

## Evaluating the effectiveness of local wisdom-based disaster mitigation education in primary schools

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**Abstract:** This study aims to evaluate the effectiveness of a disaster mitigation education program based on local wisdom in enhancing disaster preparedness among primary school students. A quasi-experimental design with a non-equivalent control group was employed, involving 346 students from Medan and Yogyakarta. The experimental group received an intervention incorporating local cultural values and practices into disaster education, while the control group followed the standard curriculum. Data were collected using pre-tests and post-tests and analyzed using paired and independent t-tests. The findings indicate a statistically significant improvement in the experimental group's understanding of disaster mitigation, with a post-test average score of 78.4 compared to 52.3 in the control group ( $p < 0.001$ ). The results highlight the effectiveness of integrating local wisdom into disaster education to enhance students' contextual understanding and readiness. In conclusion, the local wisdom-based model presents a promising and culturally relevant approach to disaster education. Practical implications suggest that policymakers and educators should adopt this model to foster disaster-resilient behaviors from an early age, particularly in regions prone to climate-induced hazards.

**Keywords:** Disaster mitigation education, Disaster preparedness, Elementary school, Local wisdom, Quasi-experiment.

### 1. Introduction

Disaster preparedness in educational settings has garnered significant attention from various organizations, including the American Academy of Pediatrics and the National Association of School Nurses, who emphasize the necessity of integrating disaster preparedness plans into schools [1]. Incorporating disaster simulations and mitigation training into school curricula can foster psychological resilience, equipping students with the skills to effectively manage disaster situations [2-4]. Implementing comprehensive frameworks like Disaster-Prepared Schools and Safety Models, which adopt a multi-hazard approach, represents a strategic measure to ensure schools are well-equipped for various types of disasters.

One key issue that amplifies disaster risk is the lack of awareness and knowledge about disaster risk reduction among children. This gap largely stems from the insufficient integration of local context into elementary school curricula, which limits students' practical understanding of disaster preparedness [5-9]. Current curricula predominantly emphasize theoretical knowledge, with limited focus on practical applications that could aid children in effectively responding to disasters. Furthermore, many teachers lack adequate training in disaster preparedness education, which hinders their ability to impart relevant skills and knowledge. The availability of resources, such as teaching materials and simulation facilities, is often limited, with insufficient support from schools and families, further obstructing the promotion of

disaster preparedness programs [10-12]. Therefore, there is an urgent need for more practical and locally informed disaster preparedness education models.

Effective disaster preparedness requires the collaborative effort of students, teachers, families, and communities. Research shows that students who are well-trained in disaster preparedness exhibit better response skills, thereby reducing injury and fatality risks during disaster events [13, 14]. Teachers play a crucial role in this educational process and must employ interactive and practical teaching strategies to ensure comprehensive student understanding [15-17]. Additionally, the involvement of families and communities is essential, as disaster preparedness should extend beyond the school environment. Engaging parents and communities in disaster preparedness initiatives fosters a culture of resilience, strengthening the broader community's ability to mitigate the impact of disasters [18-21].

A preliminary study involving 36 students and 27 teachers revealed that understanding and preparedness for disaster mitigation in schools remain very limited. The majority of students (93.3%) had never heard of disaster mitigation education, with only 6.7% understanding the concept, and most (98.3%) had never seen related teaching materials or participated in disaster response simulations. Only 16.7% of students knew how to prevent flooding, and a small percentage (1.7%) had a plan to deal with such events. On the teachers' side, 88.9% reported the existence of disaster management policies in their schools, yet none had organized disaster simulations, and only a small number of schools had extracurricular activities or visual materials related to disaster preparedness. While both students and teachers recognized the importance of disaster mitigation education, practical implementation and training in schools remain minimal. These findings indicate a gap between awareness and action, highlighting the need for increased training and educational materials to enhance disaster preparedness in schools.

The lack of disaster mitigation education and preparedness in schools, as highlighted by the study, poses significant negative impacts. Without proper knowledge and training, students remain highly vulnerable during disaster events, increasing the risk of injury, panic, and even fatalities [22-24]. The absence of disaster response simulations and practical education leaves both students and teachers unprepared to handle emergencies, potentially leading to chaotic evacuations and ineffective responses [25-27]. Additionally, the limited availability of educational materials and extracurricular activities focusing on disaster preparedness hinders the development of long-term resilience among the school community [28-30]. The disconnect between awareness of the importance of disaster education and its implementation exacerbates these vulnerabilities, potentially putting entire school populations at risk during natural disasters. Addressing this issue promptly is critical to ensure that schools become safer environments, equipped to foster a culture of preparedness and resilience among students, teachers, and the broader community.

In the context of primary schools in Indonesia, specific steps are required to enhance disaster preparedness education based on research findings. Schools must develop resilience policies and adopt culturally relevant teaching methods that engage students effectively [31, 32]. While [25-27]. Indonesia has established policies promoting disaster-safe education, the implementation of these guidelines remains inconsistent across the country. Innovative educational tools, such as multimedia and interactive games, have proven effective in engaging students and enhancing disaster preparedness education [33-36]. Moreover, integrating Disaster Risk Management (DRM) into the curriculum and promoting a culture of school safety are vital for equipping students with essential disaster mitigation skills [37-39].

Incorporating local wisdom into disaster risk reduction curricula can provide additional benefits, making disaster preparedness education more relevant and effective. Local wisdom, which includes traditional disaster response methods, can enhance understanding by offering context-specific strategies that resonate with students' everyday lives [40, 41]. This approach fosters community identity and collective responsibility, which are key to building resilience at a community level [42, 43]. Therefore, an education model that combines local wisdom and practical disaster mitigation strategies has the potential to significantly improve disaster preparedness among Indonesian students.

