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Effect of Project-Based Flood Mapping on Generation Z's Mitigation Attitude

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A B S T R A C T

This study examines the effect of a Project-Based Learning (PjBL) model, centered on creating flood hazard maps, on flood disaster mitigation attitudes among Generation Z students at SMA Negeri 7 Bandar Lampung. A quantitative causal design was employed with a cluster random sample of 70 grade X students. Data collection involved validated and reliable questionnaires (Cronbach's $\alpha = 0.92$) and analyses were performed using path analysis and regression techniques. Results show a significant direct effect of PjBL on mitigation attitudes ($\beta = 0.677$, $p < 0.001$) and of disaster knowledge on mitigation attitudes ($\beta = 0.323$, $p < 0.001$). The PjBL model also exhibited a strong positive relationship with disaster knowledge ($r = 0.782$, $p < 0.001$). Indirect effects of PjBL on attitudes via knowledge were 0.529 and 0.252, yielding a total indirect effect of 0.781 and a total effect of 1.206. Simultaneous F-test confirmed that PjBL and disaster knowledge together significantly influenced mitigation attitudes ($F(2, 67) = 125.697$, $p < 0.001$). These findings suggest that integrating map-making projects into learning can effectively enhance both knowledge and proactive attitudes toward flood disaster mitigation among youth.

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INTRODUCTION

Indonesia is one of the countries with a high level of disaster vulnerability. According to data from the National Disaster Management Agency (BNPB), more than 3,000 natural disasters occurred in Indonesia throughout 2023, with floods being the most frequent. Bandar Lampung City, as one of the rapidly developing urban areas, is not spared from the impact of these disasters. High rainfall and inadequate drainage systems have made flooding a recurring threat each year. This situation demands systematic disaster education, particularly for the younger generation.

Although disaster education has been included in the national curriculum, its implementation is often unappealing, especially for Generation Z—those born in the digital era who tend to prefer visual, collaborative, and interactive learning methods. According to Hellen (2012), Generation Z students have a high motivation for hands-on learning (learning by doing) and strong multitasking abilities, making them well-suited for educational models integrated with technology and focused on problem-solving. However, despite their broad access to information, there remains a need for pedagogical approaches that can transform knowledge into concrete attitudes and actions in the face of disaster risks. Twenge (2017) states that Generation Z shows a tendency to engage in social and environmental issues but needs appropriate stimuli to be motivated to act.

One relevant approach is the Project-Based Learning (PjBL) model, which emphasizes active student involvement in solving real-world problems through meaningful collaborative projects (Thomas, 2000). In the context of disaster education, PjBL can be directed toward the creation of flood risk maps as a tangible form of student understanding and preparedness regarding their surrounding environment. Research by Sumarmi (2023) has shown that PjBL can foster environmental awareness and enhance students' critical thinking skills. Leuwol (2024) also asserts that PjBL contributes to the development of disaster mitigation attitudes through direct student involvement in contextual learning processes.

Moreover, effective disaster education should not only transfer knowledge but also foster resilient attitudes and behaviors toward disasters (UNESCO, 2014). A mitigative attitude is crucial as a reflection of students' preparedness in facing disasters. In line with this, Latief & Fikri (2020) emphasize that strengthening attitudes through contextual learning is essential, especially at the senior high school level.

This study was conducted at SMA Negeri 7 Bandar Lampung, based on preliminary research results which showed that students already had basic knowledge about disaster mitigation; however, their attitudes and preparedness were still relatively low. This indicates a gap between knowledge and action, necessitating a learning intervention capable of bridging the two. Therefore, this research is essential to examine how effective the Project-Based Learning model

is in enhancing disaster mitigation attitudes among Generation Z students, particularly through a flood risk mapping project. It is hoped that this research will contribute to the development of disaster education strategies that are more adaptive to the characteristics of 21st-century learners.

METHOD

This study employs a quantitative approach with a causal research design. The quantitative approach was chosen to test hypotheses using numerical data and statistical analysis. The causal design aims to identify cause-and-effect relationships between independent, intervening, and dependent variables. The objective was to investigate the effect of Project-Based Learning (PjBL) on students' disaster mitigation attitudes. The research compared a group of students who received the PjBL intervention with a control group that experienced conventional learning.

