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Learning Model Development of Disaster Mitigation for Elementary School Students at Lombok, Indonesia

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Abstract: A research study conducted in Lombok Island, Indonesia, developed a learning model for disaster mitigation for elementary school students. The model is based on a scientific approach and incorporates knowledge about natural disasters, their causes, and effects. Students are taught how to identify and respond to warning signs of a disaster, and the importance of being prepared for one. The study found that the learning model was effective in increasing students' knowledge, skills, and attitudes about disaster mitigation. Students who participated in the study were better able to identify the warning signs of a disaster and take appropriate action, as well as express a greater sense of preparedness for a disaster. The learning model can be used to educate elementary school students about disaster mitigation in other regions prone to natural disasters. Teachers can use various resources to teach students about natural disasters, provide opportunities for practice identifying warning signs and responding to disasters through role-playing exercises, and help students develop a sense of preparedness by discussing the importance of having a disaster plan and practicing what to do in the event of a disaster. By incorporating the learning model into their curriculum, teachers can ensure that their students are prepared to face the challenges of natural disasters.

Keywords: Disaster Mitigation; Elementary Students; Learning Model; Lombok Island.

Introduction

Indonesia is the only country in the world with a bottomless inter-island sea between two archipelago arcs, namely the Banda Sea (more than 5,000 meters) and the Weber Trench (more than 7,000 meters). Two major volcanic paths in the world and several mountain paths in the world's folds meet one another in Indonesia. The tectonic activity of these three plates has made Indonesia a disaster-prone area (BNPB, 2016).

Indonesia's position is on the meeting point of 3 tectonic plates, namely the Indo-Australian Plate, the Eurasian Plate, and the Pacific Plate, so it is an area prone to earthquakes. Indonesia is located in the ring of the fire zone, which causes the area to be very vulnerable to earthquakes and mount eruptions. The events of earthquakes and eruptions that historically have often occurred in the territory of Indonesia need to be studied well, as the understanding of impact and characteristics of each event is important for recovery and reconstruction process, disaster mitigation, and disaster education efforts (Ramdani,2019).

Based on the Indonesian Disaster Information Data, the trend of disaster events has fluctuated in the last decade and increased in the last four years (Figure 1). As many as 3,814 disasters occurred in 2019, with 478 people dead, 111 people missing, 3,421 injured, and 6.1 million affected or displaced.

Lombok is an island in West Nusa Tenggara Province in Indonesia. The island consists of four districts: West Lombok, North Lombok, Central Lombok, and East Lombok. It has a total area of 4.725 square kilometers and is roughly circular (Horwath HTL, 2017). Lombok Island is an island in the southern part of Indonesian Archipelago, a neighbour to Bali Island in the east side. Geologically, it is situated between Flores Thrust in the north and Java trench in the south, which is the subduction zone between two major plates of India-Australia and Eurasia which caused this area to be vulnerable to earthquakes (Figure 2).

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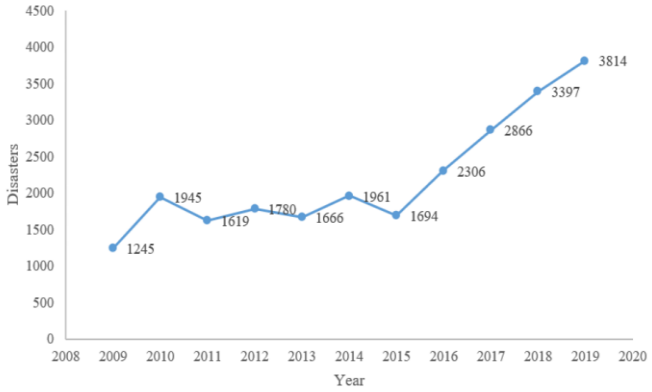

