

Integrating Local Wisdom into Disaster Mitigation Education to Improve the Understanding of Disasters

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ABSTRACT

Indonesia is highly vulnerable to disasters, highlighting the need to strengthen disaster understanding through higher education. This study aims to analyze the improvement of students' disaster understanding through local wisdom-based learning in the Introduction to Earth Science and Disaster Mitigation course. A descriptive quantitative method with a one-group pretest-posttest design was used. The research subjects were sixth-semester students of the Physics Education Program in the 2024/2025 academic year. A multiple-choice test was used, covering conceptual understanding of disasters, local wisdom, and real-life application. Paired sample t-test results showed significant improvement in all three aspects: conceptual understanding increased from 70.34 to 85.05 (N-Gain = 0.50), local wisdom increased from 63.18 to 87.58 (N-Gain = 0.66), and application life increased from 71.32 to 92.40 (N-Gain = 0.74). These findings indicate that local wisdom-based learning is effective in strengthening students' scientific and contextual understanding of disasters, with moderate to high effectiveness based on N-Gain analysis.

Keywords: Local wisdom, disaster mitigation, understanding of disaster

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INTRODUCTION

Indonesia is one of the countries with a very high risk of natural disasters. Geographically, Indonesia is located at the meeting point of several major tectonic plates, namely the Eurasian, Indo-Australian, Pacific, and Philippine plates. This position places Indonesia within the Pacific Ring of Fire, resulting in high frequencies of earthquakes and volcanic eruptions across various regions (Morath et al., 2020). Additionally, steep topography, high rainfall, and widespread deforestation further increase the potential for hydrometeorological disasters such as floods and landslides, particularly in densely populated areas like Java and Kalimantan (Aeni & Khoirul Anwar, 2024). In addition to geographical factors and hydrometeorological conditions, massive deforestation in Java, Kalimantan, and Sumatra also contributes to the increased risk of disasters such as floods and landslides. In addition to geographical factors and hydrometeorological conditions, large-scale deforestation in Java, Kalimantan, and Sumatra also contributes to the increased risk of hydrometeorological disasters such as floods and landslides. Data from 2024 shows that Indonesia lost 261,575 hectares of forest cover, an increase of around 4,191 hectares compared to the previous year, with Kalimantan contributing the most at

129,896 hectares (Nusantara, 2025). The loss of forest cover, especially in upstream areas, has weakened the function of rainwater absorption and soil stability, thereby expanding the areas prone to landslides and floods in downstream areas (Putra et al., 2025).

According to the 2023 World Risk Report (Bündnis Entwicklung Hilft & IFHV, 2023), Indonesia ranks second highest in the world in terms of disaster risk index, with a score of 43.5 out of 100. This situation underscores the importance of strengthening disaster literacy, particularly through higher education, so that students, as future educators and leaders, have the awareness and capacity to mitigate and adapt to disasters. Higher education plays a strategic role not only in transferring scientific knowledge but also in fostering critical awareness and mitigative competencies among students regarding potential disasters in their environment (Patel et al., 2023). Although assessments of students' disaster mitigation knowledge indicate a good understanding of disaster mitigation principles (Fransiska Wantok & Noviana, 2022), risk management and disaster mitigation in higher education institutions remain very limited (Saputro & Nasrulloh, 2023). This is further reinforced by the lack of direct experience and the absence of learning approaches that link course content to the local conditions faced by communities (Ekaputri et al., 2024).

The problem of low correlation between theoretical understanding and practical application in disaster learning shows that disaster learning in higher education needs to be designed to be more applicable, interdisciplinary, and contextual. Education that focuses solely on cognitive aspects without considering the affective and psychomotor dimensions of students tends to fail in fostering a comprehensive awareness and responsive attitude toward disasters (Işık Mercan, 2022). This fact indicates that the current disaster education system still fails to equip students with reflective, empathetic, and solution-oriented skills when facing real disaster situations. Therefore, an approach is needed that can connect scientific knowledge with the social and cultural realities present in the students' surrounding environment (Gadeng et al., 2024).

One potential approach to bridging the gap between disaster theory and contextual application in the field is the integration of local wisdom into the disaster mitigation learning process (Musthofa & Indartono, 2020). Learning based on local wisdom provides students with the opportunity to understand disasters not only as scientific natural phenomena but also as social events closely tied to the culture and experiences of local communities (Anggara Putri et al., 2024; Ayub et al., 2021). Local wisdom can serve as a bridge to strengthen understanding of basic disaster concepts while fostering sensitivity to the socio-cultural context of affected communities (Kariadi et al., 2021). Therefore, the application of local wisdom-based learning in the Earth Science and Disaster Mitigation course is relevant and strategic. Through the integration of local values and practices that

have proven effective in dealing with disasters, students not only gain conceptual understanding of geosphere processes and disaster risks but also develop sensitivity to the socio-cultural dynamics of affected communities. Thus, this learning is expected to enhance students' holistic understanding of disaster management, both from scientific and cultural perspectives.

