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Local Wisdom-Based Storytelling for Volcanic Disaster Preparedness: A Quasi-Experimental Study Among Elementary Students in Ternate City

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Abstract

Background: Indonesia's position within the Pacific Ring of Fire exposes it to frequent natural disasters, including volcanic eruptions. Mount Gamalama in Ternate City, North Maluku Province, is among the country's most active volcanoes, and its 2018 eruption caused significant damage to surrounding communities. Elementary school-age children constitute a particularly vulnerable group due to limited knowledge and preparedness. **Objective:** This study aimed to examine the effect of a local wisdom-based storytelling model on volcanic eruption disaster preparedness among elementary school students in disaster-prone areas of Ternate City. **Methods:** A quasi-experimental design using a non-equivalent control group pre-test–post-test approach was employed, involving 60 students selected through purposive sampling (30 per group). The intervention group received health education via local wisdom-based storytelling incorporating illustrated comic books, animated videos, and mini booklets, while the control group received conventional classroom lectures. **Results:** Dependent t-test results indicated statistically significant improvements in both knowledge (control: $p = 0.014$; intervention: $p = 0.019$) and attitude (control: $p = 0.040$; intervention: $p = 0.006$) within both groups following the intervention. Mann-Whitney analysis revealed no significant between-group difference in either knowledge ($p = 0.680$) or attitude ($p = 0.318$), suggesting comparable short-term effectiveness of both approaches. **Conclusion:** The local wisdom-based storytelling model is an effective and contextually appropriate strategy for improving disaster preparedness. It is recommended as a participatory disaster education approach in volcanic eruption-prone areas.

Keywords
Disaster preparedness, Elementary school students, Local wisdom, Storytelling model, Volcanic eruption

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1. BACKGROUND

Indonesia is an archipelagic nation situated along the Pacific Ring of Fire, placing it among the world's most disaster-prone countries, with high exposure to volcanic eruptions, earthquakes, and

tsunamis (Manumayoso et al., 2025; BNPB, 2021; UNISDR, 2015). As the country with the most active volcanoes globally, Indonesia records numerous eruptions annually, resulting in casualties and substantial material losses (Sasidharan & Dhillon, 2022). Ternate City, located in North Maluku Province, is among the most at-risk areas, as its urban center sits on an island dominated by the active volcano Mount Gamalama. According to data from the Ternate City Regional Disaster Management Agency (BPBD), Mount Gamalama has erupted 70 times between 1538 and 2016 (Alwi La Masinu, 2018).

According to the National Action Plan for Disaster Risk Reduction (2014), Ternate City is classified as a high-risk disaster-prone area with a risk index of 160.4. It is included among 136 districts and cities targeted for national-level disaster risk reduction efforts. Approximately 65% of Ternate's total population of 218,000 residents (2017 census) are exposed to disaster threats, positioning the city as one of Indonesia's most urgent contexts for disaster preparedness.

The Ternate Disaster Risk Assessment (KRB) 2014–2018 found that the city's overall Preparedness Index was low at 27.80, encompassing composite indices of disaster knowledge and attitude, emergency response planning, early warning systems, and resource mobilization. Ahmad & Fathoni (2018) found that most families lacked sufficient knowledge, particularly in disaster management, emergency planning, and resource mobilization. This is consistent with Wahyuni (2015), who found that knowledge, attitudes, family emergency plans, and understanding of early warning systems shape community preparedness. Kusumastuti et al. (2021) further confirmed that effective knowledge management is a strong predictor of disaster preparedness, particularly in resource-limited communities.

The preparedness phase of the disaster management cycle is the most critical, as it determines community self-reliance, the effectiveness of emergency responses, and the preservation of lives during disasters (ICN & WHO, 2009). The Sendai Framework for Disaster Risk Reduction 2015–2030 (UNISDR, 2015) explicitly emphasizes the importance of culturally sensitive, child-centered education as part of disaster risk reduction strategies. A primary goal of preparedness planning is to build communities capable of responding to emergencies, including by integrating disaster education into school curricula (Levac, Toal-Sullivan, & O'Sullivan, 2012; Suryadi & Ulya, 2024; Guo et al., 2025).

