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ANALYSIS OF THE IMPACT OF EARTHQUAKE DISASTER PREPAREDNESS ON STUDENTS OF MUHAMMADIYAH 1 BAMBANGLIPURO JUNIOR HIGH SCHOOL USING SIMULATION METHODS

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Abstract

Objective: This study aims to determine the impact of earthquake simulations on the preparedness level of students at Muhammadiyah 1 Bambanglipuro Junior High School. Indonesia is a country prone to various natural disasters, including earthquakes. One of the most devastating earthquakes in the country occurred in Yogyakarta in 2006, with a magnitude of 5.9 on the Richter scale, resulting in 4,659 fatalities, with the highest number of victims recorded in Bantul Regency. Preparedness is a crucial component of proactive disaster management, which must be established before a disaster occurs.
Method: This study employed a quantitative research approach using a pre-experimental method. The research design utilized was a one-group pretest-posttest design. A total of 144 students participated, comprising 28 seventh-grade, 54 eighth-grade, and 62 ninth-grade students, selected from a population of 217 students. The sample was obtained using random sampling techniques.
Results: Before participating in the earthquake disaster simulation, 61.1% of students were classified as "prepared." Following the simulation, the level of preparedness increased, with 42.2% of students classified as "very prepared" and 57.6% as "prepared." The Wilcoxon non-parametric statistical test yielded a p-value of 0.000, indicating a significant effect of the simulation on students' preparedness levels.

Keywords: earthquake; preparedness; simulation

INTRODUCTION

Indonesia is located at the convergence of three major tectonic plates: the Indo-Australian, Eurasian, and Pacific plates. This geographical positioning makes the country highly vulnerable to natural disasters, including earthquakes (Suardana & Made, 2021). One of the disasters that often occur in Indonesia is earthquakes (Sakdiah., 2019). According to the Meteorology, Climatology, and Geophysics Agency (BMKG), Indonesia is an earthquake-prone region, where earthquakes can occur at any time with varying magnitudes. However, no technology can precisely predict when, where, or how strong an earthquake will be, leading BMKG to never issue earthquake predictions (Admindlh, 2019).

One of the most devastating earthquakes in Indonesia occurred in Yogyakarta in 2006 (Aulady & Fujimi 2019). The 5.9-magnitude earthquake was centered at coordinates 8º 42'00" S and 114º 27.6' E, about 25 km south of Yogyakarta, at a depth of 17.1 km (Studi

et al., 2018). The disaster caused 4,659 fatalities and 19,401 injuries, with the highest casualties recorded in Bantul (4,121 deaths), Sleman (240 deaths), Yogyakarta City (195 deaths), Kulon Progo (22 deaths), and Gunung Kidul (81 deaths) (Studi et al., 2018). More recently, on June 30, 2023, Yogyakarta experienced another earthquake with a magnitude of 6.0 (Dinisari, 2023).

A lack of understanding of disaster characteristics, irresponsible environmental behavior, and poor early warning systems are major factors that increase disaster risks (Setyaningrum & Rumagutawan, 2018). According to Government Regulation of Indonesia No. 21 of 2008 on Disaster Management, disaster mitigation involves both physical development and awareness-building initiatives to enhance preparedness and reduce risks (Nursyabani & Putera, 2020).

Preparedness is a crucial component of proactive disaster control measures and plays a vital role in minimizing casualties (Anisah,2020). Disaster management requires coordination among government institutions, organizations, communities, and individuals. In particular, health professionals, especially nurses, play a crucial role in disaster response, including pre-incident, during the incident, and post-incident phases (Doondori & Paschalia, 2021).

Schools serve as effective platforms for disseminating disaster-related knowledge and skills (Fauzi & Handayani, 2021). Disaster preparedness programs in educational institutions, especially schools, are essential because they help students and teachers understand risks and respond effectively (Suardana & Made, 2021). To assess school vulnerability and preparedness, it is necessary to conduct an analysis of students' preparedness levels (Nastiti *et al.*, 2020).

Various approaches can be used to enhance preparedness, including educational materials, awareness campaigns, and simulation-based training. Earthquake simulation exercises are particularly valuable in improving knowledge, agility, courage, and survival skills among students (Hermawan, 2022). Disaster preparedness in schools is the responsibility of all school members, including students, teachers, administrative staff, and school principals (Suardana & Made, 2021). However, disaster management efforts often neglect pre-disaster preparedness, even though this stage is crucial in ensuring effective response and recovery efforts (Setyaningrum & Rumagutawan, 2018).

