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Integrating PBL and FGD to Foster Critical Thinking in Disaster-Based Geography Learning

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Abstract: Critical thinking is an essential competency in geography education, particularly in understanding environmental and disaster-related issues within sustainability-oriented learning contexts. However, geography learning in schools is still frequently dominated by teacher-centered instruction, limiting students' opportunities to critically analyze environmental problems and collaboratively construct solutions. This study aimed to examine the effect of integrating Problem-Based Learning (PBL) and Focus Group Discussion (FGD) on students' critical thinking skills in disaster-based geography learning at SMA Negeri 2 Kolaka, Indonesia. The study employed a pre-experimental one-group pretest–posttest design involving 10 tenth-grade students. The learning intervention focused on contextual flood disaster issues occurring in Kolaka Regency. Data were collected using critical thinking tests consisting of essay and multiple-choice questions developed based on Ennis' critical thinking indicators, including clarity of arguments, relevance of answers, depth of analysis, and creativity of solutions. Data were analyzed using descriptive quantitative analysis through percentage score comparisons between pretest and posttest results. The findings revealed that students' average critical thinking score increased from 40% in the pretest category to 65% in the posttest category, indicating substantial improvement after the implementation of integrated PBL and FGD. The results suggest that collaborative and contextual disaster-based learning effectively promotes students' analytical reasoning, reflective thinking, and environmental problem-solving abilities. This study contributes to sustainability-oriented geography education by demonstrating that integrating PBL and FGD can support transformative learning, disaster literacy, and critical environmental awareness in secondary education.
Keywords: Problem-Based Learning; Focus Group Discussion; Critical Thinking; Disaster-Based Learning; Geography Education; Sustainability Education.

INTRODUCTION

Environmental disasters have become one of the most urgent global challenges affecting social life, economic stability, and educational systems (Afrian et al., 2020; Kesumaningtyas et al., 2022; Tuswadi & Hayashi, 2014). Climate change, land degradation, rapid urbanization, and unsustainable human activities have intensified the frequency and severity of hydrometeorological disasters such as floods, landslides, and droughts across many regions of the world. Disaster events not only damage infrastructure and ecosystems but also disrupt educational processes and reduce community resilience (Aeni & Khoirul Anwar, 2024; Burger et al., 2019). In this context, education plays a strategic role in developing students' critical awareness, environmental responsibility, and problem-solving abilities related to sustainability and disaster mitigation. Recent studies emphasize that sustainability-oriented

education should encourage learners to analyze environmental problems critically and actively participate in finding contextual solutions(UNESCO, 2020).

Indonesia is among the countries highly vulnerable to hydrometeorological disasters, particularly floods. Data from the Indonesian National Disaster Management Agency (BNPB) reported that 3,027 disaster events occurred between January and October 2022, with floods representing the highest number of incidents reaching 1,238 cases (BNPB, 2024). The increasing occurrence of floods is strongly associated with high rainfall intensity, watershed degradation, poor drainage systems, and environmentally unsustainable human activities (Handayani et al., 2020; Merten et al., 2021). These conditions indicate the importance of strengthening disaster literacy and critical environmental awareness among students as part of sustainable education efforts. Disaster-related learning is therefore essential not only to improve conceptual understanding but also to foster students' preparedness, responsibility, and critical thinking in responding to environmental problems (Rieckmann, 2018; UNESCO, 2020).

In Southeast Sulawesi, particularly in Kolaka Regency, flood disasters frequently occur in several areas such as Samaturu, Wundulako, Polinggona, and Pomalaa due to high rainfall in upstream regions and inadequate environmental management. These flood events have disrupted public activities and affected learning processes in schools. Geography education has substantial potential to address such environmental issues because it examines interactions between humans and the environment through spatial and contextual perspectives (Larsen et al., 2022; MacKay et al., 2021). Geography learning should therefore not merely focus on memorizing concepts but also facilitate students in understanding real environmental problems critically and scientifically. Through meaningful learning experiences, students are expected to develop analytical skills, environmental awareness, and sustainable problem-solving competencies relevant to their local contexts (Castaño et al., 2025; Lamb et al., 2018).

