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The Impact of Playing a Snakes and Ladders Game about Mount Merapi Disaster Awareness on Students' Preparedness Knowledge at Kepuharjo Cangkringan Elementary School

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Abstract

Background: Indonesia is a country that is highly susceptible to natural disasters, particularly due to the frequent volcanic eruptions occurring on the island of Java. This situation underscores the importance of ensuring that students in disaster-prone regions are well-prepared for such events. Traditional outreach methods have often been deemed insufficient in enhancing students' understanding of disaster preparedness. In response to this challenge, this research introduces an innovative educational tool: modified "Disaster Snakes and Ladders" game. This game aims to improve students' readiness for a specific focus on the potential eruptions of Mount Merapi. The study's objective is to evaluate the effectiveness of the game in enhancing the understanding of disaster preparedness among students at Kepuharjo State Elementary School.
Method: Employing a quasi-experimental design with a one-group pre-test and post-test approach, the study selected fifty students through total sampling. Data collection involved administering questionnaires before and after game implementation.
Results: Analysis using the Wilcoxon Signed-Rank Test revealed promising results: initial scores averaged 17.08, increasing to 17.92 post-test. Statistical significance was confirmed p-value of 0.016, indicating a substantial improvement in students' disaster preparedness knowledge.
Conclusion: the Disaster Snakes and Ladders game effectively enhances elementary students' awareness and understanding of disaster preparedness, specifically geared towards Mount Merapi-related disasters.

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INTRODUCTION

There is a constant risk of earthquakes, tsunamis, floods, and volcanic eruptions throughout the Indonesian archipelago. Situated in the Pacific Ring of Fire, the nation experiences at least one large earthquake and one substantial volcanic eruption annually (UNDP, 2018). One of the most active volcanoes in Indonesia is Mount Merapi, which frequently erupts and affects the surrounding communities, including children who attend school in disaster-prone areas.

Mount Merapi is a mountain that is located between the provinces of Central Java and Special Region of Yogyakarta. The remaining southern side is located in the administrative division of Sleman, Yogyakarta and the other sides are located in Central Java, including Magelang Regency on the western side, Boyolali Regency on the northern and eastern sides, and Klaten Regency on the southeastern side. Mount Merapi, the world's most active mountain, has experienced eruptions since ancient times. In 2018, Mount Merapi's activity level was classified as alert as Waspada (level II) (National Park Association, 2025).

Disaster mitigation efforts around Mount Merapi have been carried out through various approaches involving different parties, from the government to local communities. Some disaster mitigation initiatives implemented in the Mount Merapi area include training programs for the community on how to respond to volcanic eruptions, evacuation procedures, and safety measures. Evacuation simulations and disaster response drills are conducted to ensure that the community can act quickly and effectively in emergency situations (Isnanto, 2025) The research conducted by (Ayuningtyas et al., 2021) that people living at the foot of Merapi showed signs of extraordinary resilience to the 2010 eruption. Community disaster resilience was partly built on well-developed informational capital. Present informational capital, which is modern and unique, is different from traditional approaches based on Merapi's spiritual volcanic culture. More specifically, regardless of the coping advantage, traditional informational capital embodies low potential risks.

The goal of mitigation is to limit the impact of disasters in order to minimize the loss of life and property. Mitigation is the process of taking steps now, before the next tragedy strikes, to lessen the financial and human costs later on (risk analysis, risk reduction, risk insurance) (Gougelet, 2016). Disaster mitigation is carried out through physical construction or regulations, as well as through awareness-raising or education efforts. According to the Head of the National Disaster Management Agency (BNPB) Regulation No. 4 of 2008, disaster mitigation is divided into structural mitigation and non-structural mitigation. Structural mitigation is implemented through physical development efforts and community infrastructure aimed at reducing disaster risk. Non-structural mitigation is conducted through awareness and education efforts to reduce disaster risk (Hayati, 2019) Response includes steps to lessen the effects, recovery includes restoring and rebuilding damaged places and resources, readiness includes empowering communities to improve their chances of surviving, and mitigation concentrates on lowering or eliminating hazard (Hermawan et al., 2024).

Eruption can effect consequently, high rates of generalized anxiety and psychological discomfort were reported, which gradually decline. Risk variables that were most frequently mentioned included exposure level, traumatic event experience, female gender, low income, low educational attainment, previous physical or mental health conditions, and lack of social support. Recent research has identified the feeling of place as a risk factor that might raise anxiety levels and the degree of unwillingness to leave one's home, increasing the risk to one's safety and the need for support services. Protective elements include social cohesion, resilience, and the ability to reconstruct one's life elsewhere before being able to return home (Malas & Tolsá, 2024).