Figure 1. Trends of disasters in the last decade

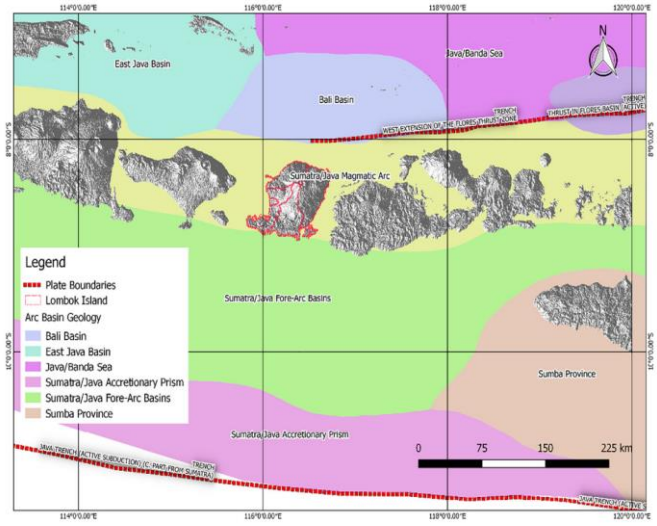

Figure 2. Geologic setting of Lombok Island

Lombok Island is a seismically active region, overlaid with significant earthquake as in figure 3. Residents living here must always be aware of the sudden danger of earthquakes. Earthquakes are a natural disaster that can cause significant damage and loss of life. Therefore, it's crucial to know how to stay safe during an earthquake. Figure 3 shows some of the major earthquakes in the area, collected from National Centers for Environmental Information (NCEI) of the National Oceanic and Atmospheric Administration (NOAA) earthquake database, in the last 40 years (NCEI, 2018). We can evaluate from the figure 2, most of the earthquakes occurred in the northern part of the island. The 6.9 magnitude earthquake that occurred on August 5, 2018 has a hypocenter depth of 34 km, with location coordinate of 8.258°S 116.438°E (USGS, 2018). USGS reported, the cause of the earthquake was a shallow thrust fault at or near the Flores Back Arc Thrust. The initial focus mechanism for earthquakes shows that slip occurs in one of the south sloping thrust faults, or in steep northern inclined faults (USGR, 2018).

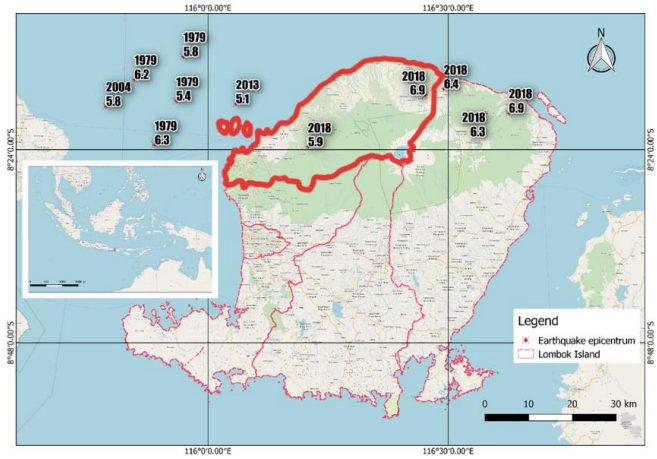

Figure 3. Lombok Island overlaid with significant earthquake database derived from NCEI of NOAA

On 5 August 2018, a magnitude seven earthquake struck Lombok, West Nusa Tenggara Province, Indonesia with a depth of 32 kilometers after a series of earthquakes in early July 2018 with a strength of 6.9 SR. According to the Head of the Regional Disaster Management Agency (BPBD) of West Nusa Tenggara Province, the loss due to the earthquake reached 1 trillion IDR. Then, according to the National Disaster Management Agency (BNPB), the number of victims of the earthquake was >100 people, with 238 people injured, thousands of homes damaged, and tens of thousands becoming refugees (Antara, 2018). The 2018 earthquakes experienced a drastic increase of 4,648 tectonic earthquake events from the previous year (Umasugi, 2018).

The earthquake on Lombok Island, West Nusa Tenggara, was one of the worst earthquakes in 2018 (Widowati, 2019). This event has a unique and successive occurrence that causes various impacts. After the first earthquake occurred, several aftershocks were of even greater strength. There were several large earthquakes within a short period, namely on July 29 with a magnitude of 6.4 Mw; August 5 with a magnitude of 7 Mw; August 9 with a magnitude of 5.9 Mw; August 19 occurred two earthquakes measuring 6.3 Mw and 7 Mw; and August 25 with a magnitude of 5.5 Mw. The BMKG recorded that of the entire Lombok earthquakes in 2018, six earthquakes with a magnitude of more than 5.5 Mw and a total of 2,000 earthquakes, both felt and not felt (Zulfakriza, 2018).