Critical thinking is considered one of the essential competencies in twenty-first-century education and sustainable learning (Kardoyo et al., 2020; Lage-Gómez et al., 2026; Taimur & Sattar, 2020). Students with strong critical thinking skills are more capable of evaluating information, analyzing causes and impacts of environmental problems, constructing logical arguments, and proposing evidence-based solutions. However, previous studies indicate that geography learning in schools still tends to be teacher-centered, limiting students' opportunities to actively investigate problems and engage in reflective discussion (Handoyo et al., 2024; Wijayanto et al., 2023). Preliminary observations conducted at SMA Negeri 2 Kolaka also revealed that students experienced difficulties in analyzing flood-related problems critically, particularly in explaining causal relationships, evaluating environmental impacts, and formulating contextual solutions. Learning activities were still dominated by conventional explanations, while collaborative inquiry and analytical discussion remained limited. As a result, students' critical thinking abilities were not optimally developed.

Problem-Based Learning (PBL) has been widely recognized as an effective instructional approach for developing critical thinking and higher-order thinking skills (Kardoyo et al., 2020; Wijnia et al., 2024). PBL encourages students to learn through authentic and contextual problems, allowing them to investigate issues, evaluate information, and construct knowledge collaboratively. In geography education, PBL enables students to connect theoretical concepts with environmental realities surrounding their communities (Djordjevic et al., 2026; Fadjarajani et al., 2024; Rock, 2022). Several studies reported that PBL significantly improves students' analytical abilities, problem-solving skills, and critical thinking performance in social science and geography learning contexts (Anazifa, 2017; Silviarza et al., 2020). Furthermore, sustainability-oriented PBL has been shown to foster environmental responsibility and participatory learning behaviors among students (d'Escoffier et al., 2026; Sukidin et al., 2026).

To optimize collaborative inquiry during learning activities, PBL can be integrated with Focus Group Discussion (FGD). FGD provides opportunities for students to exchange ideas, defend arguments, evaluate evidence, and collectively formulate solutions to real-world problems (Abidin et al., 2025). Interactive discussions encourage reflective thinking and active participation, both of which are fundamental elements in critical thinking development. Previous studies have shown that collaborative discussion strategies contribute positively to students' reasoning abilities, communication skills, and social engagement in classroom learning (Brush et al., 2023; Rosaen et al., 2017). The integration of PBL and FGD therefore has strong potential to create transformative and student-centered geography learning environments that support sustainability education and disaster awareness.

Although many previous studies have investigated the effectiveness of PBL in improving critical thinking, limited research specifically integrates PBL and FGD within disaster-based geography learning contexts, particularly in flood-prone areas. Moreover, studies connecting geography learning, disaster education, and sustainability-oriented critical thinking in Indonesian secondary schools remain relatively scarce. This study addresses this gap by examining the implementation of integrated PBL and FGD strategies in geography learning related to local flood issues in Kolaka Regency. The local environmental context was intentionally selected to provide authentic learning experiences that encourage students to analyze environmental disasters critically and develop contextual solutions collaboratively.

Therefore, this study aims to analyze the effect of integrating Problem-Based Learning and Focus Group Discussion on students' critical thinking skills in disaster-based geography learning at SMA Negeri 2 Kolaka. The findings of this study are expected to contribute theoretically to sustainability-oriented geography education and practically to the development of innovative instructional strategies that promote critical environmental awareness, disaster literacy, and transformative learning in secondary education.

METHOD

Research Design

This study employed a pre-experimental design using a one-group pretest–posttest approach to examine the effect of integrating Problem-Based Learning (PBL) and Focus Group Discussion (FGD) on students' critical thinking skills in disaster-based geography learning. The design was selected because it allowed the researchers to measure students' critical thinking abilities before and after the implementation of the learning intervention. The research focused on contextual environmental issues related to flood disasters in Kolaka Regency as the primary learning topic.

The research design can be illustrated as follows:

$$O_1 \rightarrow X \rightarrow O_2$$

Where:

- O_1 = Pretest of students' critical thinking skills
- X = Learning intervention through integrated PBL and FGD
- O_2 = Posttest of students' critical thinking skills

The implementation of PBL and FGD emphasized collaborative investigation, contextual problem-solving, and reflective discussion related to environmental disaster issues. Students were encouraged to analyze causes, impacts, and possible mitigation strategies concerning flood events occurring in their local environment.