Disaster Education provided in schools will certainly be very beneficial for students in the future. There are many aspects that can be explored in Disaster Education at school. This education can start from early childhood education up to elementary school and can even continue through secondary school and higher

education (Rahmawati et al., 2024). The core procedure of the disaster prevention workflow is disaster education. Effective disaster education creates a network of information sharing from the school to the family to the community, enabling students to learn the fundamentals of disaster avoidance and to react correctly in the case of a disaster. Increasing students' motivation to learn is crucial in disaster education rather than depending solely on cognitive instruction. Enhancing student interest and participation is largely dependent on the instructional strategy employed(Tsai et al., 2020) .

Students are one of the vulnerable groups in natural disasters, this happens because of the lack of knowledge, understanding, and skills of students towards natural disasters. Students need to have preparedness, as (Hafida et al., 2025) one key component of lowering the risk of disasters is preparedness, which involves students' knowledge and skills in dealing with emergencies. Based (Tsai et al., 2020) the findings demonstrated that students' disaster prevention abilities, learning interest, self-awareness, and sense of civic duty were all significantly impacted by the Battle of Flooding Protection learning package.

Therefore, early childhood education institutions, teachers, and parents must invite and involve children in disaster risk reduction programs using the snakes and ladders game as a learning medium that is valid, practical, and effective. Education in the form of engaging and enjoyable games for children can enhance their focus and increase their motivation to learn (Artha et al., 2020). There is universal agreement that disaster education initiatives for children will increase families' and kids' preparedness and resilience to catastrophes(Mohebi et al., 2018).

In addition to maintaining conventional games, learning media through the snake and ladder game can help address the issue of students finding it difficult to receive learning materials from their teachers, especially about mitigation(Utami & Mustari, 2020). These days, disaster education ought to be specifically addressed as a means of raising children's resilience and disseminating knowledge to lower the likelihood of disasters occurring in their homes (Mohebi et al., 2018).

Kepuharjo State Elementary School was selected as the research site due to its geographical proximity to Mount Merapi, one of the most active volcanoes in Indonesia. Located within a high-risk disaster-prone zone, the school and its students are directly vulnerable to the impacts of volcanic activity, including lava flows, ash fall, and pyroclastic surges. Historical data show that this region has experienced multiple eruptions, significantly affecting local communities and infrastructure. As such, there is a critical need to strengthen disaster preparedness among school-aged children in this area. By conducting the study in Kepuharjo, Cangkringan sub district, the research targets a population with a high urgency for disaster education, ensuring that the intervention is both contextually relevant and immediately beneficial to the community most at risk.

In conventional method for disaster education, the method tends to be one-way, where students only listen without any active involvement in the learning process. This leads to a low level of understanding and preparedness among students regarding disasters. Learning media Snakes and ladders is an educational media developed based on the traditional game, adjusted to the characteristics of students with the aim of achieving learning objectives as a substitute for information for students. Based on (Bai et al., 2024) seven distinct game types and 16 studies were identified between the database's creation and April 21, 2024, gamification teaching methods, such as tabletop games, VR-MGBAs, serious games, themed games, scenario-based simulations, escape rooms, and board games, are frequently used in disaster education and each has its own advantages.

These results are consistent with earlier research on game-based learning. Therefore, the purpose of this research is to evaluate the effectiveness of the modified “Disaster Snakes and Ladders” game in improving disaster preparedness knowledge among students at Kepuharjo State Elementary School, a school located in the high-risk area near Mount Merapi.

METHODS

The study conducted Quasi-experimental study that produces evidence with cause-and-effect relationships between research variables, namely examining whether one variable has an effect on other variables. With a pre-experimental design and a One Group Pre-Test Post-Test Design where there is only one subject being studied by conducting measurements before and after a treatment. The study population consisted of fourth and fifth-grade students from Kepuharjo State Elementary School, a school located in a disaster-prone area near Mount Merapi. Students in grades 4 and 5 (typically aged 9–11 years) are at a developmental stage where they begin to understand more complex concepts, including natural disasters. Students have sufficient reading and comprehension skills to engage with educational materials and activities, such as games or simulations, which are often used in disaster preparedness programs. The total population of 55 students (26 from grade IV and 29 from grade V, whose are the actual student numbers in each grade) was determined based on school approval and the suitability of age characteristics for the intervention. This research served as a pilot or preliminary study to evaluate the feasibility and effectiveness of a specific intervention a preparedness game, do a small, well-defined, and manageable population is appropriate at this stage. There were no other schools enrolled to this study. This approach was taken due to the relatively small and manageable population size and to ensure comprehensive data representation, so the sampling technique used was Total Sampling, a type of Nonprobability Sampling, where all students in the defined population were included as research subjects. Inclusion criteria were students enrolled in grades IV and V at Kepuharjo State Elementary School, students who obtained permission from their parents/guardians to participate, and students who were present during both the pre-test and post-test sessions. Exclusion criteria were students who were absent during either the pre-test or post-test, students who were unable to participate due to health or learning difficulties as identified by the school. Base on this, fifty students were enrolled to this study.