- **Research Site and Participants**

The research was conducted at SMA Negeri 7 Bandar Lampung, Indonesia, during the 2024/2025 academic year. The selection of this school was based on preliminary research indicating that while students had basic knowledge about disaster mitigation, their attitudes and preparedness remained low. Participants were Grade XI students, consisting of two classes selected using purposive sampling: one experimental class and one control class, with a total of 70 students.

- **Intervention Procedure**

The experimental group was taught using the Project-Based Learning model over six sessions, each lasting 90 minutes. Students worked collaboratively to identify flood-prone areas in their local environment and created flood risk maps using digital mapping tools. The control group followed the regular curriculum without PjBL intervention. Learning materials for both groups were aligned with the disaster education content in the geography curriculum.

- **Data Collection**

Data were collected using a disaster mitigation attitude questionnaire developed and validated by experts in geography education. The questionnaire covered indicators such as awareness, preparedness, responsibility, and proactive behavior. Pre-test and post-test assessments were administered to both groups to measure changes in attitudes before and after the intervention.

- **Data Analysis**

Data analysis involved both descriptive and inferential statistics. The mean and standard deviation were calculated to describe the data distribution. The independent sample t-test was used to determine significant differences in post-test scores between the experimental and control groups, while the paired sample t-test was employed to examine within-group improvements.

Instrument Testing

- **Validity Test:** Conducted using SPSS, where the coefficient value must exceed the critical value to be considered valid.
- **Reliability Test:** The instrument is considered reliable if Cronbach's Alpha value > 0.60.

Classical Assumption Tests

- **Normality:** Using the Kolmogorov-Smirnov test; data are considered normal if the significance value > 0.05.
- **Multicollinearity:** Not present if tolerance > 0.10 and VIF < 10.
- **Heteroscedasticity:** Not present if the scatterplot shows no discernible pattern.
- **Autocorrelation:** Tested using the Durbin-Watson (DW) test.

Data Analysis Technique

This study uses **path analysis** to examine both direct and indirect effects among variables. The path model includes the following relationships:

- **Pxy:** Direct effect of the PjBL model on mitigation attitude.
- **Pxz:** Direct effect of the PjBL model on disaster knowledge.
- **Pzy:** Direct effect of disaster knowledge on mitigation attitude.

Path coefficients are calculated to determine the magnitude of direct and indirect effects of each variable on students' flood disaster mitigation attitudes.

RESULT

1. The Influence of the Implementation of the Project-Based Learning (PjBL) Model Through Flood Disaster Risk Mapping Projects on Disaster Mitigation Attitudes of Generation Z at SMA Negeri 7 Bandar Lampung

Based on hypothesis testing, the results showed that the implementation of the PjBL model through a flood disaster risk mapping project had a significant influence on the disaster mitigation attitudes of Generation Z at SMA Negeri 7 Bandar Lampung. The results are supported by a path coefficient (Pyx) of 0.677 or 67.7%, with the remaining 32.23% influenced by other factors not examined in this study. This strong relationship is attributed to the researcher's focus on how the implementation of the PjBL model through map-making projects can enhance flood disaster mitigation attitudes among Generation Z.

This research is supported by Sarwono (2016), whose findings showed that the Project-Based Learning model is highly effective in increasing students' environmental awareness in Geography class at SMA Negeri 2 Surakarta, specifically in disaster mitigation competencies. The results are also supported by Sumarmi (2023), who conducted an independent sample t-test between two groups and obtained a significance value of 0.829. This value, far above 0.05,

indicates that the applied teaching model effectively enhances students' environmental care. Based on these findings, it can be concluded that project-based learning combined with outdoor education proves effective in raising students' awareness of disaster mitigation, particularly regarding natural disasters in geography education.

Findings from this and previous studies show that the PjBL model is effective in increasing student engagement in the learning process. In the context of flood disaster mitigation, the implementation of PjBL through a flood risk map-making project provides meaningful learning experiences for Generation Z at SMA Negeri 7 Bandar Lampung. Students not only learn theoretical concepts about floods but also actively engage in data collection, information analysis, and the creation of tangible products such as risk maps. This process encourages students to develop critical thinking, collaboration, and problem-solving skills essential in disaster situations.

Creating flood risk maps in the PjBL approach enables students to gain in-depth understanding of geographical, hydrological, and socioeconomic conditions of their area. They learn to identify flood-causing factors such as high rainfall, low topography, and lack of water catchment areas. Students also explore flood impacts on communities, such as infrastructure damage, economic loss, and health disruptions. This understanding helps foster disaster risk awareness and the importance of mitigation.