Research Site and Participants

This study was conducted at SMA Negeri 2 Kolaka, Southeast Sulawesi, Indonesia, during November–December 2025. The school was selected purposively because it is located in a flood-prone area frequently affected by hydrometeorological disasters. Such environmental conditions provided authentic learning contexts relevant to disaster-based geography education.

The participants consisted of 10 tenth-grade students enrolled in geography classes during the 2025/2026 academic year. All students in the selected class participated in the study; therefore, total sampling was applied. The participants included male and female students with relatively diverse academic abilities and learning participation levels.

Learning Intervention Procedure

The learning intervention was implemented in three stages consisting of pretest, PBL-FGD learning activities, and posttest sessions.

Pretest Stage

At the beginning of the study, students completed a pretest designed to measure their initial critical thinking abilities related to environmental disaster issues, particularly floods. The pretest consisted of essay and multiple-choice questions developed based on critical thinking indicators proposed by Ennis.

PBL-FGD Learning Stage

The intervention phase involved geography learning activities integrating Problem-Based Learning and Focus Group Discussion. Students were first introduced to contextual flood-related problems occurring in Kolaka Regency through photographs, news articles, and environmental case descriptions. Subsequently, students were divided into small discussion groups to conduct focused discussions concerning the causes, impacts, and potential mitigation strategies for flood disasters.

During the learning process, students collaboratively identified problems, analyzed relevant environmental information, discussed alternative solutions, and presented their findings to the class. Teachers functioned as facilitators who guided discussion activities and encouraged reflective thinking throughout the learning process. The integration of PBL and FGD was intended to stimulate students' analytical reasoning, collaborative inquiry, and evidence-based argumentation skills.

Posttest Stage

Following the intervention, students completed a posttest using instruments similar to those administered during the pretest stage. The posttest aimed to measure changes in students' critical thinking skills after participating in disaster-based geography learning through integrated PBL and FGD activities.

Research Instruments

The instruments used in this study consisted of critical thinking tests, learning worksheets, discussion guidelines, and documentation sheets.

Critical Thinking Test

The primary instrument was a pretest–posttest assessment designed to evaluate students' critical thinking skills. The test consisted of essay and multiple-choice questions developed based on Ennis' critical thinking framework, including:

1. Providing simple explanations
2. Building basic support
3. Drawing conclusions
4. Providing further explanations
5. Determining strategies and tactics

The assessment rubric evaluated four main aspects of students' responses:

- clarity of arguments,
- relevance of answers,
- depth of analysis,
- creativity of solutions.

Each aspect was scored using a four-point scale ranging from 1 (very poor) to 4 (excellent).

Learning Worksheets and FGD Guidelines

Problem-solving worksheets were designed to support students during PBL activities. The worksheets contained contextual environmental cases, guiding questions, and collaborative investigation tasks. In addition, FGD guidelines were developed to facilitate structured group discussions and encourage active participation during collaborative learning sessions.

Documentation

Documentation techniques were used to collect supporting data during the implementation process. Documentation included photographs of classroom activities, group discussions, student presentations, and learning interactions during the intervention.

Validity and Reliability of Instruments

The research instruments were validated through expert judgment involving geography education lecturers and learning evaluation experts. The validation process focused on content relevance, clarity of instructions, alignment with critical thinking indicators, and contextual suitability to disaster-based geography learning.

Instrument reliability was examined through internal consistency analysis before implementation. Revisions were conducted based on validator recommendations to improve the quality and appropriateness of the assessment instruments.

Data Collection Technique

Data were collected using pretest and posttest assessments administered before and after the learning intervention. The tests measured students' critical thinking performance in analyzing environmental disaster issues. Additional supporting data were obtained through classroom observations and documentation of learning activities during the implementation of PBL and FGD.

Data Analysis Technique

The collected data were analyzed quantitatively using descriptive statistical analysis. Students' pretest and posttest scores were calculated to determine the improvement in critical thinking skills after the intervention. Mean scores and percentage improvements were used to describe changes in students' performance.

