
Research Article

Design and Development of Disaster Mitigation–Based Geography Teaching Modules in the Implementation of the Merdeka Curriculum at Senior High Schools in Ambon City

Dewilna Helmi ^{1*}, Yossepus A Hallatu ²

¹⁻² Pendidikan Geografi, Universitas Pattimura, Indonesia

* Corresponding Author: email : dewilnahelmi@gmail.com

Abstract: Indonesia's position along the Pacific Ring of Fire makes it highly vulnerable to natural disasters, highlighting the urgent need to integrate disaster mitigation into school learning. Geography, as a discipline that examines Earth's physical and human phenomena, holds strategic potential for strengthening students' disaster awareness and preparedness, especially in high-risk regions such as Ambon. The Merdeka Curriculum provides instructional flexibility that enables the incorporation of disaster-related themes into learning processes. This study aims to design and develop a disaster-mitigation-based geography teaching module for senior high schools in Ambon City. A qualitative case study approach was employed, involving classroom observations, in-depth interviews, and document analysis to explore existing teaching practices and needs. The study produced a comprehensive design for a disaster-mitigation-integrated geography module. The findings demonstrate that integrating disaster mitigation into geography learning through a structured module enhances the relevance, applicability, and effectiveness of instruction. This research contributes to strengthening disaster-responsive geography education within the Merdeka Curriculum and supports efforts to improve student preparedness in disaster-prone areas.

Keywords: Design; Disaster Mitigation; Geography Learning; Integration; Merdeka Curriculum.

Received: August 01, 2025

Revised: August 15, 2025

Accepted: August 30, 2025

Published: August 31, 2025

Curr. Ver.: August 31, 2025



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1. Introduction

Indonesia is recognized as one of the countries with the highest levels of disaster risk, experiencing frequent earthquakes, tsunamis, volcanic eruptions, floods, and landslides (Wahyudi, 2021). Its geographical position at the convergence of three major tectonic plates and within the Pacific Ring of Fire makes the nation highly susceptible to intense seismic and volcanic activities (Sutarto, 2018). This condition requires strong disaster awareness and preparedness among communities to reduce risks and impacts (National Disaster Management Agency, 2020). Ambon City, located in the Maluku region, is no exception; it frequently experiences various natural disasters that cause significant material losses and casualties. For this reason, disaster mitigation efforts are crucial to minimize these impacts.

Education plays a central role in fostering disaster awareness and preparedness. Geography, as a discipline that examines physical and human phenomena on Earth, provides essential conceptual and spatial understanding related to natural hazards (Yulianto, 2017). Through geography learning, students gain knowledge about different types of disasters, their causes, and strategies for reducing risks and impacts. This makes geography a strategic subject for integrating disaster mitigation content, especially in disaster-prone regions such as Ambon.

The Merdeka Curriculum, as Indonesia's latest national curriculum, provides greater flexibility for schools to design contextual and relevant learning materials. This creates opportunities to integrate disaster mitigation into geography learning at the senior high school level. Previous studies emphasize that interactive and participatory learning—such as disaster simulations, field projects, and collaboration with relevant institutions—can enhance collective disaster preparedness (Wahyudi, 2021). Strengthening disaster responsiveness at the school level is expected to extend its impact to the wider community.

Integrating disaster mitigation into geography learning requires systematic instructional planning. Instructional design is a strategic process aimed at creating effective learning experiences (Gagné et al., 1981). This includes setting clear learning objectives, selecting relevant content, identifying learning resources, and determining appropriate teaching strategies. These must be aligned with curriculum standards and learning needs through SMART objectives and resource selection (Nasution, 2017). Teachers then prepare detailed teaching modules containing learning steps, strategies, and assessments such as tests, observations, and portfolios (Putro & Nidhom, 2021). Flexibility and adaptation are essential to ensure the teaching plan remains responsive to classroom dynamics.

Geography learning itself promotes deep understanding of natural and social phenomena, spatial relationships, and environmental interactions. It employs various methods such as field observation, statistical analysis, and the use of Geographic Information Systems (GIS) to support critical, analytical, and synthetic thinking (Sumaatmadja, 2001). Disaster mitigation, therefore, can be meaningfully embedded within relevant subtopics of geography to provide contextual and practical learning experiences.

In alignment with the research roadmap of the Faculty of Teacher Training and Education at Pattimura University—particularly the emphasis on using environmental resources as learning materials, media, and sources—the integration of disaster mitigation into geography learning is highly relevant. The Merdeka Curriculum encourages participatory learning that reflects the geographic characteristics of Maluku as a region defined by islands and marine environments. Contextual learning allows students to directly apply disaster-related knowledge in their own environmental settings, making the learning experience more meaningful and impactful.

