

Disaster Mitigation Education and Simulation: Impact on Islamic Boarding School Students' Knowledge and Preparedness

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ABSTRACT

Introduction: Islamic boarding schools are environments at high risk for disaster-related casualties due to inadequate education and limited supporting infrastructure. The majority of students are between 13 and 22 years old, an age group considered highly vulnerable to disasters. Given these substantial risks, disaster education is essential to improve students' knowledge and preparedness. This study aimed to evaluate the levels of knowledge and preparedness among Islamic boarding school students before and after receiving disaster education through mitigation and simulation programs. **Methods:** This study utilized a quantitative research design with a pre-experimental approach (one-group pretest-posttest design). The study population consisted of 342 students, from which a sample of 47 participants ($n = 47$) was selected using cluster sampling. The inclusion criteria comprised students serving as dormitory room leaders and members of the school health unit committee. Statistical analysis was performed using the Paired t-test. **Results:** The analysis revealed a significance value of 0.000 ($p < 0.05$), indicating a statistically significant difference in students' knowledge and preparedness levels before and after the implementation of the disaster education and simulation program. **Conclusions:** Disaster education through mitigation and simulation programs significantly improves students' knowledge and preparedness in facing disaster situations.

Introduction

Islamic boarding schools are unique educational institutions where students live, study, and carry out daily activities within the same environment. As students spend most of their time in the boarding school area, disaster preparedness becomes an important aspect in ensuring their safety and well-being. Al-Muhibbin Islamic Boarding School is located near the Gedang, Gude, and Tambak Beras Rivers, underscoring the need for increased awareness and preparedness for potential disaster risks. In addition, students aged 13–22 years are expected to possess adequate knowledge and preparedness to respond appropriately during emergencies. Therefore, disaster mitigation education and simulation are important strategies to strengthen students' knowledge and preparedness in facing potential disasters.

Based on several international studies, research on fire disaster preparedness in educational settings has primarily focused on the development of disaster-resilient school models, the identification of factors influencing preparedness, and the evaluation of disaster education programs (Madona, 2021). A study conducted by Widowati et al. (2023) highlighted the importance of disaster-prepared school indicators, including training programs, evacuation drills, institutional policies, and safety facilities, in enhancing students' preparedness. Furthermore, studies conducted in boarding school environments have shown that the level of fire preparedness remains constrained by inadequate facilities and the lack of continuous evacuation training programs (Susanto, 2006).



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In disaster risk reduction efforts, the education sector plays a strategic role in enhancing students' knowledge, awareness, and preparedness regarding potential disaster threats from an early age (Fariza, 2022). Furthermore, the implementation of school-based disaster risk management, supported by regular educational activities and disaster simulation exercises, is effective in fostering a culture of disaster awareness and strengthening the resilience of educational communities (Danil, 2021). Nevertheless, the implementation of disaster mitigation and management programs across educational institutions continues to face several challenges, including limited resources, insufficient training opportunities, and the suboptimal integration of disaster-related content into educational curricula and learning activities (Fariza, 2022).

Disaster Preparedness and Safety School as a Conceptual Framework of Comprehensive School Safety by (D. Widowati, 2023) emphasized that disaster preparedness in educational settings is influenced by training programs, disaster simulations, institutional policies, and school safety facilities. The study focused on the concept of disaster-prepared schools and the factors that support students' preparedness for disaster situations. Disasters caused by natural and non-natural factors can result in loss of life, environmental damage, property losses, and psychological impacts (BPBD Jawa Timur, 2023). Natural disasters include events such as earthquakes, tsunamis, volcanic eruptions, tornadoes, or severe windstorms (BPBD Jawa Timur, 2023). Human-induced disasters are caused by human activities or behaviors that trigger adverse environmental consequences, including fires, floods, and landslides (Nisa et al, 2014). Flooding is one of the most frequent climate-related natural disasters in Indonesia and has significant impacts on communities, including disruptions to the education sector (Nugroho, 2021). The high risk of flooding necessitates the implementation of disaster mitigation education and simulation programs to enhance students' knowledge and preparedness for responding effectively to emergency situations (KEMENKES, 2022). The adverse impacts of floods can be reduced through disaster mitigation education and by strengthening community preparedness from an early age (BPBD Pangkalpinang, 2026). *The Global Natural Disaster Assessment Report 2021* reported that 367 natural disasters occurred worldwide in 2021, affecting 127 countries and territories. Among these events, 206 were flood-related disasters, accounting for 56.13% of the total number of natural disasters and making floods the most frequent disaster type globally (Wilujeng, 2022). Disasters pose a significant threat to the lives of millions of children worldwide, particularly in low and middle-income countries (Wilujeng, 2022). It was estimated that approximately 66 million children were affected by disasters, highlighting the substantial impact of such events on younger populations (Wilujeng, 2022). Children represent the largest age group affected by disasters globally, with more than 100 million children estimated to be exposed to disaster events each year (Nugroho, 2021).