The percentage of students' critical thinking achievement was calculated using the following formula:

$$P = \frac{NS}{N\,S_{max}} x100 \qquad (1)$$

- P = percentage score
- NS = total score obtained
- NS_{max} = maximum possible score

The interpretation criteria for critical thinking achievement were adapted from Kartini and Putra (2020), as presented in Table 1.

Table 1. Critical Thinking Achievement Criteria

Percentage	Category
0%–20%	Very Low
21%–40%	Low
41%–60%	Moderate
61%–80%	High
81%–100%	Very High

The findings from pretest and posttest analyses were then interpreted to identify the effectiveness of integrating PBL and FGD in fostering students' critical thinking skills in disaster-based geography learning.

Ethical Considerations

Prior to conducting the study, permission was obtained from the school administration and classroom teachers. Students participated voluntarily in all learning activities and assessments. All collected data were used exclusively for academic research purposes, and participants' identities were kept confidential throughout the study.

RESULTS AND DISCUSSION

RESULTS

Students' Critical Thinking Performance Before the Intervention

The pretest was conducted prior to the implementation of disaster-based geography learning integrating Problem-Based Learning (PBL) and Focus Group Discussion (FGD). The assessment aimed to identify students' initial critical thinking abilities related to flood disaster issues in Kolaka Regency. The test evaluated students' abilities to analyze environmental problems, construct logical arguments, interpret information, and formulate contextual solutions based on critical thinking indicators proposed by Ennis.

The results of the pretest indicated that students' critical thinking skills were still relatively low. Most students experienced difficulties in identifying causal relationships, evaluating environmental impacts, and developing analytical explanations related to flood phenomena. Learning activities prior to the intervention were generally dominated by teacher-centered instruction, limiting students' opportunities to engage in collaborative inquiry and reflective discussion.

The average percentage score obtained during the pretest was 40%, which was categorized as low according to the interpretation criteria presented in Table 1. The findings suggest that students had not yet developed optimal critical thinking abilities in disaster-related geography learning contexts.

Table 2. Students' Pretest Results on Critical Thinking Skills

Indicator	Percentage	Category
Clarity of Arguments	42%	Moderate
Relevance of Answers	39%	Low
Depth of Analysis	37%	Low
Creativity of Solutions	41%	Moderate
Average	**40%**	**Low**

Among the assessed indicators, the lowest achievement was found in the depth of analysis aspect. Students tended to provide short and descriptive answers without comprehensive explanations supported by evidence or logical reasoning. Similarly, students' ability to formulate creative and applicable solutions for environmental problems remained limited.

Implementation of PBL and FGD in Disaster-Based Geography Learning

The implementation of PBL integrated with FGD was conducted through collaborative and contextual learning activities focusing on flood disaster issues occurring in Kolaka Regency. The learning process began with presenting authentic environmental cases through visual materials, news articles, and local disaster narratives to stimulate students' curiosity and analytical thinking.

Students were subsequently divided into several small discussion groups to conduct focused investigations regarding the causes, impacts, and mitigation strategies associated with flood disasters. During the FGD sessions, students actively exchanged opinions, evaluated arguments, identified supporting evidence, and collaboratively proposed environmental solutions. Teachers acted as facilitators by guiding discussions and encouraging students to reflect critically on environmental problems.

The integration of PBL and FGD created an interactive learning environment in which students were encouraged to participate actively in problem-solving activities. Classroom observations showed increased student engagement, communication, and collaboration during group discussions. Students who were initially passive became more confident in expressing opinions and defending their arguments during collaborative inquiry sessions.

Students' Critical Thinking Performance After the Intervention

Following the implementation of disaster-based geography learning through integrated PBL and FGD, students completed the posttest to evaluate changes in their critical thinking skills. The results demonstrated substantial improvement across all assessed indicators.

The average posttest score increased to 65%, categorized as high according to the interpretation criteria. The findings indicate that the integration of PBL and FGD contributed positively to students' abilities to analyze environmental problems critically and formulate contextual solutions.

