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THE EFFECT OF SIMULATION METHOD EDUCATION ON EARTHQUAKE DISASTER PREPAREDNESS AT SMP NEGERI 7 PALU

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ABSTRACT

Central Sulawesi lies within a seismically active region, particularly along subduction zones and fault lines that extend across both marine and terrestrial domains. This area has experienced several major earthquakes, resulting in substantial physical destruction, human casualties, and profound socio-economic repercussions. Consequently, targeted educational initiatives are essential to enhance community resilience and preparedness. Among various approaches, simulation-based training stands out as an effective strategy, offering participants hands-on experience in managing emergency scenarios. This study aimed to evaluate the impact of simulation-based education on earthquake disaster preparedness among adolescents.

Employing a quasi-experimental design with a non-equivalent control group approach, the research involved 45 participants in the intervention group and 45 in the control group. Data analysis utilized the Wilcoxon signed-rank test for within-group comparisons and the Mann-Whitney U test for between-group differences, with statistical significance set at $p < 0.05$. The Mann-Whitney U test on pre-intervention data yielded a p-value of 0.267 ($p > 0.05$), indicating no significant difference in baseline earthquake preparedness between the groups. In contrast, post-intervention analysis revealed a p-value of 0.000 ($p < 0.05$), demonstrating a statistically significant divergence in preparedness levels between the intervention and control groups. These findings suggest that simulation-based education positively influences earthquake preparedness among adolescents at SMP Negeri 7 Palu. It is anticipated that such interventions will bolster students' knowledge, attitudes, and practical behaviors toward earthquake mitigation, thereby improving their capacity for self-rescue during seismic events .

BACKGROUND

Earthquakes represent one of the most devastating natural hazards, capable of inflicting widespread destruction and substantial loss of human life. In Indonesia, a country situated along the tectonically volatile Pacific Ring of Fire, seismic events are a recurrent threat, particularly in regions like Central Sulawesi where high tectonic activity prevails (Haryanto, 2017).

Over recent decades, this province has endured multiple significant earthquakes, including the catastrophic event on September 28, 2018, which resulted in numerous fatalities and extensive infrastructure damage (Ministry of Health of the Republic of Indonesia, 2020). Central Sulawesi's long-standing vulnerability to seismic-induced disasters underscores the urgent need for robust mitigation strategies (Simanjuntak, 2021). In this context, fostering community preparedness—especially among school-aged children—emerges as a critical imperative for minimizing risks and enhancing resilience (Hidayat, 2018).

Despite these challenges, data from the National Disaster Management Agency (NDMA) reveal that public preparedness levels remain alarmingly low across Indonesia. Approximately 60% of the population lacks sufficient knowledge of disaster mitigation practices, a gap that extends to students who form a key demographic in vulnerability assessments. To counteract this, BNPB has rolled out several initiatives, including the "Disaster Safe School" program, school-based evacuation drills, and awareness campaigns disseminated via educational materials and social media. However, these efforts have been inconsistently applied, with priority often given to high-risk zones, leaving many communities underserved.

Adolescents in junior high school, navigating a pivotal stage of physical and psychological development, are particularly susceptible during earthquakes (Rahmawati & Wulandari, 2022). Integrating earthquake preparedness education into school curricula is thus essential, equipping students with the knowledge and skills to navigate emergencies effectively (Purwanto, 2020). Beyond self-protection, these young individuals can serve as catalysts for broader change, propagating disaster awareness within their families and communities (Rahmawati & Wulandari, 2022). Such approaches align seamlessly with national objectives to cultivate a culture of disaster resilience encompassing all societal segments (Meteorology, Climatology, and Geophysics Agency, 2023).

Among educational strategies, simulation-based training has gained prominence as a dynamic tool for preparing the younger generation against seismic threats. By immersing students in realistic scenarios, simulations enable them to internalize appropriate responses, from evacuation procedures and identifying safe zones to administering basic first aid (Suyanto, 2017; Aminah, 2019).

At institutions like SMP Negeri 7 Palu, located in a seismically prone area, this method holds particular promise. Through hands-on engagement, simulations not only heighten students' understanding of earthquake dynamics but also cultivate the responsiveness needed for real-world crises, ultimately empowering them to act decisively in the face of potential disasters (Kurniawan & Putra, 2019).

METHODS

This study employed a quasi-experimental design, specifically a non-equivalent control group approach, to assess the impact of simulation-based education on earthquake preparedness. Unlike true experimental designs, randomization was not applied to the selection of either the experimental or control groups, reflecting the practical constraints of the school setting. Both groups participated in a pre-intervention assessment to

establish baseline levels of preparedness. Subsequently, the experimental group received a comprehensive intervention comprising lectures, audio-visual materials, and hands-on earthquake simulations, whereas the control group was exposed only to lectures and audio-visual aids. The study concluded with post-intervention assessments for each group to measure changes in preparedness.

