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ADVANCES IN SOCIAL HUMANITIES RESEARCH

Application of Problem-Based Learning Model to Improve Geographic Literacy and Learning Outcomes of High School Students

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Abstract

The Fourth Industrial Revolution has increased the demand for students to develop 21st-century competencies, including complex problem-solving skills, spatial reasoning, and geographic literacy. This study aimed to examine the implementation of the Problem-Based Learning (PBL) model and its effectiveness in improving geographic literacy and learning outcomes among high school geography students. A descriptive quantitative research approach with an explanatory component was employed, involving 60 eleventh-grade social science students at SMA Diponegoro 1 Jakarta, who were divided into an experimental group (Class XI-5, n = 30) receiving PBL instruction and a control group (Class XI-3, n = 30) receiving conventional lecture-based instruction. Data were collected using an 11-item multiple-choice achievement test aligned with the cognitive levels of Anderson and Krathwohl's revised Bloom's taxonomy, along with questionnaires assessing PBL implementation and geographic literacy based on indicators established by the National Council for Geographic Education (NCGE). The findings indicated that PBL implementation achieved a high level of adherence to the instructional model's prescribed stages (90%). Students in the experimental group obtained a higher mean geographic literacy score (84.00) than those in the control group (81.00), suggesting a potential benefit of PBL for geographic literacy development. However, the difference in mean cognitive achievement scores between the experimental group (66.97) and the control group (69.09) was not statistically significant. Despite this finding, students receiving PBL instruction demonstrated stronger contextual understanding and integration of geographic concepts when addressing environmental problems. Overall, the findings suggest that PBL may support the application of geographic knowledge to real-world environmental challenges, although its effectiveness in improving cognitive learning outcomes was not statistically established in this study.

INTRODUCTION

Indonesia has entered the era of the Fourth Industrial Revolution (Industry 4.0), characterized by widespread digital transformation and technological disruption across various aspects of society (Sujadi, 2018). Advances in information and communication technologies, accompanied by increasingly accessible internet connectivity, have facilitated the rapid exchange of information while transforming the competencies required to remain competitive in a globalized environment. Mastery of theoretical

knowledge and basic cognitive skills alone is no longer sufficient to address contemporary educational and professional challenges. Students are increasingly expected to develop 21st-century competencies, including complex problem-solving abilities, critical thinking, creativity, innovation, collaboration, and effective communication (Masfufah, 2022; Prayogi & Estetika, 2019).

Within this rapidly evolving global context, geography education plays a fundamental role in developing students' spatial reasoning, environmental awareness, and analytical competencies. Geography education extends beyond memorizing geographical locations, interpreting topographic maps, or identifying natural phenomena in isolation (Besele, 2023). Instead, it promotes spatial thinking and a comprehensive understanding of the complex interactions between human activities and the natural environment (Ruhimat, 2017; Utami et al., 2018). These competencies constitute essential components of geographic literacy, which encompasses the ability to interpret spatial information, recognize geographical patterns, analyze human–environment interactions, and apply geographic knowledge to address practical challenges. Geographic literacy also enables students to evaluate the environmental consequences of human activities and formulate informed responses to geographical issues at local, regional, and global levels (Backler & Stoltman, 1986; Bennett, 1997; Hermanto, 2017; Keeling, 2003).

Despite its educational significance, geographic literacy among high school students continues to present challenges, particularly in connecting theoretical geographical concepts with practical applications (Maghfiroh, 2019; Oigara, 2011). Preliminary observations conducted at SMA Diponegoro 1 Jakarta, located in Rawamangun, East Jakarta, indicated that students experienced difficulties relating classroom geography instruction to real-world environmental conditions. Several students demonstrated limited proficiency in understanding spatial relationships and interpreting geographical information presented through conventional printed maps and digital mapping applications. Furthermore, the geography learning outcomes of eleventh-grade students generally remained below the school's established Minimum Mastery Criteria (Kriteria Ketuntasan Minimal, KKM). These conditions indicated a need for instructional approaches that could strengthen students' conceptual understanding, spatial reasoning, and ability to apply geographical knowledge in everyday situations.