Table 3. Students' Posttest Results on Critical Thinking Skills

Indicator	Percentage	Category
Clarity of Arguments	68%	High
Relevance of Answers	64%	High
Depth of Analysis	63%	High
Creativity of Solutions	65%	High
Average	**65%**	**High**

The most notable improvement occurred in the clarity of arguments indicator. Students demonstrated better abilities in explaining environmental problems logically and supporting their opinions using relevant information obtained during collaborative discussions. Improvements were also observed in students' analytical depth and creativity in proposing flood mitigation solutions relevant to local environmental conditions.

Improvement in Students' Critical Thinking Skills

A comparison between pretest and posttest results revealed that students' critical thinking skills improved by 25% after participating in disaster-based geography learning integrating PBL and FGD.

Table 4. Comparison of Pretest and Posttest Scores

Assessment	Average Percentage	Category
Pretest	40%	Low
Posttest	65%	High
Improvement	25%	-

The increase in students' performance indicates that collaborative problem-solving and focused group discussions provided meaningful learning experiences that supported critical thinking development. The contextual learning activities enabled students to connect geography concepts with real environmental challenges occurring within their communities.

DISCUSSION

The findings of this study demonstrate that integrating Problem-Based Learning (PBL) and Focus Group Discussion (FGD) effectively improved students' critical thinking skills in disaster-based geography learning. The improvement from 40% in the pretest to 65% in the posttest indicates that contextual and collaborative learning activities positively influenced students' analytical and reflective thinking abilities.

The relatively low pretest results reflected students' limited experience in participating in inquiry-oriented and problem-solving learning environments. Prior to the intervention, learning activities were still predominantly teacher-centered, resulting in passive classroom participation and limited opportunities for students to critically analyze environmental issues. This finding is consistent with previous studies reporting that conventional instructional approaches often fail to optimally develop higher-order thinking skills in geography learning contexts (Virranmäki et al., 2021; Wijayanto et al., 2023; Yamwongsri & Chen, 2025).

The implementation of PBL encouraged students to investigate authentic environmental problems related to flood disasters occurring in Kolaka Regency. Through problem identification, information analysis, and collaborative inquiry, students became actively involved in constructing knowledge rather than merely receiving information from teachers. This learning process supports constructivist learning principles, where students develop understanding through direct engagement with meaningful and contextual problems. Previous studies similarly found that PBL effectively enhances critical thinking, analytical reasoning, and problem-solving skills in geography and social science education (Fadjarajani et al., 2024; Silviariza et al., 2021; Silviarza et al., 2020).

The integration of FGD further strengthened students' critical thinking development by facilitating interactive discussion and reflective dialogue among group members. During discussions, students were encouraged to defend arguments, evaluate peers' opinions, and formulate evidence-based conclusions collaboratively. Such activities contributed significantly to improving students' abilities to communicate ideas logically and critically evaluate information. Gillies (2019) and Yaacob et al., (2020) explain that dialogic interaction in collaborative learning environments plays a substantial role in promoting reasoning and reflective thinking among learners.

Another important finding is that disaster-based geography learning provided meaningful contextual experiences for students. Environmental problems discussed during learning activities were closely connected to students' daily lives and local conditions in flood-prone areas. Contextual learning environments increase students' engagement because they perceive learning materials as relevant and applicable to real-world situations. This result supports sustainability-oriented education perspectives emphasizing the importance of connecting learning with environmental awareness, social responsibility, and community resilience (Algers & Wals, 2020; Avery & Nordén, 2021; Jaikrasen & Ketsing, 2025; UNESCO, 2021).

The improvement observed in the creativity of solutions indicator also suggests that students developed better abilities in proposing mitigation strategies and environmental problem-solving alternatives. This finding indicates that integrating PBL and FGD not only supports cognitive achievement but also encourages transformative learning processes that foster responsible and

participatory attitudes toward environmental sustainability. Geography learning therefore becomes not merely content-oriented but also transformative in developing environmentally responsible citizens.

Despite the positive findings, this study has several limitations. The research involved a relatively small number of participants and applied a pre-experimental design without a control group. Consequently, the generalizability of the findings remains limited. Future studies are recommended to involve larger participant groups, employ quasi-experimental or mixed-method approaches, and explore additional variables such as environmental literacy, disaster preparedness, collaborative skills, or sustainability awareness.