The devastating experience starkly exposed the vulnerability of life in Lombok's earthquake-prone paradise. This prompted a fervent need for better disaster preparedness, especially in elementary schools, where young minds lacked the tools to face nature's fury.

Driven by the tragedy, a dedicated research project produced a comprehensive program empowering

Lombok's elementary school students. This program teaches earthquake and tsunami science, enabling students to recognize early warnings and become more disaster-resilient. Knowledge is fortified with action. The program empowers students with disaster preparedness kits and clear survival guides, instilling confidence in evacuation, hazard awareness, and the resilience to rebuild homes and lives.

Resilience is needed by students who live in disaster-prone areas. With strong resilience, students can implement disaster mitigation (Dwiningrum, 2020). Syahrial, A. (2022) proposed a prototype of disaster mitigation education curriculum to produce Indonesian people who are aware and prepared for disasters through strengthening integrated attitudes, skills and knowledge. In general, the prototype of disaster mitigation education curriculum can be seen in Figure 4.

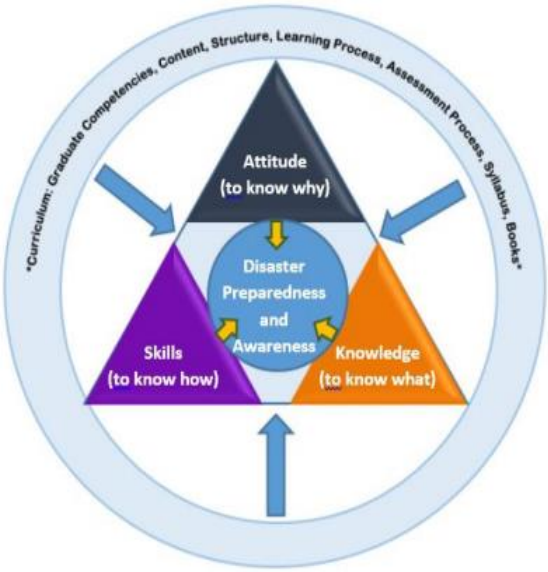

Figure 4. Overview of the Disaster Mitigation Curriculum Prototype

This program's significance transcends the confines of academic exercise; it represents a critical lifeline woven into the very tapestry of Lombok's social fabric. Its reach extends far beyond the classroom walls, empowering not just the students it directly serves but also their families, neighbors, and indeed, the entire island. In a region where the specter of disaster casts a perpetual shadow, preparedness emerges as the fundamental currency, its value surpassing all others

Method

This research is a development research that uses the research and development (R&D) method. The flow chart is presented on figure 5. The product developed in this research is a disaster mitigation education curriculum used in disaster education in elementary schools. The research and development (R&D) in this study was developed in accordance with the ten stages, namely.

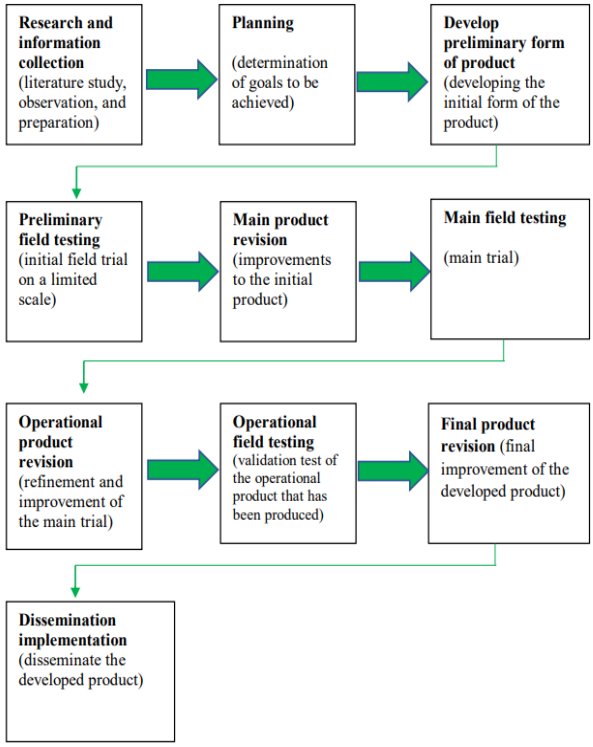

Figure 5. Research Flow Chart

The research was conducted at SDN 23 Cakranegara. The sample was 15 teachers at SDN 23 Cakranegara. These teachers received a trial of the implementation of the developed disaster mitigation education. The research data were expert validation data and data on the ability to face disaster threats.