The objective of this program is to empower students through the SOS-Tren (*Santri of Source/ Disaster-Aware Student Group Pondok Pesantren*) group to enhance preparedness for flood and fire disasters. This empowerment initiative is implemented by promoting disaster literacy, providing disaster education, and conducting preparedness training for students, staff, and caregivers within the Islamic boarding school community. Through the empowerment of students in the SOS-Tren group, the program aims to develop disaster-prepared students who possess disaster mitigation competencies and are capable of disseminating disaster preparedness knowledge to the surrounding community. This study aimed to examine changes in disaster knowledge and preparedness among Islamic boarding school students before and after participation in disaster mitigation education and simulation programs.



Methods

Study Design

A quantitative research method with a one-group pretest–posttest pre-experimental design was adopted for this study.

Setting

This study was conducted at Al-Muhibbin Islamic Boarding School, Jombang, Indonesia, between July and August 2025.

Research Subject

The study population consisted of 342 male and female students enrolled at the boarding school. Samples were selected using a cluster sampling technique based on predetermined research criteria. The inclusion criteria were students who served as dormitory leaders and/or members of the school health unit (UKS), were aged between 13 and 22 years, and participated in all educational and disaster simulation activities. The exclusion criterion was prior participation in disaster education programs. A total of 47 participants were recruited, comprising 22 male students and 25 female students.

Instruments

The research instruments consisted of a disaster knowledge questionnaire and a disaster preparedness questionnaire. The pre-test was conducted to assess participants' levels of disaster knowledge and preparedness prior to the implementation of disaster education and simulation activities, whereas the post-test was administered following the completion of these interventions. The questionnaires used in this study were adapted from the instrument developed by Kholis et al. (2022). Validity testing for the knowledge variable was performed using the Pearson Product–Moment correlation technique at a significance level of 5% ($p = 0.05$). For the preparedness variable, validity testing was conducted on 30 respondents, yielding an r -table value of 0.361, indicating that all questionnaire items were valid. Reliability testing demonstrated that the valid items (seven knowledge items and twenty-two preparedness items) had Cronbach's alpha coefficients of 0.832 and 0.901, respectively, indicating good reliability of the instruments.

Intervention

Disaster education was delivered by the researchers, while disaster simulation activities were conducted in collaboration with the Regional Disaster Management Agency (BPBD) of Jombang Regency. The educational intervention consisted of two sessions. The first session lasted for two hours and covered the concepts of disasters and disaster mitigation. The second session, also conducted over two hours, focused on disaster prevention and management strategies. The third session involved practical disaster simulations, including fire, earthquake, and flood scenarios, and was carried out for three hours in collaboration with the BPBD team of Jombang Regency.

Data Analysis

Data analysis was performed using both univariate and bivariate approaches. Univariate analysis was conducted by generating frequency distributions for each variable category. Bivariate analysis employed the paired-samples t -test to assess the effect of the independent variable on the dependent variable.



The levels of knowledge and preparedness were assessed using structured questionnaires. The total scores obtained from the questionnaires were categorized into three levels: poor (1–36), moderate (37–73), and good (74–110). Higher scores indicated better levels of disaster knowledge and preparedness among the participants. These categories were used to describe respondents' levels of knowledge and preparedness before and after the implementation of disaster mitigation education and simulation programs.

To evaluate the statistical significance of the changes between the pretest and posttest scores, the data were analyzed using a paired t-test. This parametric analysis was selected because it is specifically designed to compare the means of two related groups in this case, the same participants measured before and after the intervention thereby allowing for the assessment of whether a significant difference exists between the two periods.

Ethical Consideration

This research was conducted by paying attention to the ethical principles of confidentiality, beneficence and has obtained informed consent from respondents and meets ethical eligibility with Number 0624070020/KEPK/STIKES-PEMKAB/JBG/VII/2024 at KEPK STIKES Pemkab Jombang.

Results

Table 1. Distribution of SOSTREN characteristic data

Description		N	percentage
Gender	Man	22	46%
	Woman	25	53%
Age	teenagers	34	72,3%
	Young adults	13	27,6%
Level of education	low : SMP	9	19,1%
	Middle : SMA	31	65,9%
	High : D3/S1 :	7	14,8%

Primary Data Sources 2025

Table 1 presents the distribution of the respondents' demographic characteristics. The majority of respondents were male (46%) and belonged to the adolescent age group (72,3%). Regarding educational attainment, most respondents had completed secondary education (senior high school) (65,9%), whereas respondents with lower education levels (junior high school) and higher education levels (diploma/bachelor's degree) accounted for 19,1% and 14,8%, respectively. These findings indicate that the study sample was predominantly composed of adolescents with a secondary educational background.