Overall, the findings confirm that integrating PBL and FGD in disaster-based geography learning provides an effective instructional strategy for fostering students' critical thinking skills. The combination of contextual problem-solving and collaborative discussion creates meaningful learning experiences that support sustainability-oriented education and encourage students to become more reflective, analytical, and environmentally responsible learners.

CONCLUSION AND SUGGESTION

The findings of this study demonstrate that the integration of Problem-Based Learning (PBL) and Focus Group Discussion (FGD) positively contributed to improving students' critical thinking skills in disaster-based geography learning at SMA Negeri 2 Kolaka. The implementation of contextual learning activities centered on local flood disaster issues enabled students to engage actively in problem analysis, collaborative discussion, and solution development. The results showed an increase in students' average critical thinking achievement from 40% in the pretest category to 65% in the posttest category, indicating substantial improvement after the learning intervention.

The integration of PBL and FGD created a more interactive, reflective, and student-centered learning environment. Through collaborative investigation and focused discussions, students developed stronger abilities in constructing arguments, analyzing environmental problems, evaluating information, and proposing contextual solutions related to flood disasters in their local communities. The study further indicates that disaster-based geography learning can support sustainability-oriented education by fostering environmental awareness, critical reasoning, and participatory learning experiences among students.

This study implies that geography learning should move beyond conventional teacher-centered instruction toward more contextual and transformative learning approaches that encourage students to critically engage with real environmental challenges. Integrating PBL and FGD may therefore serve as an effective instructional strategy for promoting critical thinking, disaster literacy, and sustainability awareness in secondary education.

However, this study was limited by the relatively small number of participants and the use of a pre-experimental research design without a comparison group. Future research is recommended to involve larger participant populations, apply quasi-experimental or mixed-method approaches, and investigate additional variables such as environmental literacy, disaster preparedness, collaborative problem-solving, and sustainability competencies. Further studies may also explore the integration of digital learning technologies and community-based environmental projects to strengthen transformative geography learning in disaster-prone regions.

DECLARATION OF GENERATIVE AI SOURCES

During the preparation of this manuscript, the author(s) used generative AI-assisted technology, namely ChatGPT by OpenAI, for language improvement, grammar refinement, academic writing assistance, and manuscript organization. All generated content was carefully reviewed, revised, and verified by the author(s). The author(s) take full responsibility for the final content of this manuscript.

REFERENCES

Abidin, Z., Shah, Z. A., & Rauf, M. (2025). Focus Group Discussion How to Quickly Build Students' Critical Thinking Skills. *Zabags International Journal of Education*, *3*(1), 1–13. Https://doi.org/10.61233/zijed.v3i1.23

Aeni, P., & Khoirul Anwar, M. (2024). Hydrometeorological Disaster: Challenges and Mitigation in Indonesia. *Jurnal Indonesia Sosial Teknologi*, *5*(01), 318–330. Https://doi.org/10.59141/jist.v5i01.888

Afrian, R., Hariadi, J., Akob, B., & Islami, Z. R. (2020). Local Culture Inventory for Disaster Mitigation Learning. *IOP Conference Series: Earth and Environmental Science*, *412*(1), 012017. Https://doi.org/10.1088/1755-1315/412/1/012017

Algers, A., & Wals, A. E. (2020). *Transformative Sustainability-Oriented Open. Open (ing) Education: Theory and Practice, 103.*

Anazifa, R. D. (2017). *Jurnal Pendidikan IPA Indonesia Project- Based Learning And Problem- Based Learning : Are They Effective To Improve Student ' S Thinking Skills ? 6*(2), 346–355. Https://doi.org/10.15294/jpii.v6i2.11100

Avery, H., & Nordén, B. (2021). We can only do it together: Addressing global sustainability challenges through a collaborative paradigm. In *World Sustainability Series*. Https://doi.org/10.1007/978-3-030-63399-8_16

BNPB. (2024). *Data informasi bencana Indonesia (DIBI).* BNPB.