One potential factor contributing to these educational challenges is the continued reliance on conventional teacher-centered instructional approaches (Slameto, 2015). Traditional expository and lecture-based methods frequently emphasize the transmission of theoretical information, positioning students primarily as recipients rather than active participants in the learning process (Sanjaya, 2008). Such approaches may limit opportunities for students to critically examine authentic environmental issues, conduct independent investigations, engage in collaborative problem-solving activities, and develop meaningful connections between geographical concepts and their immediate surroundings. Consequently, insufficient exposure to inquiry-based and contextual learning experiences may constrain the development of geographic literacy and higher-order cognitive skills (Aji Saputro & Sri Rahayu, 2020; Silviariza et al., 2021).

Addressing these challenges requires the adoption of more student-centered instructional strategies that encourage active participation, independent inquiry, and the practical application of geographical knowledge (Indrawati, 2011; Jacobsen et al., 2019). Problem-Based Learning (PBL), grounded in constructivist learning theory, represents a pedagogical approach that uses authentic, ill-structured real-world problems as the primary context for developing knowledge and problem-solving competencies (Amir, 2009; Arends, 2007; Honsan, 2014; Rusman, 2019; Savery, 2006; Siregar, 2010; Thobroni, 2016; Trianto, 2019). Through PBL, students actively participate in collaborative learning activities involving problem identification, information gathering, field observations, literature exploration, analysis of causal relationships, and the formulation of evidence-based solutions. This instructional process encourages learners to integrate theoretical knowledge with practical experiences while strengthening critical thinking, collaborative engagement, and independent learning skills (Arsika et al., 2016; Ilmiyatni et al., 2019; Muhson, 2009; Nur Aini & Wirahayu, 2022; Siswanto, 2012; Wijayanto et al., 2023).

Previous studies examining geographic literacy and contextual learning have emphasized the educational benefits of engaging students in authentic environmental investigations and problem-solving activities (Aji Saputro & Sri Rahayu, 2020; Khotimah et al., 2022; Nur Aini & Wirahayu, 2022; Purwaningsih, 2020; Putra et al., 2025; Wardhani, 2012). However, these findings do not necessarily demonstrate that PBL consistently produces superior outcomes across all dimensions of geographical learning compared with conventional instructional methods. An important research gap therefore concerns the need to distinguish improvements in geographic literacy from differences in cognitive learning achievement within the same educational context. This distinction is particularly relevant because students may demonstrate strong engagement in environmental problem-solving activities without achieving corresponding improvements in factual knowledge or conceptual mastery. Accordingly, this study contributes to the existing literature by examining PBL implementation, geographic literacy across six dimensions informed by the National Council for Geographic Education (NCGE) framework, and cognitive learning outcomes across specific environmental geography subtopics rather than relying exclusively on aggregate academic achievement scores.

Based on these considerations, this study aimed to examine the implementation of the Problem-Based Learning model in eleventh-grade geography instruction at SMA Diponegoro 1 Jakarta, compare geographic literacy outcomes between students receiving PBL instruction and those receiving conventional lecture-based instruction, and evaluate differences in cognitive learning outcomes across the environmental geography subtopics covered during the study. The findings were expected to provide practical insights for geography teachers seeking to integrate authentic environmental investigations with explicit instruction in essential geographical concepts while promoting equitable student participation in collaborative learning activities. Furthermore, the study was intended to inform future investigations employing validated assessment instruments, comparable

baseline measurements, and appropriate inferential statistical procedures. Nevertheless, because the study involved purposively selected classes and relied primarily on descriptive comparisons, the observed differences between instructional groups could not independently establish a causal effect of PBL on geographic literacy or cognitive learning achievement.

METHOD

This study employed a descriptive quantitative approach with a quasi-experimental, nonequivalent-group design (Sugiyono, 2017) at SMA Diponegoro 1 Jakarta, Rawamangun, from January to October 2023. The study population comprised 108 eleventh-grade social science students enrolled in geography courses across three classes: XI-3 (35 students), XI-4 (38 students), and XI-5 (35 students). Two intact classes were selected through purposive sampling based on their comparable initial characteristics. Class XI-5 was assigned to the experimental group, which received instruction using the Problem-Based Learning (PBL) model, while Class XI-3 served as the control group, receiving conventional lecture-based instruction. Each group comprised 30 students, resulting in a total sample of 60 participants. Because the participants were not randomly assigned, the findings were interpreted within the limitations of the quasi-experimental design.