Table 2. Results of the Paired t-Test

Varibel	Pre-test Mean	Post-test Mean	Results
Knowledge	2,49	12,27	0,00
Preparedness	2,23	74,66	0,00

Primary Data Sources 2025



Based on the results of the paired-samples t-test, a statistically significant difference was observed between the pre-intervention and post-intervention scores for both knowledge and preparedness, with a significance value of 0.000 ($p < 0.05$). The mean knowledge score increased by 9.78 points, whereas the mean preparedness score increased by 72.43 points following the intervention. These findings indicate that the intervention was effective in improving respondents' knowledge and preparedness, as evidenced by the significantly higher post-test scores compared to the pre-test scores.

Discussion

The results of this study revealed a significant difference in the levels of knowledge and disaster preparedness among Islamic boarding school students before and after the implementation of disaster education and simulation interventions. Prior to the intervention, most students demonstrated low to moderate levels of knowledge and preparedness. This initial condition may be attributed to the absence of structured disaster education programs, either initiated by the boarding school administration or by external disaster management agencies. This is particularly concerning given that Al Muhibbin Islamic Boarding School in Jombang is highly vulnerable to flooding due to its geographical location, being surrounded by three rivers—Gedang River, Gude River, and Tambak Beras River—which places the institution at considerable risk of flood-related disasters.

Following the implementation of disaster mitigation education and simulation interventions, a substantial increase was observed in the mean scores of both knowledge and preparedness. The average knowledge score increased from 2.49 to 12.27, while the average preparedness score rose from 2.23 to 74.66. Statistically, the effectiveness of the intervention was confirmed through a paired samples test, which yielded a significance value of 0.000 ($p < 0.05$), indicating a highly significant improvement following the intervention. These findings are consistent with previous studies that have reported the positive impact of disaster education and simulation programs on enhancing individuals' knowledge and preparedness toward disaster risks.

The improvement in students' knowledge and preparedness following disaster mitigation education and simulation interventions indicates that learning approaches involving active participant engagement are more effective than conventional lecture-based methods alone (Ayu, 2021). Disaster simulations provide participants with hands-on experience in practicing evacuation procedures and emergency response actions, enabling them to develop a deeper understanding that is more easily retained (Madona, 2021). In addition to enhancing cognitive outcomes, simulation activities also foster practical skills and self-confidence in dealing with real disaster situations (Syahrani, 2025). Therefore, the integration of disaster mitigation education and simulation exercises can serve as an effective strategy for strengthening students' disaster preparedness capacity (Hidayati, 2020). The findings of this study further demonstrate that adequate knowledge plays a crucial role in shaping individual preparedness behaviors during disaster events (Hidayati, 2020). Individuals who possess a clear understanding of disaster risks and mitigation measures are generally better prepared to make appropriate decisions and respond effectively during emergency situations (Irawan, 2023).

These findings are consistent with previous studies indicating that low levels of preparedness among students are often attributed to the lack of systematic disaster mitigation education within educational settings (Hayudityas, 2020). Furthermore, the limited integration of disaster mitigation content into the learning curriculum contributes to insufficient knowledge and preparedness among students when facing disaster situations (Genika, 2023). Disaster



simulation activities provide participants with more realistic learning experiences, thereby enhancing their understanding and practical skills in responding to emergency conditions (Lukman, 2023). These findings are further supported by previous studies demonstrating that disaster education and simulation programs can effectively enhance students' awareness and preparedness for emergency situations through more practical and experiential learning approaches (Lestari, 2024). The continuous implementation of disaster mitigation education accompanied by simulation activities represents an effective strategy for enhancing students' preparedness and strengthening their capacity to respond appropriately to various potential disaster hazards (Saputra, 2024).

Conclusion

Disaster mitigation education and simulation significantly improved the knowledge and preparedness levels of students at Al-Muhibbin Islamic Boarding School. The paired-samples t-test showed a statistically significant difference between pre-test and post-test scores for both knowledge and preparedness ($p = 0.000$). The mean knowledge score increased from 2.49 to 12.27, while the mean preparedness score increased from 2.23 to 74.66 after the intervention. These findings indicate that disaster education combined with simulation activities is effective in enhancing students' understanding of disaster risks and improving their preparedness for disaster situations.

Ethics approval and consent to participate

This research was conducted by paying attention to the ethical principles of confidentiality, beneficence and has obtained informed consent from respondents and meets ethical eligibility with Number 0624070020/KEPK/STIKES-PEMKAB/JBG/VII/2024 at KEPK STIKES Pemkab Jombang

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