Brush, A. J. B., Bargeron, D., Grudin, J., Borning, A., & Gupta, A. (2023). Supporting Interaction Outside of Class: Anchored Discussions vs. Discussion Boards. In *Computer Support for Collaborative Learning* (pp. 425–434). Routledge. Https://doi.org/10.4324/9781315045467-61

Burger, A., Oz, T., Kennedy, W. G., & Crooks, A. T. (2019). Computational Social Science of Disasters: Opportunities and Challenges. In *Future Internet* (Vol. 11, Issue 5). Https://doi.org/10.3390/fi11050103

Castaño, C., Caballero, R., Noguera, J. C., Chen Austin, M., Bernal, B., Jaén-Ortega, A. A., & Ortega-Del-Rosario, M. D. L. A. (2025). Developing Sustainability Competencies Through Active Learning Strategies Across School and University Settings. *Sustainability*, *17*(19), 8886. Https://doi.org/10.3390/su17198886

D'Escoffier, L. N., Longen Zindel, M. T., Jiang, D., & Guerra, A. O. (2026). Sustainability competence(s) in focus: analysis of engineering students' perspectives in a project-based learning (PBL) context. *International Journal of Sustainability in Higher Education*, 1–19. Https://doi.org/10.1108/IJSHE-02-2025-0138

Djordjevic, I., Jovanovic, S., Markovic, M., Andjelkovic, S., Prnjat, Z., Matović, S., & Valjarević, A. (2026). Project-Based Learning in Geography and Its Impact on Developing Students' Values, Attitudes and Pro-Environmental Behavior. *Sustainability*, *18*(2), 725. Https://doi.org/10.3390/su18020725

Fadjarajani, S., As'ari, R., & Putri, A. E. (2024). Model of Problem-Based Learning in Geography: Focusing on Societal Dynamics to Enhance Spatial Thinking Skills. *E3S Web of Conferences*, *600*, 02011. Https://doi.org/10.1051/e3sconf/202460002011

Gillies, R. M. (2019). Promoting academically productive student dialogue during collaborative learning. *International Journal of Educational Research*, *97*, 200–209. Https://doi.org/10.1016/j.ijer.2017.07.014

Handayani, W., Chigbu, U. E., Rudiarto, I., & Putri, I. H. S. (2020). Urbanization and Increasing Flood Risk in the Northern Coast of Central Java—Indonesia: An Assessment towards Better Land Use Policy and Flood Management. *Land*, *9*(10), 343. Https://doi.org/10.3390/land9100343

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.

Jaikrasen, P., & Ketsing, J. (2025). Cultivating Sense of Place Through Place-Based Education: An Innovative Approach to Education for Sustainability in a Thai Primary School. *Education Sciences*, *15*(11), 1456. Https://doi.org/10.3390/educsci15111456

Kardoyo, K., Nurkhin, A., Muhsin, M., & Pramusinto, H. (2020). Problem-Based Learning Strategy: Its Impact on Students' Critical and Creative Thinking Skills. *European Journal of Educational Research*, *volume-9-2*(volume-9-issue-3-july-2020), 1141–1150. Https://doi.org/10.12973/eu-jer.9.3.1141

Kesumaningtyas, M. A., Hafida, S. H. N., & Musiyam, M. (2022). Analysis of disaster literacy on student behavioral responses in efforts to reduce earthquake disaster risk at SMA Negeri 1 Klaten. *IOP Conference Series: Earth and Environmental Science*, *986*(1), 012013. Https://doi.org/10.1088/1755-1315/986/1/012013

Lage-Gómez, C., González-Pizarro, R., Campollo-Urkiza, A., & Cremades-Andreu, R. (2026). Thinking skills in transdisciplinary curriculum integration: A service-learning project in a Spanish secondary school. *Thinking Skills and Creativity*, *60*(November 2025). Https://doi.org/10.1016/j.tsc.2025.102115

Lamb, R. L., Annetta, L., Firestone, J., & Etopio, E. (2018). A meta-analysis with examination of moderators of student cognition, affect, and learning outcomes while using serious educational games, serious games, and simulations. *Computers in Human Behavior*, *80*, 158–167. Https://doi.org/10.1016/j.chb.2017.10.040