One of the key activities that can be implemented to enhance disaster preparedness is providing education through simulation (Rafi, 2018). Disaster response simulations serve as an effective medium for developing practical skills in handling emergencies on the ground. This is supported by a study conducted by Yustisia et al. (2019), which found that simulation exercises significantly influenced the earthquake preparedness of students at SDN 86 Bengkulu City, although the statistical analysis yielded a p-value of 0.500, indicating a non-significant result in that particular context.

A preliminary study conducted at Muhammadiyah 1 Bambanglipuro Junior High School revealed that the school was impacted by the 2006 Yogyakarta earthquake, suffering severe damage to the school fence and minor structural damage to the school building.

Despite having disaster signage and evacuation routes in place, the school has never conducted awareness sessions, seminars, or disaster simulations specifically related to earthquake preparedness. Located in Bantul, an area with a high disaster risk, the school is situated in a region where, according to Indonesia's Disaster Risk Index (IRBI) 2022, Bantul recorded a disaster risk score of 167.97—the highest score among the five regencies in the Yogyakarta Special Region. Given this context, it is crucial to conduct earthquake simulation drills for the students, especially considering that around 10 students were injured during the 2006 earthquake.

Based on the above background, the researcher is interested in conducting a study to examine the effect of earthquake disaster simulation methods on the preparedness level of students at Muhammadiyah 1 Bambanglipuro Junior High School in facing future disaster events.

METHOD

This study employed a quantitative research approach, as the data could be measured numerically and analyzed statistically. The research design used was pre-experimental, specifically the one-group pretest-posttest design, where the researcher conducted a pretest measurement prior to the earthquake simulation, followed by a posttest measurement after the simulation (Sugiyono, 2022).

The population in this study, based on a preliminary study, consisted of 217 students from Muhammadiyah 1 Bambanglipuro Junior High School. The sampling technique used was probability sampling with random sampling. A total of 144 students were selected as the sample, calculated using the Slovin formula with a 5% margin of error. The sample was then proportionally divided across grade levels using a stratified sampling method, resulting in 28 students from Grade VII, 54 from Grade VIII, and 62 from Grade IX.

The instrument used in this study was a questionnaire containing questions related to students' preparedness for earthquake disasters. This questionnaire was adopted from Nurchayat, (2014) in a study titled "Differences in Preparedness for Earthquake Disasters Between Groups of Elementary School Students Managed with Pedagogical and Andragogical Strategies."

The data collection method used in this study was primary data collection, meaning the data was directly obtained by the researcher from respondents. Each respondent was asked to complete an informed consent form, followed by the first questionnaire (pretest). After completing the pretest, respondents received educational materials on earthquake preparedness and response, and then participated in an earthquake simulation. After the simulation, respondents completed the second questionnaire (posttest).

To determine whether there was a significant effect of the earthquake simulation on the preparedness level of students at Muhammadiyah 1 Bambanglipuro Junior High School, data were analyzed using the Wilcoxon test. The results of this study are presented in tabular form. This study received ethical clearance from the Ethics Committee of Universitas 'Aisyiyah Yogyakarta on September 18, 2023, with reference number 3218/KEP-UNISA?IX/2023.

RESULTS

This section presents the characteristics of respondents who participated in the study, including their gender and age distribution.

Table 1. Frequency Distribution of Respondents' Characteristics (n:144)

No	Respondent Characteristics	Frequency (n)	Percentage (%)
	Gender		
1	Male	84	58.3
	Female	60	41.7
	Age (years)		
2	11–12	8	5.6
	13–14	95	66.0
	15–16	41	28.5

Source: Primary Data (2024)

The gender distribution of the respondents indicates that the majority were male (84 respondents, 58.3%), while female respondents totaled 60 (41.7%). In terms of age, the largest group was 13–14 years old with 95 respondents (66.0%), followed by 15–16 years old with 41 respondents (28.5%), and the smallest group was 11–12 years old, comprising 8 respondents (5.6%).

The effect of the earthquake disaster simulation on students' preparedness levels was analyzed by comparing the results of the pretest and posttest. Preparedness levels were classified into three categories: Very Prepared, Prepared, and Less Prepared. The data were processed and analyzed using the Wilcoxon non-parametric statistical test to determine whether there was a significant difference before and after the intervention. The detailed distribution and statistical analysis results are presented in Table 2.

Table 2. Preparedness Levels Before and After Simulation and Statistical Test Results

Preparedness Level	Frequency (n)	Percentage (%)	Standard Deviation	p-value
	Before Simulation			
Very Prepared	0	0.0	0.582	0.000
Prepared	88	61.1		
Less Prepared	1	0.7		
	After Simulation			
Very Prepared	61	42.2	0.496	
Prepared	83	57.6		
Less Prepared	0	0.0		

Source: Primary data, processed (2024)

Table 2 demonstrates a clear improvement in student preparedness following the earthquake simulation. Before the intervention, most students were classified as "prepared" (88 respondents, 61.1%), with 1 respondent (0.7%) in the "less prepared" category. After the simulation, 42.2% of students (61 respondents) reached the "very prepared" level, while 57.6% (83 respondents) remained "prepared."