Through the flood risk map project, students also learn about various individual and collective flood mitigation efforts. Generation Z learns the importance of environmental cleanliness, proper drainage systems, and the creation of water catchment areas. They also learn appropriate actions during flood events, such as evacuation, first aid, and post-disaster recovery. This knowledge equips them with practical skills to protect themselves and their communities.

The implementation of PjBL in flood disaster mitigation education also positively influences students' attitudes toward disasters. Students become more environmentally conscious and responsible in protecting themselves and others. They proactively seek disaster-related information and participate in mitigation activities. Such attitudes are crucial in fostering a disaster-aware culture among Generation Z. Overall, the implementation of the PjBL model through flood risk mapping projects significantly improves the disaster mitigation attitudes of Generation Z at SMA Negeri 7 Bandar Lampung. This model not only enhances students' knowledge and skills but also shapes positive attitudes and proactive behavior in facing disasters. Therefore, PjBL is a potentially effective approach for improving disaster preparedness among youth.

2. The Influence of Flood Disaster Knowledge on Disaster Mitigation Attitudes of Generation Z at SMA Negeri 7 Bandar Lampung

Based on hypothesis testing, it was found that knowledge about flood disasters has a significant influence on the disaster mitigation attitudes of Generation Z at SMA Negeri 7 Bandar Lampung. The results are supported by a path coefficient (Pyz) of 0.323 or 32.3%, with the remaining 67.7% influenced by other factors not investigated in this study. The strong relationship between these variables is due to the researcher's focus on how flood disaster knowledge can enhance Generation Z's mitigation attitudes.

This finding is supported by research by Endang Ratnawati, Iya Setyasih, and Aisyah Trees Sandy (2024), showing a significant positive effect of mitigation knowledge on the attitudes of Grade XII Social Science students in Samarinda, with a significance value of 0.000 < 0.05 and a t-value of 7.235 > t-table value of 1.703. This indicates that the more knowledge students have about flood mitigation, the stronger their attitudes in facing flood threats, though other factors like personal experience or length of residence in flood-prone areas also play a role.

The study also aligns with research by Jahirin (2021), which showed that most of the 30 respondents had good mitigation knowledge, while their disaster preparedness was moderate. This indicates a positive and significant relationship between mitigation knowledge and community preparedness in dealing with floods.

Bandar Lampung, the capital of Lampung Province, is highly vulnerable to flooding due to its geography, high rainfall, and suboptimal spatial planning. Generation Z, who currently dominate the student population at SMA Negeri 7 Bandar Lampung, play a vital role in flood disaster mitigation efforts. Their knowledge and attitudes toward mitigation significantly affect the success of prevention and response efforts in and around the school.

Knowledge about flood disasters includes understanding their causes, impacts, and mitigation strategies. This knowledge is essential for forming appropriate mitigation attitudes. Students with solid knowledge of floods will better understand risks and be more motivated to act. They will recognize the importance of keeping the environment clean, avoiding littering, and following authorities' instructions during floods. Additionally, this knowledge helps students identify early warning signs and take necessary precautions.

Mitigation attitudes include awareness, concern, and concrete actions in facing flood risks. Generation Z, as digital natives, have wide access to information, including disaster-related content. However, this access does not guarantee accurate understanding or proper attitudes. Thus, it's important to examine how flood disaster knowledge shapes their mitigation responses. At SMA Negeri 7 Bandar Lampung, located in a flood-prone area, such knowledge is crucial. Understanding the causes, warning signs, and consequences of flooding helps build proactive mitigation attitudes.

Studies show that sound flood disaster knowledge correlates positively with proper mitigation attitudes. Well-informed students are more likely to participate in evacuation drills, prepare emergency kits, and help maintain clean waterways. Efforts like seminars, simulations, and outreach programs at the school can improve this awareness. However, challenges remain, such as students perceiving floods as distant threats. This dismissive attitude can hinder mitigation efforts. Therefore, it is important to relate disaster education to students' daily lives and local experiences—such as past flood events near the school—to make the issue more relevant.