The target population consisted of 174 seventh-grade students enrolled at SMP Negeri 7 Palu, a public junior high school in a seismically active region. Sampling followed guidelines proposed by Roscoe (1975), who recommends that experimental studies include at least 10–20 participants per group or a minimum of 15 to ensure adequate statistical power. Accordingly, 15 students were purposively selected from each of three intact classes, yielding a total sample of 90 respondents (45 in the experimental group and 45 in the control group). This selection maintained class integrity while balancing group sizes.

Data were analyzed using both univariate and bivariate techniques, facilitated by statistical software. To evaluate within-group changes from pre- to post-intervention, we applied the paired samples t-test, supplemented by the non-parametric Wilcoxon signed-rank test as an alternative when normality assumptions were violated. Between-group differences were examined using the independent samples t-test, with the Mann-Whitney U test serving as the non-parametric counterpart. All analyses were conducted at a significance level of $p < 0.05$, ensuring rigorous evaluation of the intervention's effects.

RESULTS

The demographic profile of the study participants revealed a predominance of 13-year-olds in both the treatment and control groups, with 25 respondents (55.6%) in each group falling into this age category. This age distribution aligns with the typical enrollment demographics for seventh-grade students at SMP Negeri 7 Palu. Regarding gender, males constituted the majority in the treatment group, accounting for 30 participants (66.7%), while in the control group, males also formed the larger proportion, comprising 28 individuals (62.2%). These characteristics suggest a balanced yet slightly male-skewed sample, reflective of the school's overall student body (Table 1).

Analysis of the treatment group revealed notable improvements in earthquake preparedness following the intervention. Prior to the educational program, the mean preparedness score was 7.98 (SD = 0.98), which rose to 9.47 (SD = 0.78) post-intervention, representing an average increase of 1.49 points. This enhancement underscores the potential of the multifaceted approach—combining lectures, audio-visual aids, and simulations—to elevate students' readiness for seismic events. The Wilcoxon signed-rank test, employed to assess these pre- and post-intervention differences, yielded a p-value of 0.000 ($p < 0.05$), confirming a statistically significant effect of the intervention on earthquake preparedness among adolescents at SMP Negeri 7 Palu (Table 2).

In the control group, which received education limited to lectures and audio-visual aids without simulations, the mean preparedness score was 9.09 (SD = 0.91) prior to the intervention and increased modestly to 9.18 (SD = 0.88) afterward,

reflecting an average gain of 0.09 points. This minor improvement suggests a subtle positive influence from the basic educational components. However, the Wilcoxon signed-rank test indicated a p-value of 0.06 ($p > 0.05$), which did not reach the threshold for statistical significance. Consequently, while the intervention showed a numerical uptick in preparedness among adolescents at SMP Negeri 7 Palu, it did not demonstrate a robust, statistically significant effect on earthquake readiness (Table 3).

The data analysis revealed that, prior to the intervention (pre-observation phase), there were no significant differences in earthquake disaster preparedness levels between the treatment and control groups among the adolescent respondents. This equivalence was confirmed by the Mann-Whitney U test, which yielded a p-value of 0.267 ($p > 0.05$), indicating comparable baseline preparedness across both groups. In contrast, post-observation assessments demonstrated a marked divergence, with a p-value of 0.000 ($p < 0.05$) from the Mann-Whitney U test, signifying a statistically significant improvement in the treatment group's earthquake disaster preparedness relative to the control group. These findings underscore the substantial impact of the disaster preparedness training program on enhancing earthquake readiness among students at SMP Negeri 7 Palu (Table 4)

Table 1. Frequency distribution of respondents' characteristics based on age and gender at SMP Negeri 7 Palu

Characteristics	**Treatment Group**		**Control Group**	
	Total (n)	Frequency (f)	Total (n)	Frequency (f)
Age				
13 years	25	55.6	25	55.6
14 years	19	42.2	18	40.0
15 years	1	2.2	2	4.4
Total	**45**	**100**	**45**	**100**
Gender				
Male	30	66.7	28	62.2
Female	15	33.3	17	37.8
Total	**45**	**100**	**45**	**100**

Table 2. Pre- and Post-Intervention Differences in Mean Levels of Earthquake Disaster Preparedness in the Treatment Group at SMP Negeri 7 Palu

Variabel	N	Mean ± s.b.	Min-Max	p
Preparedness before treatment	45	7.98±0.98	6-9	0.000
Preparedness after treatment	45	9.47±0.786	7-10	

Table 3. Pre- and Post-Intervention Differences in Mean Levels of Earthquake Disaster Preparedness in the Control Group at SMP Negeri 7 Palu

Variable	**N**	**Mean ± s.b.**	**Min-Max**	***p***
Preparedness before treatment	45	9.09±0.91	5-10	0.071
Preparedness after treatment	45	9.18±0.88	6-10	

Table 4. Differences in Mean Earthquake Disaster Preparedness Scores Between Treatment and Control Groups During Pre- and Post-Observation Periods at SMP Negeri 7 Palu

Observation	Treatment	Control	Mean Differences	*p*
Pre	7.98	9.09	-1,11	0.267
Post	9.47	9.18	0.29	0.000

DISCUSSION

The results of this study affirm that educational interventions incorporating lectures, audiovisual materials, and simulation exercises exerted a statistically significant influence on enhancing students' earthquake disaster preparedness. This observation is consistent with the findings of Setioputro et al. (2025), who highlighted the potential of school-based programs to bolster readiness in disaster-vulnerable areas. Their work documented improvements in students' knowledge and self-efficacy following intensive training protocols. Central to these gains were simulations, which deliver immersive experiences in managing emergencies, thereby translating abstract concepts into actionable responses. This perspective is echoed in Haryuni Sri's (2018) research on elementary schools, where simulation activities were shown to substantially elevate children's earthquake response capabilities.