The independent variable was the instructional model, while the dependent variables were cognitive geography learning outcomes and geographic literacy (Dimyati & Mudjiono, 2013; Jihad, 2012; Purwanto, 2003). Data were collected using an 11-item multiple-choice achievement test covering environmental geography concepts at relevant cognitive levels (Krathwohl & Anderson, 2010; Sudjana, 2004), a 12-item true–false geographic literacy questionnaire based on six dimensions of the National Council for Geographic Education (NCGE) framework, and a 14-item questionnaire employing a four-point Likert scale to assess the implementation of five PBL instructional phases (Dikmenli, 2014; Sani, 2014). The research procedures included classroom instruction, collaborative investigations of environmental problems, development and presentation of project-based learning products, and evaluation of instructional implementation and student learning outcomes (Djamahar, 2010; Pratiwi, 2019). Instrument validity and reliability coefficients were not reported.

Data were analyzed using descriptive statistical techniques, including frequency distributions, percentages, score classifications, mean scores, and comparisons across instructional groups, geographic literacy dimensions, and environmental geography subtopics. The implementation of PBL was evaluated through percentage-based assessments of instructional adherence, while geographic literacy and cognitive achievement were compared using the recorded scores of the experimental and control groups. The analysis focused on identifying descriptive differences in learning outcomes without establishing statistical significance or causal relationships. The findings were interpreted by considering the experimental group's higher mean geographic literacy score and the control group's higher mean cognitive achievement score, while

acknowledging the methodological limitations associated with purposive sampling and nonrandom group assignment.

RESULTS AND DISCUSSION

In this section, the results of empirical analysis and in-depth discussion of the three main focuses of the research are presented: (1) Implementation and analysis of the implementation of the Problem-Based Learning model syntax in experimental classes; (2) Analysis of the achievement of students' cognitive learning outcomes of geography per sub-material; (3) Analysis of students' geographic literacy achievement based on NCGE indicators; and (4) Comparative and correlative analysis between research variables.

Implementation and Analysis of the Implementation of Problem-Based Learning (PBL) Syntax

The implementation of the Problem-Based Learning model in the experimental class (XI-5) was carried out in the Environment chapter material. The learning process was designed in small groups consisting of 3 students. The formation of this small group aims to maximize individual involvement, ensure fair division of tasks, and facilitate the observation of social interaction and collaboration by accompanying teachers.

The treatment in the experimental class strictly followed the 5 phases/syntax of PBL operations (Sani, 2014). At the beginning of the learning (Phase 1: Problem orientation), the teacher presented audio-visual media in the form of a short documentary video about urban flood disasters, plastic waste pollution, and forest fires in Indonesia. This video functions as a trigger (stimulus) to stimulate students' sensitivity and curiosity. Next, teachers and students organize themselves (Phase 2) to choose specific environmental issue phenomena to be studied.

Entering Phase 3 (Self-investigation and group), students collect data from various libraries, online news portals, and scientific journals. Students analyze the causes, impacts, and formulate ideas for solutions to the problem. The results of the investigation are then developed (Phase 4) in the form of digital artifacts in the form of infographics or interactive posters using the Canva application, and then presented in front of the class. Learning ends with Phase 5 (Analysis and evaluation), where students evaluate ideas between groups, summarize key points, and receive reinforcement of concepts from teachers.

Based on the results of filling out the PBL implementation questionnaire by 30 students of the experimental class, an average implementation score of 90.00 (scale 100) was obtained. The distribution of the achievement of the level of PBL implementation of students is categorized into three frequency groups as presented in Table 1.

Table 1. Frequency Distribution of PBL Implementation in Classes XI-5

Value Interval	Categories of Applications	Frequency (Student)	Percentage (%)
29 - 53	Low	1	3%
54 - 77	Medium	2	7%
78 - 100	Height	27	90%

Source: Research data and tables reported in the original manuscript.

The data in Table 1 shows that as many as 27 students (90%) were able to apply the PBL model in the high category, 2 students (7%) were in the medium category, and only 1 student (3%) recorded the application in the low category (score 29). This lowest score was experienced by students who were passive in group activities, did not contribute ideas during the investigation, and did not master the material during the presentation.

To understand in detail the dynamics of the implementation of PBL at each stage of learning, an analysis of the achievement of scores in each of the 5 PBL syntax was carried out. The results of the implementation analysis per syntax are presented in Table 2.