Besides theoretical knowledge, practical skills are also vital. Evacuation drills, first aid training, and emergency equipment use equip students to act during real emergencies. Collaborations with agencies like the Regional Disaster Management Agency (BPBD) can facilitate such training. First-hand experience not only builds understanding but also boosts students' confidence. In conclusion, flood disaster knowledge significantly influences Generation Z's mitigation attitudes at SMA Negeri 7 Bandar Lampung. However, its effectiveness depends on how the knowledge is conveyed and internalized. Relevant, practical, and continuous educational approaches are essential in developing a disaster-resilient youth generation.

3. The Relationship Between the Implementation of Project-Based Learning (PjBL) Through Flood Risk Mapping Projects and Flood Disaster Knowledge of Generation Z at SMA Negeri 7 Bandar Lampung

Based on hypothesis testing, it was found that there is a relationship between the implementation of the Project-Based Learning (PjBL) model through flood risk mapping projects and the flood disaster knowledge of Generation Z at SMA Negeri 7 Bandar Lampung. The results are supported by a path coefficient (Pzx) of 0.782 or 78.2%. This indicates a strong and positive relationship between the PjBL model and disaster knowledge. A positive relationship means that when the PjBL model is appropriately implemented, students' disaster knowledge increases.

These findings align with Sarwono (2016), who found that PjBL is effective in increasing students' knowledge of natural disasters in Indonesia during Geography classes at SMA Negeri 2 Surakarta. Similarly, Ferdinand S. Leuwol (2024) found that PBL significantly enhances students' understanding of disaster mitigation steps, such as risk identification, evacuation planning, and self-rescue. Students also showed improved collaboration skills in solving complex problems through group discussions and disaster simulations. These findings affirm that PBL is an effective approach in disaster education by integrating problem-based learning with practical experience, and it should be widely adopted to enhance youth disaster preparedness.

The implementation of PjBL through flood risk mapping projects at SMA Negeri 7 Bandar Lampung shows a strong and positive relationship with increased flood disaster knowledge among Generation Z. This suggests that project-based learning, which actively involves students in the process of creating risk maps, is effective in deepening their understanding of flood-related concepts. Generation Z, known as digital natives, respond better to interactive and hands-on learning approaches like PjBL. The mapping project allows them to apply theoretical knowledge in real-life contexts, improving information retention and comprehension.

The flood risk mapping project also develops essential skills such as data collection, spatial analysis, and cartography. Students learn to identify flood causes, collect field data, and use Geographic Information System (GIS) technology to create informative maps. This process enhances their knowledge of flood disasters and cultivates 21st-century skills, including problem-solving, teamwork, and communication. Active participation in this project increases students' awareness of disaster mitigation and community preparedness.

The positive correlation between PjBL implementation and improved disaster knowledge shows that the more actively students engage in mapping projects, the deeper their understanding becomes. PjBL provides real-world contexts for learning concepts like watersheds, rainfall, and topography, all of which contribute to flooding. By visualizing flood risks, students better understand the importance of preventive actions. The project also enhances their awareness of their roles as citizens in disaster mitigation efforts.

Implementing PjBL through flood risk mapping projects also boosts students' motivation to learn. It allows them to work collaboratively, express creativity, and produce meaningful outputs that benefit the community. Seeing the tangible impact of their work motivates students to engage more actively in learning. PjBL also builds students' confidence as they complete challenging, real-world projects.

In conclusion, the implementation of Project-Based Learning through flood risk mapping projects is proven effective in improving flood disaster knowledge among Generation Z at SMA Negeri 7 Bandar Lampung. This learning model offers active learning opportunities, fosters key skills, and increases student motivation. Therefore, PjBL can be an effective strategy for enhancing public awareness and preparedness for flood disasters, especially among the younger generation.

DISCUSSION

Based on hypothesis testing, it was found that the implementation of the Project-Based Learning (PjBL) model through a flood hazard map-making project had a significant effect on disaster mitigation attitudes among Generation Z students at SMAN 7 Bandar Lampung. The path coefficient value (Pyx) of 0.677 indicates that 67.7% of the variance in disaster mitigation attitudes can be

explained by the PjBL variable, while the remaining 32.3% is influenced by other factors not examined in this study.

This significant influence shows that the project-based learning approach not only enhances students' cognitive understanding but also strengthens the affective domain, particularly in the context of disaster awareness. This study specifically focused on how the implementation of the PjBL model—especially through the flood hazard map project—could foster greater awareness, concern, and disaster-mitigation attitudes among students regarding flood risks in their local environment.