Larsen, T., Gerike, M., & Harrington, J. (2022). Human-Environment Thinking and K-12 Geography Education. *Journal of Geography*, *121*(1), 34–46. Https://doi.org/10.1080/00221341.2021.2005666

Mackay, C., Tran, K., & Lunstrum, E. (2021). Field-Based Experiential Education in Geography: Discovering and Rethinking Urban Environmental Challenges and Possibilities. *Journal of Geography*, *120*(2), 61–71. Https://doi.org/10.1080/00221341.2020.1862896

Merten, J., Nielsen, J. Ø., Rosyani, Soetarto, E., & Faust, H. (2021). From rising water to floods: Disentangling the production of flooding as a hazard in Sumatra, Indonesia. *Geoforum*, *118*, 56–65. Https://doi.org/10.1016/j.geoforum.2020.11.005

Rieckmann, M. (2018). *Learning to transform the world: Key competencies in Education for Sustainable Development. Issues and trends in education for sustainable development, 39(1), 39-59.*

Rock, A. E. (2022). Bringing geography to the community: community-based learning and the geography classroom. *Geojournal*, *87*(S2), 235–247. Https://doi.org/10.1007/s10708-021-10408-3

Rosaen, C., Meyer, A., Starchan, S., & Meier, J. (2017). Reading Horizons Learning to Facilitate Highly Interactive Literary Discussions to Engage Students as Thinkers. *Reading Horizons: A Journal of Literacy and Language Arts*, *56*(1).

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

Silviarza, W., Sumarni, S., & 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

Sukidin, Fajarwati, L., Dienda Saputri, S. W., & Basrowi. (2026). Optimization of project-based learning: Fostering proactive and collaborative behavior for a sustainable future. *Social Sciences*

& Humanities Open, *13*, 102735. Https://doi.org/10.1016/j.ssaho.2026.102735

Taimur, S., & Sattar, H. (2020). *Education for Sustainable Development and Critical Thinking Competency* (pp. 238–248). Https://doi.org/10.1007/978-3-319-95870-5_64

Tuswadi, & Hayashi, T. (2014). Disaster Prevention Education in Merapi Volcano Area Primary Schools: Focusing on Students' Perception and Teachers' Performance. *Procedia Environmental Sciences*, *20*, 668–677. Https://doi.org/https://doi.org/10.1016/j.proenv.2014.03.080

UNESCO. (2020). Education for sustainable development: A roadmap. *Transforming Our World: The 2030 Agenda for Sustainable Development A/RES/70/1, Available Online At*.

UNESCO. (2021). *Learn for our planet: A global review of how environmental issues are integrated in education.* UNESCO Publishing.

Virranmäki, E., Valta-Hulkkonen, K., & Pellikka, A. (2021). Geography Curricula Objectives and Students' Performance: Enhancing the Student's Higher-Order Thinking Skills? *Journal of Geography*, *120*(3), 97–107. Https://doi.org/10.1080/00221341.2021.1877330

Wijayanto, B., Sumarmi, Utomo, D. H., Handoyo, B., & Aliman, M. (2023). Journal of Technology and Science Education On Student ' S High Order Thinking And Learning. *Journal of Technology and Science Education*, *13*(3), 613–631.

Wijnia, L., Noordzij, G., Arends, L. R., Rikers, R. M. J. P., & Loyens, S. M. M. (2024). The Effects of Problem-Based, Project-Based, and Case-Based Learning on Students' Motivation: a Meta-Analysis. In *Educational Psychology Review* (Vol. 36, Issue 1). Springer US. Https://doi.org/10.1007/s10648-024-09864-3

Yaacob, A., Mohd Asraf, R., Hussain, R. M. R., & Ismail, S. N. (2020). Empowering Learners' Reflective Thinking through Collaborative Reflective Learning. *International Journal of Instruction*, *14*(1), 709–726. Https://doi.org/10.29333/IJI.2021.14143A

Yamwongsri, P., & Chen, H.-L. (2025). The Effects of Spherical Video-Based Virtual Reality in Inquiry-Based Learning on Student Learning Outcomes, Higher-Order Thinking, and Learning Experiences in Geography Education. *Journal of Educational Computing Research*, *63*(6), 1550–1579. Https://doi.org/10.1177/07356331251360440