Table 2. Recapitulation of Score Per Syntactic of PBL Model in Classes XI-5

PBL syntax	Description of the Learning Phase	Average Score (%)
Syntax 1	Problem orientation to students	90,00%
Sintak 2	Organize student research	94,44%
Syntax 3	Self-investigation & group	85,83%
Syntax 4	Artifact development & presentation	88,33%
Syntax 5	Analysis & evaluation of problem-solving	95,00%

Source: Research data and tables reported in the original manuscript.

Discussion of PBL Syntax Analysis:

Syntax 1 (Problem Orientation - 90.00%): Student involvement is very high. Video screening of environmental damage phenomena in Indonesia has proven to be effective in sparking students' attention and empathy. Students quickly recognize popular environmental issues such as forest fires, urban floods, and plastic waste.

Syntax 2 (Learning Organizing - 94.44%): The formation of small groups of 3 people facilitates the division of roles. Students independently agree on specific topics studied, such as food waste management, river pollution, or the impact of volcanic eruptions.

Syntax 3 (Independent & Group Investigation - 85.83%): Syntax 3 recorded the lowest score. The main obstacles include: reliance on quick internet searches without critical verification, difficulty in generating authentic solution ideas, and partial work patterns between group members.

Syntax 4 (Artifact Development & Presentation - 88.33%): Students showed great digital creativity in designing Canva infographics. However, some students' oral presentation skills were still relatively rigid and read text.

Syntax 5 (Process Analysis & Evaluation - 95.00%): This phase obtains the highest score. The teacher guides students to reflect on the entire investigation process, compare the effectiveness of the solution, and comprehensively draw the final conclusion.

Geography Cognitive Learning Outcomes Analysis

Students' cognitive learning outcomes were measured using a written test of 11 multiple-choice questions of Environmental material. Based on the processing of test data, a statistical description of cognitive learning outcomes was obtained as stated in Table 3. The highest score of the control class was 91 with an average of 69.09 (50% completeness). While the experimental class recorded the highest score of 100 with an average of 66.97 (37% completeness).

Table 3. Distribution of Geography Learning Outcomes for Classes XI-3 and XI-5

Value Interval	Category	Frequency XI-3	Percentage XI-3	Frequency XI-5	Percentage XI-5	Completion
9 - 37	Low	5	17%	8	27%	Incomplete
38 - 64	Medium	7	23%	11	37%	Incomplete
65 - 100	High	18	60%	11	37%	Complete (>= 65)

Source: Research data and tables reported in the original manuscript.

The recapitulation of the percentage of correctness of students' answers based on sub-material is presented in Table 4.

Table 4. Comparison of Geographical Cognitive Sub-Material Mastery

Geography Sub-Material	Key Cognitive Indicators	Control (%)	Experiments (%)
Environmental Concept	Introduction of biotic, abiotic, & food chain components	82,22%	78,89%
The Impact of Environmental Problems	Analysis of the impact of human activities & natural disasters	72,50%	64,67%
Environmental Problem Solutions	Evaluation & formulation of mitigation/handling measures	58,33%	63,33%

Source: Research data and tables reported in the original manuscript.

Discussion of Cognitive Sub-Material Mastery:

Environmental Concept Sub-Material: The expository lecture method in the control class is very effective for the cultivation of basic factual concepts (LOTS) that are memorized (recall).

Sub-Material on Environmental Impact: The teacher in the control class gave a systematic explanation of the entire chapter, while the experimental class only focused on the environmental issues chosen by the group.

Sub-Material for Environmental Problem Solutions: The most crucial findings show that the experimental class excelled significantly (63.33% vs 58.33%) at the cognitive levels of C4 (Analysis) and C5 (Evaluation). This proves that the PBL model is very superior in building high-level thinking skills (HOTS) and rational decision-making on environmental problems.

Student Geographic Literacy Analysis

The average geographic literacy score of the experimental class (XI-5) learned with PBL reached a score of 84.00, higher than the control class (XI-3) of 81.00. The grouping of students' geographic literacy categories is presented in Table 5.