To ensure the program's effectiveness, it went through various checks: a) Expert review: Three lecturers evaluated the curriculum, disaster kit, and teaching materials for accuracy and usefulness; b) Small-scale trial: Teachers tested the disaster awareness quiz to assess its clarity, difficulty, and effectiveness; c)Pre and post-tests: Students took tests before and after the program to measure their understanding of disaster preparedness. By following these steps, the researchers ensured the program's quality and its readiness for wider implementation.

Result and Discussion

The Disaster Mitigation Curriculum is a curriculum that can produce Indonesian people who are aware and prepared for disasters through strengthening integrated knowledge, skills, and attitudes.

Knowledge (to know what), namely basic knowledge about disasters, signs of disasters, risk impacts and efforts to reduce, disaster mitigation learning structures, local wisdom, first aid tools for victims. Skills (to know how), namely know how to teach it (Disaster Mitigation Learning model), to know how to treat victims (First Aid Procedures for Victims), to know how to prepare for disasters (Preparedness). Attitude (to know why), namely disaster mitigation. Mitigation is an effort that has a number of objectives, namely to recognize risks, awareness of disaster risks, planning for countermeasures, and so on. It can be said, disaster mitigation is all efforts ranging from prevention before a disaster occurs to handling after a disaster occurs.

Disasters can be divided into three, namely Natural Disasters, Non-Natural, Disasters and Social Disasters. Natural disasters such as earthquakes, tsunamis, landslides, floods, tornadoes, drought, volcanic eruptions. Non-natural disasters such as disease outbreaks, technological failures. Social disasters such as social conflict, war, acts of terror, sabotage.

The Graduate Competency Standards of the disaster mitigation education curriculum have the qualifications of knowledge, skills and attitudes, as in the Table 1.

Table 1. Disaster education curriculum

Graduate Competency Standards	Indicators
Knowledge	Have basic knowledge about disaster, signs of disaster, disaster impacts, risks and efforts to reduce the consequences of disasters, culture in the community about disasters, first aid tools for disaster victims and disaster mitigation learning structures.
Skills	Having the ability to act effectively and creatively in the concrete realm to anticipate disasters through organization and through appropriate and effective steps. Have the ability to teach disaster with student-oriented learning and have the ability to perform first aid on disaster victims.
Attitude	Having a disaster-aware and alert behavior to reduce disaster risk through awareness in increasing the ability to face disasters.

Graduate Competency Standards form the basis for the development of Core Competencies, Basic Competencies and Indicators, as in the Table 2.

Table 2. Competencies in disaster education

Core competencies		Basic Competencies		Indicators	
1	Demonstrate tsunami disaster preparedness	1.1	Make a tsunami self-rescue evacuation map.	1	Identify vulnerable areas during a tsunami at school
		1.2	Perform self-rescue based on the tsunami evacuation map	2	Identifying potentially vulnerable areas during a tsunami at home
				3	Identify potentially vulnerable places where tsunamis could occur in the neighbourhood
				4	Identify places that are safe from tsunami hazards
				5	Showing the cardinal directions at school
				6	Skillfully make a self-rescue evacuation map
				7	Skillfully use the self-rescue map

The subjects provided and developed in the disaster mitigation education curriculum are as in the following Table 3.

Disaster awareness in this study, including disaster knowledge (PK), signs of disaster (TB), risk impacts and efforts to reduce (DR), preparedness (KN), and procedures, first aid tools for victims (AP). The initial test questions covered the 5 disaster awareness knowledge and skills described above. Questions that have met the requirements are used to measure students' initial abilities. After the initial test was conducted, learning was then carried out using disaster mitigation box props for 5 meetings. The five meetings were 1) PK, 2) TB, 3) DR, 4) KS, and 5) AP. The final test was conducted on the sixth meeting using the corrected lay test questions. The results of the initial and final tests are shown in Figure 6.