Based on this rationale, this study aims to design an instructional model and develop a disaster-mitigation-based geography teaching module adapted to the environmental characteristics and educational needs of senior high schools in Ambon City.

2. Methods

This study aims to explore and understand how disaster mitigation can be integrated into geography learning within the Merdeka Curriculum. A research design essentially serves as a strategy to achieve predetermined research objectives and functions as a guide for researchers throughout the research process (Sujarweni, 2014:41). The research method employed is a qualitative.

This study employed a qualitative case study design to explore how disaster mitigation is integrated into geography learning within the Merdeka Curriculum. The research was conducted at SMA 3 Ambon and SMA Xaverius, selected through purposive sampling as pilot schools for the Merdeka Curriculum. Participants included geography teachers, students, school principals, curriculum developers, geography experts, and other relevant stakeholders. Data were collected through semi-structured interviews, classroom observations, and document analysis of curriculum materials, teaching modules, and lesson plans.

The collected data were analyzed using thematic analysis, which consisted of transcription, coding, identification of themes, and interpretation. To ensure the credibility and reliability of the findings, triangulation was applied by comparing data across interviews, observations, and documentation. Member checking was conducted by inviting participants to validate interview transcripts and preliminary interpretations, while peer debriefing with fellow researchers provided additional perspectives to strengthen the analytical process.

3. Results and Discussion

This study is based on two objectives, namely the design of disaster integration in learning, which consists of a curriculum analysis of the geography subject area and the design of a teaching module integrated with disaster mitigation. The second objective is the integration of disaster mitigation into geography learning within the Merdeka Curriculum. The implementation program for active learning, which uses projects and problem-based learning by integrating disaster mitigation in accordance with the implementation of the Merdeka Curriculum in public senior high schools (SMA Negeri) in Ambon City, is carried out based on established guidelines.

Based on the curriculum analysis of the Geography subject at the senior high school level, it is evident that disaster mitigation content can be incorporated into the majority of the subject matter and learning outcomes. According to a needs assessment conducted with school principals, teachers, and stakeholders, a significant portion of the curriculum content is suitable for integrating disaster mitigation—indeed, all topics can be integrated with disaster mitigation. The specific topics are as follows:

Integration of Disaster Mitigation in Geography Education (Grades 10–12)

10 Semester 1

Basic geography concepts are integrated with disaster mitigation through: understanding types of disasters based on geographic phenomena, case studies of disasters in Indonesia, community-based preparedness approaches, and the role of climate and weather. In mapping, students learn to read and create risk maps, evacuation routes, and apply mapping technologies. The topic “Earth as a Living Space” connects Earth’s layers, landforms, the water cycle, and ecosystems (e.g., forests and mangroves) with disaster risks. Scientific geographic research methods are applied to analyze disaster risks.

Grade 10 Semester 2

Lithosphere dynamics are linked to earthquakes, volcanic eruptions, tsunamis, landslides, and their mitigation. Atmospheric dynamics cover mitigation of extreme weather events such as floods, droughts, storms, and haze. Hydrosphere dynamics address floods, tsunamis, coastal erosion, tidal flooding (rob), and watershed management as mitigation strategies, including the use of environmental monitoring technology.

Grade 11 Semester 1

The topic “Indonesia’s Strategic Position” connects its rich natural resources with vulnerability to disasters (e.g., the Pacific Ring of Fire, forest fires, coastal erosion). “Biodiversity” emphasizes the protective role of natural ecosystems—forests, mangroves, coral reefs—in reducing disaster risk, highlighting the importance of conservation.

Grade 11 Semester 2

“Environment and Population” explores the links between population density, environmental degradation, and disaster risk, stressing the need for disaster preparedness education. The dedicated unit “Disaster Mitigation and Adaptation” covers core concepts, risk management phases, early warning systems, government-community roles, disaster-resilient culture, and school-based evacuation drills.

Grade 12 (Semesters 1 & 2)

“Regional Development and Spatial Planning” emphasizes planning that integrates mitigation to enhance safety, sustainability, and community well-being. “Regional Development, Industrial Revolution, and Their Impact on Earth’s Surface” links urbanization, industrialization, and climate change to increased disaster risk, advocating for sustainable development. “International Cooperation and Its Impact on Indonesia’s Regional Resilience” highlights the role of international aid, technology transfer, joint research, and capacity-building in strengthening national disaster resilience.