METHOD

This study is a pre-experimental study because it does not involve a control class as a comparison. The design used is a one-group pretest–posttest, in which one group of students is given a pretest before the treatment and a posttest after the treatment (Sugiyono, 2015). This type of research is descriptive quantitative, which aims to analyze the increase in students' understanding of disasters after participating in local wisdom-based learning. The study was conducted on students of the Physics Education Study Program at Sebelas Maret University who took the Introduction to Earth Science and Disaster Mitigation course in the even semester of the 2024/2025 academic year.

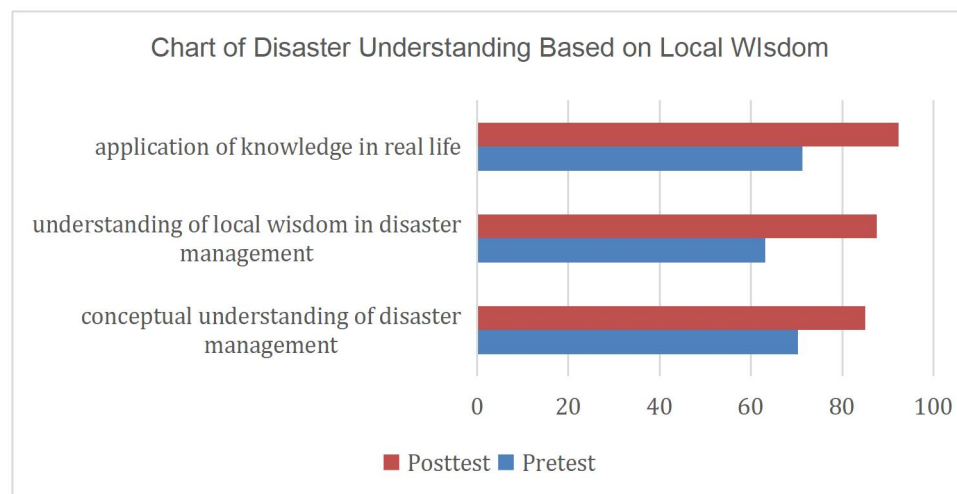
The research instrument was developed to measure three main aspects of disaster understanding, namely conceptual understanding of disasters, understanding of local wisdom in the context of disasters, and the ability to apply this knowledge in everyday life. The test items underwent a validation process before being used in the measurement. Learning was conducted by integrating disaster mitigation and local wisdom through group discussions and presentations. These activities were designed to help students understand disaster concepts within the cultural and social context of the surrounding community.

Data analysis was conducted to determine the increase in students' understanding of disasters after participating in local wisdom-based learning. The data were analyzed descriptively and inferentially. Descriptively, the increase was seen from the average pretest and posttest results, and calculated using the Normalized Gain (N-Gain) formula to assess the effectiveness of learning based on low, medium, or high categories (K. E. Lestari & Yudhanegara, 2018). Inferentially, a paired samples t-test was used to test the significance of the difference between pretest and posttest scores. Before the t-test was conducted, the data was first tested for normality using the Shapiro–Wilk test (Hanusz et al., 2016).

FINDING AND DISCUSSION

Disaster awareness is one of the important competencies that every individual must have, especially in disaster-prone countries such as Indonesia. Understanding disasters involves not only recognizing the types and characteristics of disasters but also the ability

to respond appropriately before, during, and after a disaster occurs. Disaster education in schools can be implemented through a contextual approach that combines knowledge, a caring and responsive attitude, and practical mitigation skills such as self-evacuation (Labudasari & Rochmah, 2020) . This indicates that disaster literacy must go beyond theory to include awareness and real-life preparedness. This is also supported by disaster education studies that emphasize that disaster literacy must include knowledge, awareness, and concrete actions (Tahmidaten et al., 2019) . Understanding disaster management also needs to consider aspects of local wisdom, where local wisdom functions as an empirical bridge that strengthens theoretical understanding. Local wisdom can be used as a contextual learning resource in disaster education because it contains relevant traditional practices that can be integrated into teaching materials (Febryani et al., 2024) . The integration of local wisdom in disaster education enables students to understand that disaster mitigation is not only based on modern science but also on the lived experiences of local communities. Research in Bali also demonstrates that local wisdom-based modules effectively enhance students' disaster literacy (Sumartika et al., 2025) . Therefore, the understanding of disaster management to be measured in the course Introduction to Earth Sciences and Disaster Mitigation encompasses three aspects: conceptual understanding of disaster management, understanding of local wisdom in disaster management, and the application of knowledge in real life.



Picture 1. Chart of Disaster Understanding Based on Local Wisdom

Based on the results of the pretest-posttest conducted before and after the implementation of local wisdom-based learning in the Introduction to Earth Science and Disaster Mitigation course, there was an increase in scores across all aspects of disaster understanding measured, namely conceptual knowledge, local wisdom, and real-life application. The use of local wisdom reflects local knowledge, policy, and community intelligence that contextually enhances students' disaster mitigation understanding (Putri et al., 2022) . The application of local wisdom-based learning is also able to shape

students' preparedness in facing disaster risks through the strengthening of adaptive values sourced from community traditions and experiences (Mustofa, 2020).