Table 3. Subjects in the disaster mitigation curriculum

Units	Description	Learning Hours
1	Understanding Disaster(concepts of Disaster, Hazard, Vulnerability, Risk, Capacity)	2
2	Types and Characteristics of Disaster threats	2
3	Disaster impact and Disaster Risk Reduction	2
4	Disaster Management	2
5	Disaster Risk Assessment	2
6	Disaster risk communication and policy	2
7	Disaster Mitigation	2
8	Disaster Preparedness	2
9	Disaster Emergency Response	2
10	Post-disaster rehabilitation and reconstruction	2
11	Education, technology research and disaster data	2
12	Stakeholders and disaster management funding	2
13	Resilience of cities, tourism areas, cultural heritage to disasters	2
14	Thoughts on disaster insurance	2

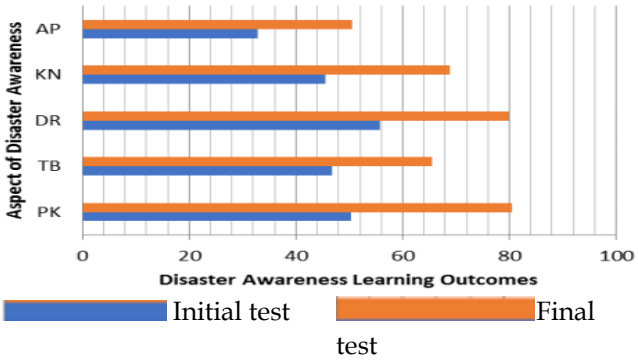

Figure 6. Initial and Final Test of Disaster Awareness Learning Outcomes

As shown in Figure 6, the post-test results are higher than the pre-test results for all measured aspects. Table 4 provides valuable insights into the differential impact of the program on various learning domains. It shows that the ability to face disasters in SD N 23 Cakranegara is classified as moderate and low in first aid for disaster victims.

Table 4. Data Gain Score Disaster Preparedness for each aspects

AKB	Pre-Test	Post-Test	Gain Score	Criteria
PK	50.25	80.61	0.61	Moderate
TB	46.78	65.63	0.35	Moderate
DR	55.64	79.85	0.55	Moderate
KN	45.52	68.76	0.43	Moderate
AP	32.76	50.52	0.26	Low

Figure 7 shows Students' responses to learning with disaster mitigation box props, It was 83.5% students stated that they were happy, 73.6% students stated that it was easy to understand and 81.43% stated that it was useful.

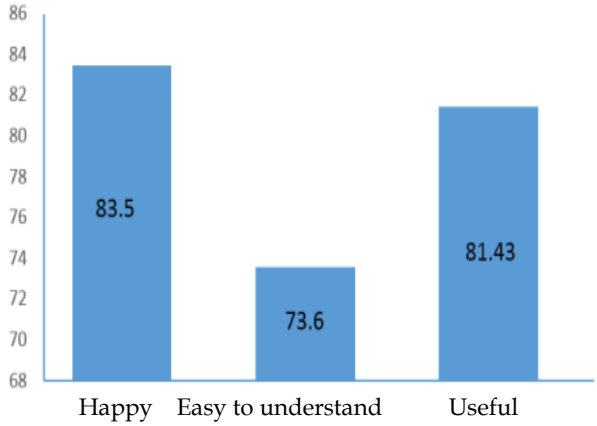

Figure 7. Histogram Student Response to Learning with Disaster Mitigation Box

Conclusion

The results of the study obtained 5 main ideas about the implementation of the landslide disaster mitigation learning model, namely 1) conditioning students to face natural disasters in the learning process, 2) teachers must have the right steps in providing an understanding of natural disasters and conducting direct demonstrations so that students understand carefully, 3) teachers must have knowledge of earthquakes, tsunamis, landslides, floods, hurricanes and volcanoes, 4) teachers provide examples of disaster mitigation learning to students using tools such as videos, disaster mitigation tools and others, 5) understanding risk/hazard, vulnerability (weakness), threat and capability/strength of landslide disaster.

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Author Contributions
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Conflicts of Interest
The authors declare no conflict of interest

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