Simulations, in particular, empower students to actively rehearse critical skills—such as identifying evacuation routes and applying self-rescue techniques—facilitating retention that surpasses passive learning from theoretical discourse alone (Setioputro et al., 2025). The marked preparedness advancements in the intervention group underscore the value of a multi-method approach (lectures, audiovisuals, and simulations) in cultivating both cognitive insights and practical proficiencies. This integrated strategy aligns seamlessly with the disaster education principles advocated by the SPAB framework (Wardhani et al., 2024).

Furthermore, simulations contribute to emotional development, fostering attributes like resilience in the face of seismic threats and a shared sense of accountability for safety. Tupper and Karacaoğlu (2025) substantiate this by emphasizing the equal importance of affective elements alongside cognitive ones in comprehensive preparedness. Ultimately, the present study illustrates that the efficacy of disaster education turns on the selection of methods; increasingly interactive and experiential techniques yield the most substantial improvements in student readiness (Wardhani et al., 2024).

Educational interventions relying solely on lecture-based methods, without incorporating simulations, demonstrated no significant impact on students' earthquake disaster preparedness. This outcome corroborates the observations of Wardhani et al. (2024), who reported that the Disaster Safe School program's effectiveness diminishes when limited to didactic lectures. They advocate for hands-on practice and active student engagement as essential components for meaningfully elevating preparedness levels. Similarly, Fitriyani et al. (2021) observed that a majority of nursing students maintained only moderate earthquake readiness, highlighting how

the absence of structured educational initiatives often results in suboptimal preparedness across communities, particularly among younger demographics.

The efficacy of simulation techniques in this context is deeply rooted in the foundational principles of andragogy and pedagogy, both of which underscore the superiority of experiential learning for knowledge retention and skill development. As Setioputro et al. (2025) illustrate, integrating digital tools and role-playing simulations has proven particularly effective in deepening adolescents' comprehension of earthquake response strategies. Consequently, school-based disaster education must extend beyond cognitive domains to encompass psychomotor skills, ensuring a more holistic approach to readiness. The present study's results further emphasize the pivotal role of schools as formal institutions in cultivating a pervasive culture of disaster awareness. Indeed, Tamil (2020) calls for a thorough reevaluation and integration of disaster preparedness into the curriculum, noting that current frameworks inadequately embed such content across all relevant subjects.

The findings of this study reveal that baseline earthquake disaster preparedness levels were comparable between the treatment and control groups prior to the educational intervention, indicating no significant differences at the outset. In contrast, post-intervention assessments demonstrated a pronounced effect from the preparedness education program—delivered through lectures, audiovisual aids, and simulations—on enhancing earthquake readiness among adolescents at SMP Negeri 7 Palu. These results suggest that integrating practical simulations into educational efforts yields tangible improvements in shaping students' disaster response capabilities.

This evidence aligns with the work of Yunus et al. (2023), who reported that training in flood disaster management positively influenced students' preparedness behaviors. Importantly, preparedness extends beyond mere cognitive understanding to encompass affective elements, such as maintaining composure and building self-confidence, alongside psychomotor skills for effective evacuation. As Setioputro et al. (2025) emphasize, bolstering self-efficacy plays a crucial role in earthquake preparedness, as heightened confidence directly enhances the execution of protective actions during crises.

Görkem (2022) further underscores the necessity of high-quality disaster education to mitigate the adverse consequences of seismic events. Effective programs should prioritize active learning strategies that engage students, leverage advanced resources and technologies, and draw on successful international models for curriculum and textbook revisions. Incorporating outdoor activities, expert input from authorized bodies, and practical school-based implementations is equally vital to foster genuine readiness.

Moreover, the present study highlights the imperative for ongoing disaster education initiatives rather than isolated sessions. Romdhonah et al. (2019) affirm that sustained educational efforts cultivate a enduring culture of disaster awareness, with regular training and contextually relevant learning enabling students to internalize systematic responses. Consequently, school-based disaster education directly equips

learners with the agility and precision needed to respond adeptly in real emergencies.

CONCLUSION

In light of the research findings, it is evident that the implementation of simulation-based educational models significantly enhances earthquake disaster preparedness among students at SMP Negeri 7 Palu.

SUGGESTION

This intervention not only fosters greater awareness but also equips adolescents with the practical tools needed to navigate seismic risks effectively. Ultimately, such targeted education is anticipated to elevate students' knowledge, attitudes, and behavioral responses toward earthquake preparedness, while bolstering their capacity for self-rescue during actual emergencies.

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