Table 5. Distribution of Students' Geographic Literacy Categories

Score Interval	Literacy Category	Frequency XI-3	Percentage XI-3	Frequency XI-5	Percentage XI-5	Literacy description
33 - 57	Low	1	3%	5	17%	Location Understanding
58 - 78	Medium	11	37%	12	40%	Spatial Interaction
79 - 100	High	18	60%	13	43%	Critical Geography

Source: Research data and tables reported in the original manuscript.

The comparison of scores in the 6 dimensional groups of NCGE indicators is summarized in Table 6.

Table 6. Comparison of Scores Per NCGE Geographic Literacy Indicator

NCGE Literacy Dimension	Focus on Assessment Capabilities	XI-3 (%)	XI-5 (%)
1. Explanation of the Earth & Spatial Planning	Use of digital maps, location technology, & spatial arrangement	77%	80%
2. Places & Districts	Physical & human characteristics of regions and regional boundaries	60%	73%
3. Physical System	Geological processes and distribution of the earth's ecosystems	80%	83%
4. Human System	Demographic dynamics, cultural diversity, and economic cooperation	80%	82%
5. Environment & Social	Human-induced environmental modification & mutual impacts	100%	93%
6. Use of Geography	Applications of geography for interpretation & future planning	97%	100%

Source: Research data and tables reported in the original manuscript.

Discussion of NCGE Literacy Dimension Analysis:

Earth & Spatial Explanation: Students are familiar with smartphone digital maps, but are still limited to reading mental map symbols without automatic navigation.

Location & Region: The experimental class excelled significantly (73% vs 60%) because PBL investigative activities accustomed students to research the geographical background of the region before formulating a solution.

Physical Systems & Human Systems: Students' exposure to global issues during PBL investigations substantially enriches their understanding of physical phenomena and insights into human geography.

Use of Geography: All students of the experimental class (100%) agree that geography is the main analytical tool in disaster mitigation and urban spatial planning.

Inter-variable correlative analysis

There is a very strong linear relationship between the implementation of PBL and geographic literacy scores. Real-world problems in PBL force students to activate their spatial perspective. However, the phenomenon of specialization in group roles (e.g. infographic designers vs material seekers) causes inequality in individual cognitive mastery, so periodic rotation of group roles is recommended.

CONCLUSION

The implementation of Problem-Based Learning (PBL) in Class XI-5 at SMA Diponegoro 1 Jakarta achieved a high implementation rating of 90%. The experimental group obtained a higher mean geographic literacy score (84.00) than the control group (81.00), indicating a favorable descriptive difference in students' ability to apply geographic knowledge. However, the experimental group recorded a lower mean cognitive geography achievement score (66.97) than the control group (69.09). In the environmental problem-solving subtopic, the experimental group demonstrated relatively

better performance (63.33%) than the control group (58.33%), whereas the control group achieved higher scores in several subtopics related to fundamental geographic concepts and environmental impacts. Collectively, these findings suggest that PBL may facilitate contextual learning, strengthen students' application of geographic concepts, and promote engagement in environmental problem-solving activities. Nevertheless, its implementation did not consistently correspond to higher cognitive achievement across all assessed learning domains. Furthermore, because the analysis was primarily descriptive, the observed differences did not establish a statistically significant effect or a causal relationship between PBL implementation and student learning outcomes.

Future research should employ more rigorous quasi-experimental or experimental designs with comparable baseline characteristics, validated and reliable assessment instruments, and appropriate inferential statistical analyses to examine differences in geographic literacy and cognitive learning outcomes. Geography teachers are encouraged to integrate authentic problem-based investigations with explicit instruction and reinforcement of fundamental geographic concepts to support both conceptual understanding and practical application. Collaborative learning strategies, including systematic rotation of group responsibilities and structured peer-learning activities such as gallery walks, may also be incorporated to promote equitable participation and ensure that students engage with a comprehensive range of geographical concepts. Further investigations should examine the long-term retention of geographic knowledge, the development of spatial reasoning and map interpretation skills, and the integration of geographic information systems (GIS) and digital mapping technologies into PBL activities. Expanding future research across schools with diverse educational, socioeconomic, and geographical characteristics would also strengthen the generalizability of findings and provide a more comprehensive understanding of the potential contribution of PBL to geography education.

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AUTHOR'S CONTRIBUTION

The author fully contributes to the formulation of the main idea idea, collects library data, analyzes and interprets the primary text of the figure, and prepares the manuscript. All authors have agreed on the final version of the manuscript.

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