The Wilcoxon non-parametric test yielded a p-value of 0.000, which is less than 0.05, indicating a statistically significant difference in preparedness levels before and after the simulation. This confirms the positive impact of the earthquake simulation on students' disaster readiness.

DISCUSSION

Preparedness Level Before Earthquake Simulation

Preparedness is an essential component of integrated disaster management. It involves assessing, planning, and training to ensure the implementation of a well-coordinated action plan (Supartini *et al*., 2017). Disaster impact reduction efforts are conducted through phases such as mitigation, preparedness, emergency response, and recovery (Huriani *et al*., 2021). Monitoring individual preparedness is critical to evaluate readiness and determine the need for further action to enhance disaster response capabilities (Darmareja *et al.*, 2022).

Preparedness levels can vary between individuals, influenced by several factors, including age. As people age, their maturity and capacity to absorb information increases, which positively affects productivity and disaster preparedness behaviors (Wijaya *et al*., 2019). This is supported by Yuliastanti & Nurhidayati (2020) whose research demonstrated a significant relationship between age and preparedness (p-value = 0.000). Age also correlates with cognitive maturity and experience as individuals grow older, they gain insights from past experiences, including previous disasters.

The people of Yogyakarta Special Region have faced multiple earthquakes between 2021–2023, with magnitudes ranging from 4.2 to 6.0. This frequency has led to increased public awareness and experience in responding to seismic events. Experience serves as a valuable source of knowledge, helping individuals recall effective actions in similar future scenarios. In this study, such factors may have contributed to the majority of students at Muhammadiyah 1 Bambanglipuro Junior High School being categorized as “prepared” even before the simulation. This aligns with Wijaya *et al.,*(2019 who found a significant relationship between experience and earthquake preparedness ($\rho = 0.000 < \alpha\ 0.05$), noting that past disaster experience fosters effective anticipation and response. The experience of disasters that have been experienced will provide lessons to prepare for disasters in the future. Preparedness can be shaped through direct experience, school-based education, or information from parents and the surrounding environment (Yuliastanti & Nurhidayati, 2020).

Improvement After Earthquake Simulation

As shown in this study, students’ preparedness improved significantly after participating in the earthquake simulation. During the simulation, supporting equipment was utilized, such as LCDs for material delivery, disaster sirens, megaphones, first aid kits, stretchers, and splint bandages for mock injuries. These tools allowed students to engage directly in realistic drills, thereby enhancing their readiness.

This result aligns with Yustisia *et al*., (2019) who reported that 85.5% of students improved to the “very prepared” category after simulation interventions. Earthquake simulation is a highly effective educational method, as it immerses students in realistic scenarios, enhancing their understanding and behavior related to disaster response (Mahmudah & Fauzia, 2022) Simulation also promotes active learning and the development of practical skills, making it particularly effective for school-aged learners.

According to Lestari (2022), earthquake simulation effectively increases disaster preparedness. The method allows students to practice and develop essential skills,

providing hands-on experience that translates to better response capabilities during real emergencies.

Statistical Impact of Simulation on Preparedness

The Wilcoxon signed-rank test conducted in this study yielded a p-value of 0.000 (< 0.05), indicating a statistically significant difference in preparedness levels before and after the simulation. Initially, students ranged from "prepared" to "less prepared," but post-simulation, a significant shift occurred toward higher preparedness levels, attributable to hands-on engagement during the simulation exercise.

This finding aligns with Anisah, (2020) who found a significant effect of simulation methods on student preparedness in facing earthquakes. Collective awareness and engagement from all school members are vital in building disaster readiness, as preparedness plays a major role in reducing casualties (Fauzi & Handayani, 2021). Schools, therefore, hold a key position in disseminating disaster knowledge before, during, and after such events (Suardana & Made, 2021). Learning from past disaster events, simulations are essential for educating students on survival strategies and preventing avoidable injuries during emergencies (Yustisia *et al*., 2019).

Simulations not only improve knowledge but also influence student actions and attitudes. Knowledge and preparedness are closely linked; better disaster knowledge fosters positive attitudes and behavior. Disaster education forms the foundation for understanding emergency protocols, mobilizing resources, and engaging in early warning system (LIPI- UNESCO/ISDR, 2006)

CONCLUSION

Based on the results and discussion presented above, it can be concluded that there is a significant impact of earthquake simulation interventions on the preparedness level of students at Muhammadiyah 1 Bambanglipuro Junior High School. The simulation effectively improved students' readiness in facing potential earthquake disasters.

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