The development of a geography teaching module based on disaster mitigation within the implementation of the Merdeka Curriculum in Ambon City demonstrates that the integration of disaster-related content into core geography topics is not only relevant but also strategic and transformative. Research findings reveal that the entire scope of geography material from Grades 10 to 12—from Basic Geographic Knowledge to Dynamics of International Cooperation—can be organically linked to disaster mitigation and adaptation concepts through a progressive, sequenced, and contextually grounded approach aligned with local conditions.

First, this integration strengthens the construction of meaningful geographic knowledge. As emphasized by Fauzi et al. (2024) and Yuliastuti & Kurniawan (2025), geography instruction disconnected from local realities tends to remain abstract and fails to foster spatial awareness. In Ambon—a city located within the Pacific Ring of Fire with a history of strong earthquakes (2019), local tsunamis (1950), and high vulnerability to floods and landslides—the use of local case studies (e.g., analyzing liquefaction zones after the 2019 earthquake or mapping landslide risks on Mount Nona) transforms concepts like the lithosphere, hydrosphere, and spatial planning from theoretical constructs into matters directly tied to students' and communities' safety. This aligns with the principles of *place-based education* (Gruenewald, 2003, cited in Novianti & Wijaya, 2023), which asserts that learning is most effective when rooted in students' real-world environments.

Second, the developed module consistently positions students as active agents of mitigation rather than passive recipients of information. Strategies such as school-based risk mapping projects, map-based evacuation simulations, and the formulation of sustainable spatial planning recommendations reflect the application of project-based learning (PjBL), in line with the Merdeka Curriculum's emphasis on differentiated, student-centered, and project-based learning (Kemendikbudristek, 2022; OECD, 2023). Fitriani & Hadi (2021) found that students' spatial literacy and disaster awareness significantly improve when they participate in local risk mapping using basic GIS tools. This is evident in the module through activities like creating evacuation route maps (Grade 10, Mapping) and analyzing watersheds for flood mitigation (Grade 11, Hydrosphere Dynamics), which integratively develop cognitive (analysis), psychomotor (mapping), and affective (social responsibility) skills.

Third, the module demonstrates strong synergy among disaster literacy, geographic literacy, and digital literacy. The use of technology—from the InaRISK application to Google Earth and QGIS Edu—not only enhances student engagement but also prepares them for the era of spatial data. Pratiwi & Wicaksono (2022) affirm that student participation in *citizen science mapping* strengthens community capacity in disaster risk reduction. In this module, technology is not an add-on but an enabler embedded in every thematic unit: monitoring the lithosphere (via GPS/seismographs), climate modeling (using BMKG data), and international collaboration (through platforms like the ASEAN Coordinating Centre for Humanitarian Assistance—AHA Centre), as integrated into the International Cooperation unit (Grade 12).

Fourth, strong local contextualization permeates the module, particularly in topics related to ecosystems and local wisdom. The integration of mangroves in tsunami mitigation, protective forests in landslide prevention, and traditional Maluku knowledge (such as the *pelagandong* social system in disaster response) renders the module not only scientific but also culturally and emotionally resonant. Harefa et al. (2022) observed that coastal students in Ambon respond more effectively to mitigation simulations when linked to local ecological signs (e.g., natural precursors to earthquakes). This aligns with the principles of *Education for Sustainable Development* (ESD), wherein disaster resilience is understood as integral to socio-ecological sustainability (UNDRR & UNESCO, 2021).

Nevertheless, this study also faces challenges. First, limited infrastructure and teacher capacity remain major barriers to fully implementing the technology-based module (Mulyadi & Rahmawati, 2021). Second, although the module is designed progressively, mitigation competence assessment lacks standardized instruments—relying instead on project evaluations and observation rather than validated tools based on a *disaster resilience competence framework*. Third, engagement with external stakeholders (e.g., Ambon City Disaster Management Agency/BPBD, Ambon BMKG Station, and volunteers) remains incidental and has not yet been institutionalized as a structural component of the learning process.

4. Conclusion

The disaster mitigation-based geography teaching module developed for the Merdeka Curriculum in Ambon City effectively bridges academic geography with real-world disaster resilience. It transforms abstract geographical concepts into actionable, locally relevant knowledge while fostering students' critical thinking, spatial literacy, digital competence, and civic responsibility. By embedding place-based, project-based, and culturally responsive approaches, the module exemplifies how curriculum innovation can contribute to safer, more resilient communities.

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