The intervention involved the use of a modified "Disaster Snakes and Ladders" game, which had been specifically adapted to include content related to volcanic disaster preparedness, particularly focusing on Mount Merapi. The game board and cards contained questions and scenarios addressing key concepts such as disaster preparedness, disaster impact, disaster management methods of Mount Merapi. The intervention was carried out over three sessions: Session 1 (45 minutes): Pre-test and introductory briefing about disaster preparedness and how to play the game. Session 2 (90 minutes): Game-based learning activity, facilitated by the researcher, who also acted as the counselor or instructor, with assistance from the classroom teacher and the last ession 3 (25 minutes) were post-test.

Knowledge about disaster preparedness was measured using a structured questionnaire developed by researcher, that was contain about: definition of eruption Mount Merapi, sign of eruption, causes and effect of eruption, prepadness, with total 20 questions. Students got 1 poin for right answer and 0 for false answer. The total of right answer were calculated by percentage. The measurement result fall into the Good category with a percentage of 76% - 100%; the Sufficient category with a percentage of 56% - 75%; and the Poor category with a percentage of ≤55%. The questionnaire underwent a content validation process by two experts in disaster education and public health. Pre-test and post-test scores were collected before and after the intervention using the validated questionnaire. Data were analyzed using the Wilcoxon Signed-Rank Test to evaluate changes in knowledge levels before and after the game-based intervention. A significance level of $p < 0.05$ was used

RESULTS AND DISCUSSIONS

This univariate data analysis was conducted to measure the level of knowledge of elementary school children about disasters, categorized into three levels: good, sufficient, and poor. Based on the research results, the characteristics of the respondents can be described based on social support as follows:

Table 1 Characteristics of the respondents

Category		Freq.	Percentage
Sex	**Male**	19	38.0
	Female	31	62.0
Grade	**4**	24	48.0
	5	26	52.0
Age	**8**	1	2.0
	9	15	30.0
	10	26	52.0
	11	6	12.0
	12	1	2.0
	13	1	2.0
Total		50	100.00

Table 2 Disaster Knowledge Pre- and post-Test at Kepuharjo State Elementary School

Category	Pretest		Posttest	
	f	%	f	%
Good	38	76	45	90
Sufficient	11	22	5	10
Poor	1	2	0	0
Total	50	100	50	100

It can be seen that the characteristics of the respondents based on the pre-test indicate that the majority have good disaster knowledge, with 38 respondents (76.0%).

Table 4 Normality test (One-Sample Kolmogorov-Smirnov Test) of Respondents' Knowledge Quality Scores at Kepuharjo State Elementary School

Group	Sig.	Description
Experimental Group Pre-Test	0.006	Not Normal
Experimental Group Post-Test	0.004	Not Normal

Table above states that the significance value is smaller than 0.05. This indicates that the data is not normally distributed, it showed this research should be tested by Wilcoxon test, so data was analyzed by univariat and bivariate Wlicoxon test (α 0,05).

Table 5 The Effect of Using Snake and Ladder Media

Variable	Effect of Using Snake and Ladder Media			
	Mean Pre	*Mean Post*	*Std. Dev*	*p-value*
Knowlegde	17,0800	17,9200	2,49477	0,016

Bivariate analysis was conducted to examine the influence between independent and dependent variables, specifically to see the effect of disaster education on the knowledge and preparedness of students at Kepuharjo State Elementary School, and whether these variables have a significant effect or are merely coincidental. The confidence level used is 95%, meaning the p-value must be less than 0.05

The research results indicate that there is a difference in the treatment of the snake and ladder game on the improvement of disaster knowledge among the students of Kepuharjo State Elementary School, with a significance value showing ($p = 0.016 < 0.05$).