Students' average score in conceptual understanding increased from 70.34 in the pretest to 85.05 in the posttest after participating in local wisdom-based learning. Based on this increase, the N-Gain score was calculated to be 0.50, which is categorized as medium. The paired sample t-test confirmed this increase as statistically significant, indicating that local wisdom-based learning has a real impact on strengthening students' conceptual foundation. This aligns with findings that local wisdom-based learning is effective in strengthening students' understanding of disaster concepts (W. Lestari et al., 2025). This improvement specifically occurred in the conceptual knowledge domain, which includes mastery of disaster terminology, understanding of mitigation principles, and the ability to connect disaster theory with local phenomena. This indicates that learning based on local wisdom specifically strengthens the conceptual foundation of disaster management effectively (Alfi, 2019). Thus, the integration of local wisdom into learning has proven to be an effective strategy in strengthening students' conceptual understanding of disaster management.

In the aspect of understanding local wisdom, the average score increased from 63.18 in the pretest to 87.58 in the posttest after participating in local wisdom-based learning. The corresponding N-Gain score was 0.66, indicating a medium level of effectiveness. The pretest and posttest results were then subjected to a paired sample t-test, which revealed a significant difference. This indicates that learning that emphasizes local values and practices successfully deepened students' understanding of local wisdom in the context of disasters. Through local wisdom-based learning, students not only learn technical terms but also understand how local communities manage disaster risks through traditions, rituals, and daily lifestyles. Knowledge derived from local wisdom is passed down through generations and used as a disaster mitigation strategy rooted in local culture (Maharani et al., 2019). A concrete example of educational local wisdom is evident in the structure of traditional stilt houses across various regions in Indonesia, which teach communities and students about the importance of earthquake-resistant buildings as a form of adaptation to disaster risks (Hastuti & Sadeli, 2024).

The average score of students in the aspect of applying knowledge in real life increased from 71.32 in the pretest to 92.40 in the posttest after participating in local wisdom-based learning. This resulted in an N-Gain score of 0.74, which falls into the high category of learning effectiveness. The pretest and posttest results were then subjected to a paired sample t-test, which showed a significant difference. This improvement indicates that learning that links disaster concepts with local values encourages students to better understand and analyze real-life situations related to

disasters. The implementation of disaster-based learning rooted in local wisdom can strengthen preparedness character, which in turn contributes to reducing the impact when disasters occur (Mustofa, 2020) . By embedding cultural values into learning, students develop both cognitive skills and social responsibility, contributing to a sustainable disaster-aware mindset (Hidayat & Yatminiwati, 2023).

The significant improvement in the three aspects of disaster understanding shows that the integration of local wisdom is not only symbolic, but also has real pedagogical power. Learning strategies that highlight local wisdom can facilitate connections between scientific knowledge and real-life experiences (Atmojo et al., 2018). This aligns with the principles of constructivist learning, where learners construct meaning through the interaction between new concepts and prior knowledge, in this case through an understanding of local culture that they have either directly experienced or indirectly encountered. Contextualizing material through local wisdom also enriches the affective dimension of learning (Karmini et al., 2024). Students demonstrate increased awareness of the role of cultural values and ancestral practices in maintaining ecological balance, as well as the importance of sustaining such practices in mitigating contemporary disasters. This reflects that contextually designed learning can foster positive values and attitudes toward environmental conservation and community-based disaster preparedness.

Local wisdom-based learning contributes to fostering students' reflective competencies, as the inquiry process integrated with local values encourages students to think critically and evaluate the relevance of cultural practices to current disaster challenges (Hunaepi et al., 2020). Through learning, students discuss how local wisdom practices can be combined with modern technology or government policies. This opens up space for a transdisciplinary approach in disaster education that integrates natural sciences, social sciences, culture, and public policy. Learning based on local wisdom has proven not only effective in enhancing cognitive understanding but also capable of fostering a disaster-resilient mindset rooted in empathy, local values, and critical thinking. This success serves as a crucial foundation for further development through interdisciplinary collaboration and cross-sectoral approaches in higher education curricula in disaster-prone regions.

CONCLUSIONS

Indonesia is a country with a very high level of disaster vulnerability due to geographical, hydrometeorological, and massive environmental degradation factors. This condition requires strengthening the understanding of disasters through higher education that emphasizes not only cognitive aspects but also the affective and applicative dimensions of students. Research findings indicate that integrating local wisdom into

disaster mitigation education in the course “Introduction to Earth Sciences and Disaster Mitigation” significantly enhances students' disaster risk understanding, encompassing three key aspects: conceptual understanding of disaster risk, understanding of local wisdom in disaster risk, and the application of knowledge in real-life situations.

The improvement in scores across these three aspects is supported by the results of a paired sample t-test, which showed significant differences between pretest and posttest scores. This demonstrates that learning based on local wisdom has a tangible impact on strengthening students' understanding of both scientific concepts and local cultural values relevant to disaster mitigation. Students not only gain knowledge about disasters but also understand locally-based mitigative practices passed down through generations by the community. Overall, the research findings indicate that learning based on local wisdom is a relevant and contextual strategy in disaster education at the university level.

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