Elementary school-age children are among the most vulnerable groups in disaster situations due to their limited knowledge of and readiness for disaster threats (Hayudityas, 2020). A study by Nekada et al. (2023) conducted near Mount Merapi demonstrated that health education on volcanic eruptions significantly improved students' disaster preparedness, with mean preparedness scores increasing from 76.00 to 84.00 ($p = 0.000$). Similarly, Kurniawan & Nirmalasari (2023) showed that animated video-based interventions effectively enhanced disaster preparedness among elementary school students. A study by Idrus, Zuhriyah, and Suharsono (2019) conducted in Ternate specifically demonstrated that simulation and animation-based methods significantly improved students' disaster preparedness knowledge compared to conventional instruction.

However, few studies have empirically tested the efficacy of locally contextualized storytelling against conventional pedagogy in volcanic disaster risk reduction (DRR) education. One innovative approach that has gained recognition is storytelling grounded in local wisdom. Local wisdom constitutes an inseparable dimension of a community's cultural identity, embedded in folklore, proverbs, songs, and traditional games. This approach is theoretically grounded in Vygotsky's sociocultural theory and narrative transportation theory, which posit that learning is most effective when new information is embedded within culturally familiar, socially mediated narratives, thereby enhancing cognitive absorption and behavioral internalization. Mustofa (2020) demonstrated that disaster education that integrates local wisdom effectively strengthens disaster-readiness characteristics in children, as safety messages embedded in culturally familiar narratives are more readily understood and internalized. Yildiz et al. (2023), in a cross-country study, found that children who received locally contextualized disaster education exhibited significantly higher risk perceptions and preparedness levels. Based on these considerations, this study aimed to examine the effect of applying a local wisdom-based Storytelling Model on volcanic eruption disaster preparedness among elementary school students in disaster-prone areas of Ternate City.

2. METHODS

This study employed a quasi-experimental design using a Non-Randomized Control Group Pre-Test–Post-Test approach. This design was

selected because full control over all relevant variables was not feasible in the field setting. The study population comprised elementary school students residing in disaster-prone areas of Ternate City (total population: 100 students). Inclusion criteria comprised students aged 7–8 years residing in the designated disaster-prone zone with active parental consent; exclusion criteria included students with cognitive impairments or chronic illnesses affecting participation. The response rate was 100% (60 out of 60 approached students). A sample of 60 students was selected using purposive sampling, with predefined inclusion and exclusion criteria applied. Participants were allocated into two groups: a control group (n = 30) and an intervention group (n = 30).

Prior to implementation, the storytelling materials (comic books, animated videos, and mini booklets) underwent content validation by experts in disaster nursing and elementary education. Facilitators received a 2-day training workshop on local wisdom integration and storytelling delivery, followed by a pilot test with 10 students to ensure comprehension and cultural appropriateness. Intervention fidelity was monitored using a standardized checklist completed by an independent observer during each session. The intervention group received health education through a local wisdom-based storytelling approach, comprising illustrated comic books, animated videos on volcanic eruption disaster preparedness, and mini booklets. Students were also invited to share experiences by narrating stories rooted in local cultural references. The control group received standard health education delivered via conventional classroom lectures.

The research instrument was a validated, standardized questionnaire previously used by Sulistyaningrum (2017) that measured two primary variables: students' knowledge of and attitudes towards volcanic eruption disaster preparedness. Data were analyzed bivariately. The dependent t-test was used to compare pre-test and post-test scores within each group (intra-group), while the Mann-Whitney U test was used to compare outcomes between the control and intervention groups (inter-group). The significance level was set at $\alpha = 0.05$. Data processing was performed using SPSS for Windows version 21. This study received ethical approval from the Ethics Committee of Poltekkes Kemenkes Ternate in 2023 (No. 076/KEPK-PKKT/EC/X/2023).

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3. RESULTS

Table 1. Characteristics of Respondents Based on Sex

Sex	Intervention Group		Intervention Group	
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
Male	5	16.7	3	10.0
Female	25	83.3	27	90.0
Total	30	100.0	30	100.0

Table 1 presents the distribution of respondents by sex across two study groups. Both groups consisted of 30 respondents each. In the Intervention Group, the majority of participants were female (25 respondents, 83.3%), while males accounted for only 5 respondents (16.7%). Similarly, in the second group (likely the Control Group), females predominated with 27 respondents (90.0%), while males accounted for 3 respondents (10.0%).

Table 2. Age Characteristics of Study Respondents

Age of Respondents	N	Min.	Max.	Mean	Std. Dev.
Control Group	30	7	8	7.73	0.45
Intervention Group	30	7	8	7.80	0.41

Table 2 displays the demographic age characteristics of study participants. Both the control and intervention groups comprised 30 respondents each, with ages ranging from 7 to 8 years. The mean age was 7.73 ± 0.45 years in the control group and 7.80 ± 0.41 years in the intervention group. The similar age distributions and low standard deviations indicate homogeneous groups with minimal age variation, suggesting successful participant matching across study groups.

