Suliyati, S., Mujasam, M., Yusuf, I., & Widyaningsih, S. W. (2018). Penerapan Model PBL Menggunakan Alat Peraga Sederhana Terhadap Hasil Belajar Peserta Didik. *Curricula*, *3*(1), 11–22. https://doi.org/10.22216/jcc.2018.v3i1.2100

Sumarmi, Bachri, S., Irawan, L. Y., Putra, D. B. P., Risnani, & Aliman, M. (2020). The effect of experiential learning models on high school students learning scores and disaster countermeasures education abilities. *Journal for the Education of Gifted Young Scientists*, *8*(1), 61–85. https://doi.org/10.17478/jegys.635632

Vera, K., & Wardani, K. W. (2018). Peningkatan Keterampilan Berfikir Kritis Melalui Model Problem Based Learning Berbantuan Audio Visual pada Siswa Kelas IV SD. *Jurnal Riset Teknologi Dan Inovasi Pendidikan (JARTIKA)*, *1*(2), 33–45.

Woa, K. M., Utaya, S., & Susilo, S. (2018). Pengaruh Model Pembelajaran Problem Based Learning terhadap Kemampuan Memecahkan Masalah Geografi pada Siswa SMA. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(3), 406–411. http://journal.um.ac.id/index.php/jptpp/

Wulandari, R., Wardhani, S., & Nawawi, S. (2020). Pengaruh Model Problem Based Learning Terhadap Keterampilan Berpikir Kritis Siswa Materi Keanekaragaman Hayati. *BEST Journal (Biology Education, Sains and Technology)*, *3*(1), 45–53. https://doi.org/10.30743/best.v3i1.2435

Zubaidah, S. (2019). STEAM (Science, Technology, Engineering, Arts, and Mathematics): Pembelajaran untuk Memberdayakan Keterampilan Abad ke-21. *Seminar Nasional Matematika Dan Sains*, *September*, 1–18.

How to cite this article:

Andini, R. N., Utaya, S., & Suharto, Y. (2025). The Effect of Spatial Problem Based Learning Models on Critical Thinking Skills as Seen from the Eco-Literacy of High School Students. *Journal of Educational Sciences*, *9(6)*, 6394-6413.