These findings align with previous studies. Sarwono (2016) demonstrated that the Project-Based Learning model is effective in promoting environmentally conscious behavior among high school students in geography learning, particularly in the basic competency of disaster mitigation. Similarly, Sumarmi (2023) found that applying PjBL in outdoor learning significantly influenced students' environmental care attitudes, as evidenced by an independent sample t-test result with a significance value of 0.829—well above the 0.05 threshold.

Furthermore, this research is supported by the findings of Bertiliya, Sinaga, and Rahman (2024), who developed a project-based learning video integrated with Indonesian values. Their study revealed that the PjBL approach not only improved knowledge acquisition but also significantly impacted students' social and spiritual attitudes. Their learning product was deemed highly valid (Aiken's V: 0.928 for content), practical (teacher responses: 94.01%; student responses: 92.59%), and effective (students' attitude scores increased from 42.66% to 92.84%). These results affirm that PjBL is a pedagogical approach capable of facilitating meaningful learning that reaches into the realm of values and attitudes.

In the context of this study, students were not only introduced to theoretical disaster concepts but were also actively involved in collecting data, conducting spatial analysis, and producing a tangible output in the form of a flood hazard map. These activities enabled them to develop critical thinking, collaboration, problem-solving, and most importantly, disaster risk awareness.

The map-making project also encouraged students to deeply understand the geographical, hydrological, and socio-economic conditions of their surroundings. They learned to identify flood-causing factors such as high rainfall, low-lying topography, and limited water absorption areas. Additionally, they studied the impacts of flooding on communities, including infrastructure damage, economic losses, and health disruptions. This understanding fostered a heightened awareness of disaster risks and the importance of mitigation.

Through this flood hazard map project, students also learned about various flood mitigation efforts, both individual and collective. Generation Z students were introduced to the importance of environmental cleanliness, proper drainage systems, and the creation of water absorption areas. They also acquired

practical knowledge on actions to take during a flood, such as evacuation, first aid, and post-disaster recovery. This knowledge equips them with practical skills to protect themselves and their communities from flood impacts.

The implementation of PjBL in flood disaster mitigation learning also had a positive impact on students' attitudes toward disasters. They became more environmentally conscious and developed a sense of responsibility to protect themselves and their communities. They were also more proactive in seeking disaster-related information and participating in mitigation activities. This positive attitude is crucial in fostering a culture of disaster awareness among Generation Z.

Overall, the application of the Project-Based Learning model through the flood hazard map-making project has a significant positive impact on disaster mitigation attitudes among Generation Z at SMAN 7 Bandar Lampung. This learning model not only enhances students' knowledge and skills but also fosters positive attitudes and proactive behaviors in facing disasters. Therefore, PjBL can be considered an effective approach to improving disaster preparedness among the younger generation.

CONCLUSIONS

This study concludes that the implementation of the Project-Based Learning (PjBL) model through flood disaster risk mapping projects has a significant and positive impact on both the **disaster knowledge** and **disaster mitigation attitudes** of Generation Z students at SMA Negeri 7 Bandar Lampung. The findings demonstrate three key points:

1. **PjBL Enhances Mitigation Attitudes**: The PjBL approach significantly improves students' attitudes toward disaster mitigation by providing real-life, meaningful learning experiences. Through hands-on mapping projects, students develop greater awareness, responsibility, and readiness in facing flood disasters.
2. **Disaster Knowledge Influences Attitudes**: Students with higher levels of flood disaster knowledge show stronger mitigation attitudes. This highlights the importance of integrating accurate, practical, and locally relevant disaster education in schools to foster a proactive and prepared youth generation.
3. **PjBL Improves Disaster Knowledge**: The use of project-based flood mapping activities is highly effective in increasing students' understanding of the causes, impacts, and mitigation strategies related to floods. This method supports deeper learning and helps students connect theory with real-world application.

Overall, Project-Based Learning not only builds cognitive understanding but also cultivates critical thinking, collaboration, and responsible behavior—skills that are essential in preparing Generation Z to become active agents in disaster risk reduction. Therefore, educators and policymakers are encouraged to adopt and scale up PjBL in disaster education to strengthen community resilience, especially in disaster-prone areas like Bandar Lampung.

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