Table 3. Comparison of Pre-Test and Post-Test Scores for Knowledge and Attitude by Study Group

Variable	Mean	Median	Min.	Max.	Std. Dev.	95% CI	p value
Knowledge							
Control Group							
Pre-test	2.13	2.0	0	5	1.36	1.62–2.64	0.014
Post-test	2.87	3.0	0	5	1.01	2.49–3.25	
Intervention Group							
Pre-test	2.20	2.0	0	5	1.30	1.71–2.69	0.019
Post-test	2.60	3.0	0	5	1.16	2.17–3.03	
Attitude							
Control Group							
Pre-test	1.47	1.0	0	5	1.14	1.04–1.90	0.040
Post-test	2.33	2.5	0	5	1.47	1.78–2.88	
Intervention Group							
Pre-test	1.80	2.0	0	5	1.35	1.30–2.30	0.006
Post-test	2.40	3.0	0	5	1.45	1.86–2.94	

Table 3 presents the pre- and post-test scores for knowledge and attitude in both groups. Mean knowledge scores in the control group increased from 2.13 (pre-test) to 2.87 (post-test), while in the intervention group they increased from 2.20 to 2.60. The dependent t-test demonstrated statistically significant improvements in both groups (control: p = 0.014; intervention: p = 0.019). Mean attitude scores in the control group increased from 1.47 to 2.33, and in the intervention group from 1.80 to 2.40, with significant improvements in both (control: p = 0.040; intervention: p = 0.006).

Table4. Comparison of Post-Test Knowledge and Attitude Scores Between Groups (Mann-Whitney U Test)

Variable	Group	Median (Min–Max)	SD	95% CI	ρ
Knowledge	Intervention (Storytelling)	57 (0–86)	26.38	37.55–63.78	0.680
	Control (Lecture)	29 (0–71)	23.18	17.86–40.99	
Attitude	Intervention (Storytelling)	57 (0–86)	24.37	43.33–67.56	0.318
	Control (Lecture)	36 (0–71)	21.31	22.79–43.99	

Table 4 presents the between-group comparison of post-test scores using the Mann-Whitney U test. The results indicate that the storytelling intervention group achieved higher median scores for both knowledge (Median = 57) and attitude (Median = 57) compared to the lecture control group (Median = 29 for knowledge and 36 for attitude). However, despite these numerical differences, the Mann-Whitney U test revealed no statistically significant difference between the two groups for either knowledge (p = 0.680) or attitude (p = 0.318). The large standard deviations and wide minimum-maximum ranges (0–86) suggest high variability in the data, which likely influenced the statistical significance.

4. DISCUSSION

The present study found that female students constituted the majority of respondents in both the control (83.3%) and intervention (90.0%) groups. This finding aligns with Wahyuni & Krianto (2011), who reported no significant sex-based differences in disaster knowledge. White-Lewis et al. (2021) corroborated this in their quasi-experimental study, demonstrating that gains in disaster preparedness knowledge were not significantly influenced by sex among school-age students. As Pangesti (2012) argued, factors such as information access, willingness to learn, prior experience, and place of residence exert a far greater influence on preparedness than sex does.

The homogeneity of respondents' ages (7–8 years) across both groups is a methodological strength, minimizing potential bias attributable to differences in cognitive development. Children aged 7–8 years are in the concrete operational stage of cognitive development, wherein learning is most effective through direct experience and contextual narrative. This developmental characteristic makes the storytelling method theoretically well-suited for this age group. The narrative-based visual media, including animated video, significantly improved disaster preparedness knowledge among school-age children, affirming the efficacy of visual-narrative approaches at this developmental stage (Saparwati et al., 2020; Siswi & Setioputro, 2023; Afandi et al., 2026).

Both groups demonstrated significant improvements in knowledge scores following their respective interventions. The control group's mean knowledge score increased by 0.74 points (from 2.13 to 2.87), while the intervention group's increased by 0.40 points (from 2.20 to 2.60). Despite differences in magnitude, both improvements were statistically significant. These findings are consistent with Idrus, Zuhriyah, & Suharsono (2019), who showed that interactive media, both simulation and animated video significantly enhanced disaster preparedness knowledge among elementary school students in Ternate. Nekada et al. (2023) similarly found that media-based educational interventions produced statistically significant improvements in preparedness among students in volcanic hazard-prone areas.