Based on recent research, it has been established that using the snake and ladder game positively affects the improvement of disaster

knowledge among students at Kepuharjo State Elementary School. Snakes and Ladders fosters active participation. Students engage in discussion, ask questions, and apply knowledge while playing. This interactive approach increases motivation, focus, and involvement, all of which are linked to better learning outcomes. Due to the nature of gameplay, players often pass through the same squares multiple times, leading to repetitive exposure to disaster-related messages. Repetition is a powerful learning tool, especially for younger learners, as it enhances memory retention. The significance value from the Wilcoxon Test indicated a p-value of 0.016, which is less than the 0.05 threshold, confirming the effectiveness of this educational approach. This finding aligns with the broader context of disaster risk reduction and preparedness efforts, which are crucial in developing resilience among young learners.

Disaster preparedness is a critical component of effective disaster management. According to (Wiarto, 2017), preparedness refers to the readiness of individuals, officials, and service institutions, including health services, to take appropriate action during disasters. This encompasses training, resources, and the establishment of protocols that can significantly mitigate the impact of disasters on communities. Students preparedness need to be enhance preparedness, according to (Sahayati, Sri et al., 2025),the result of the study showed the majority of respondents have never taken part in training or exercises related to catastrophe warning.

According (Bai et al., 2024) their studies collectively highlight the effectiveness of gamified teaching in disaster education, underscoring the significance of improving students' practical skills and coping mechanisms through the practice and simulation of real-life situations. Furthermore, they suggest that by consistently investigating and evaluating various teaching methods, educators can identify the most appropriate approach to meet students' needs and enhance learning outcomes, ultimately elevating the overall quality of disaster education.

Based on the table of the Wilcoxon hypothesis test results on the pre-test and post-test data, or before and after the application of the snake and ladder media related to volcanic disaster material, the significance value (2-Tailed) is 0.016, showing a significant difference between the scores before using the snake and ladder media and after using the developed snake and ladder media, as assessed through the post-test and pre-test of the students at Kepuharjo State Elementary School. This demonstrates that the teaching media developed by the researcher, in the form of a disaster-themed snake and ladder game, is effective in learning because it can enhance the understanding of students participating in the School Disaster Preparedness extracurricular activities regarding volcanic disaster preparedness related to Mount Merapi.

Several studies have investigated the use of snakes and ladders to help children cope with disasters. Games are entertaining resources that can be used to gauge disaster mitigation. Although the majority of students were in the ready category, there were still several in the almost ready and less ready categories, as well as one who was not ready, according to the results of the preparedness data analysis conducted before to the counselling (Astini et al., 2017). For the purpose of improving children's comprehension of earthquake disasters, this game was created especially (Nirmala et al., 2021). Based on (Utami & Mustari, 2020) study used tangga ular games to teach English language skills, which must be applied in a methodical manner. Based on the results of the pre-test and post-test, using the ular tangga game can raise the level of student satisfaction during the learning process by ensuring that there are no problems that students or teachers have during the process. (Setiawan & Phillipson, 2019; Utami & Mustari, 2020).

According (Yudanagara et al., 2024) the disaster preparedness education activity attended by 32 students from grades 4, 5, and 6 of Pagerluyung 02 State Elementary School, Mojokerto State, showed full enthusiastic involvement from both teachers and students. In addition, there was an increase in participants' understanding of the material provided, as evidenced by the 100% correct answers to questions during the snake and ladder game regarding: signs of natural

disasters, causes of natural disasters, disaster mitigation, and knowledge about institutions/ parties responsible for disaster management. The evaluation results of the educational game display showed that 87.5% (28) of the participants strongly agreed and 12.5% (4) of the participants agreed that the display of the Rangga-Erina educational game was attractive. Based on (Seddighi et al., 2020) students can be prepared for climate-related disasters by playing snakes and ladders games, which is a crucial part of disaster risk reduction and resilience building. students should be equipped with the knowledge and abilities necessary to deal with the effects of climate-related disasters because they are particularly susceptible to them.

CONCLUSION

Based on the data analysis results and the discussion, the following conclusions can be drawn Before the implementation of the snake and ladder game for preparedness, 38 students (76%) had good knowledge, while 11 students (22%) had sufficient knowledge. After the implementation of the snake and ladder game for preparedness, 45 students (90%) had good knowledge, and 5 students (10%) had sufficient knowledge. This finding highlights the game's effectiveness as an educational tool for disaster preparedness. The practical benefits of this increased knowledge are substantial. For students, it fosters better decision-making in emergency situations, enhances confidence, and builds lifelong awareness of disaster safety. For schools, it contributes to a stronger culture of preparedness, making safety education more engaging and impactful while also improving the quality and relevance of emergency drills. From a broader perspective, this approach supports national disaster risk reduction efforts by providing a scalable, low-cost educational method that can be replicated in other disaster-prone areas. It also helps extend awareness beyond the classroom, as students often share what they learn with their families and communities, contributing to greater resilience at the community level

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