The improvement in attitude was statistically more pronounced in the intervention group ($p = 0.006$) than in the control group ($p = 0.040$), suggesting that the storytelling method produces more consistent attitudinal changes. This is consistent with Steward & Wan (2007), who argued that storytelling helps learners comprehend real-world situations through contextualized case narratives. Arinata et al. (2023), in the Indonesian disaster education context, also found that structured, visually rich, narrative-based educational programs significantly improved disaster-response attitudes among elementary school students, underscoring the importance of methods that engage the affective domain.

The absence of a statistically significant between-group difference on the Mann-Whitney test (knowledge: $p = 0.680$; attitude: $p = 0.318$) suggests that the short-term effectiveness of both approaches was comparable. This outcome is understandable, given that all

respondents received information on disaster preparedness. However, several studies suggest that the advantages of culturally grounded narrative methods may be more apparent in longer-term evaluations. Kurniawan & Nirmalasari (2023) reported meaningful preparedness improvements through visual-narrative media interventions among students in volcanic hazard areas, while Yildiz et al. (2023) demonstrated that locally contextualized approaches generate stronger knowledge-to-behavior transfer, as culturally familiar narratives are more readily retained and internalized by children.

The significant improvement observed in the control group warrants discussion. Conventional classroom lectures, while traditional, remain a structured and information-dense pedagogical method that can effectively transmit foundational disaster knowledge in the short term. Furthermore, the "novelty effect" of participating in any structured health education program, coupled with the inherent motivation of school-age children to engage with new school activities, may have diluted the between-group differences in this short-term assessment. However, evidence suggests that while conventional methods yield immediate knowledge gains, culturally embedded narratives may sustain long-term behavioral retention and knowledge-to-action transfer more effectively. This aligns with school health practice frameworks and community nursing models that emphasize sustained, contextually relevant health promotion over isolated informational delivery.

The local wisdom-based storytelling model offers distinct advantages over conventional instructional methods. Mustofa (2020) argued that integrating local wisdom into disaster education provides deep cultural meaning, thereby increasing children's motivation to follow safety instructions. This is reinforced by Suryadi & Ulya (2024), who found that contextually grounded, community-based disaster education builds stronger preparedness among elementary school students. Perry (2004) further affirmed that narrative-based simulations that engage multiple community components produce a more comprehensive understanding of disaster management. Widyarani et al. (2021) added that empowering school-age children through locally grounded interactive media demonstrably enhances their preparedness for volcanic eruption disasters.

Overall, the findings of this study support the implementation of a local wisdom-based storytelling model as a

contextually appropriate, participatory disaster education method capable of improving not only knowledge but also attitudes and behavioral readiness. These findings contribute to strengthening disaster risk reduction (DRR) education, as advocated by the Sendai Framework 2015–2030 (UNISDR, 2015) and Indonesia's Safe Schools Program (SPAB), particularly by advancing child-centered, culturally sensitive disaster education in volcanic-hazard-prone communities such as Ternate City (BNPB, 2021).

5. CONCLUSION

Statistically significant improvements in knowledge were observed among students of SDN 81 Ternate City (elementary school) following the intervention, in both the control group ($p = 0.014$) and the intervention group ($p = 0.019$). Significant attitude improvements were likewise recorded in both groups (control: $p = 0.040$; intervention: $p = 0.006$). However, no statistically significant between-group differences were identified for either knowledge ($p = 0.680$) or attitude ($p = 0.318$) via the Mann-Whitney U test, indicating comparable short-term effectiveness of both methods.

The local wisdom-based storytelling model was effective in improving volcanic eruption disaster preparedness among elementary school students in disaster-prone areas of Ternate City, and is recommended as a contextually appropriate, participatory alternative for disaster education. To operationalize this, local Puskesmas and education offices can integrate these validated storytelling modules into routine school health programs (UKS) and community disaster preparedness drills. Future research utilizing longer intervention periods and larger sample sizes is needed to establish the long-term effectiveness.

AUTHOR CONTRIBUTIONS

RM: conceptualisation, study design, data collection, manuscript drafting. FNI: data analysis, interpretation of findings, manuscript review and editing. ABSA: literature review, methodology, final manuscript editing.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest in this research.

DATA AVAILABILITY STATEMENT

The data are available from the corresponding author upon reasonable request.

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