The objectives of this study are as follows: (1) to evaluate the effectiveness of local wisdom-based disaster mitigation education programs in improving primary school students' understanding and preparedness for disaster risks; (2) to analyze the contribution of local wisdom understanding to students' preparedness in facing disaster situations, by looking at the extent to which local knowledge influences their preparedness behavior; and (3) to provide an empirical basis for the development of more inclusive and local culture-based disaster mitigation education policies, aimed at building a younger generation that is more responsive to disaster threats in their environment.

## 2. Method

### 2.1. Research Design

This research uses a quasi-experimental design with a Non-Equivalent Control Group Design approach, which involves two groups, namely the experimental group and the control group. This design allows the evaluation of the effectiveness of local wisdom-based disaster mitigation education programs through the comparison of two groups, namely the experimental group that received the program intervention and the control group that did not receive the intervention. This design aims to ensure that changes in understanding or attitudes towards disaster mitigation in the experimental group can be attributed directly to the program provided, not other external factors.

Before the intervention began, both groups were given a pre-test to measure the initial level of understanding about disaster mitigation. After the local wisdom-based program was implemented in the experimental group for three months, both groups were again given a post-test to assess changes in understanding. The design of this research can be described as follows:

**Table 1.**  
Research Design.

Group	Pre-test (O1)	Intervention	Post-test (O2)
Experiment	O1	Local wisdom-based mitigation program	O2
Control	O1	No intervention	O2

A comparison between the pre-test and post-test results in each group, as well as the difference in results between the experimental and control groups, was used to assess the effectiveness of the program.

### 2.2. Population and Sample

The population in this study were elementary school students in 12 schools located in two cities, Medan and Yogyakarta, which were selected based on areas that have natural disaster risks. The selection of these schools is based on the relevance of the area to the context of local wisdom-based disaster mitigation education, so that the results of the study can describe the understanding and preparedness of students in areas characterized by disaster risk.

The sample was drawn using purposive sampling method to ensure proper representation of the students in each school. With this method, the study involved a total of 346 students, consisting of 172 students in the experimental group and 174 students in the control group. Each school contributed about 14-15 students to each group, providing an adequate sample size for reliable analysis. The equal distribution of samples between Medan and Yogyakarta as well as the experimental and control groups aimed to ensure the conformity of the results to the research objective, which was to evaluate the effectiveness of the local wisdom-based mitigation program in improving students' understanding and preparedness for disasters. Table 2 shows the distribution of samples by city and research group.

**Table 2.**  
Distribution of Research Samples.

City	Number of Schools	Experiment Group	Control Group	Total Sample per City
Medan	6 schools	87 students (14-15 students/school)	88 students (14-15 students/school)	175 students
Yogyakarta	6 schools	85 students (14-15 students/school)	86 students (14-15 students/school)	171 students
Total	12 schools	172 students	174 students	<b>346 students</b>

This distribution allows for a balanced and representative evaluation, and facilitates comparison of results between the experimental and control groups in each city.

### 2.3. Research Instruments

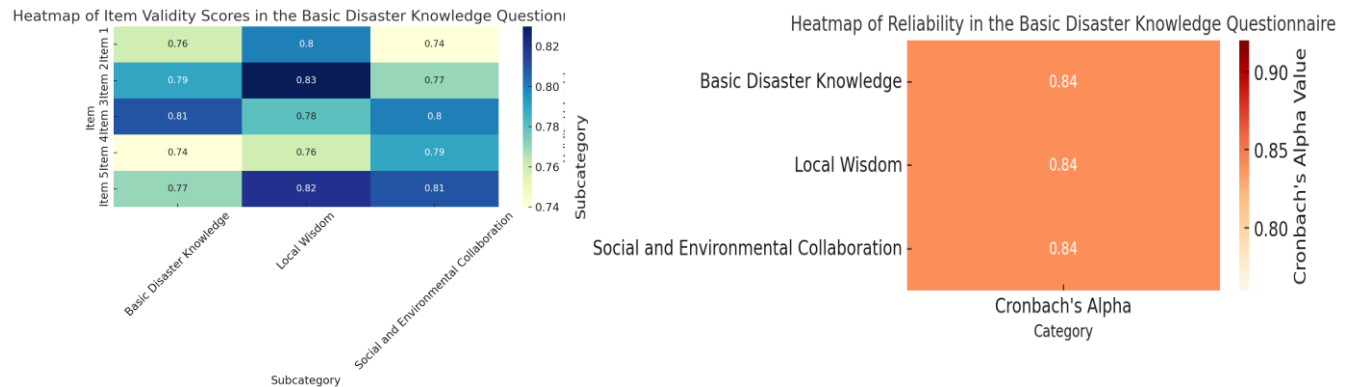
This research instrument includes three main components used to evaluate students' understanding and preparedness in local wisdom-based disaster mitigation, namely a basic knowledge questionnaire, pre-test and post-test instruments, and a Likert scale for preparedness attitudes.

The basic knowledge questionnaire consists of 15 statements covering students' understanding of different types of natural disasters, natural signs that can be recognized as early warnings, and preventive measures such as tree planting and environmental management. This instrument ensures students have a strong knowledge base in disaster mitigation. The lattice of the basic knowledge instrument is presented in Table 3.

**Table 3.**  
Questionnaire on Basic Knowledge of Disaster Mitigation.

Category	Statement	1	2	3	4	5
Basic Disaster Knowledge	I know the types of natural disasters that may occur in my area.					
	I can recognize signs of volcanic activity, such as smoke coming out of the mountain.					
	I understand the main causes of floods and how to prevent them.					
	I know the safety measures to take during an earthquake.					
	I can explain how to prevent landslides by planting trees in vulnerable areas.					
Local Wisdom	I recognize a traditional ceremony in my area that aims to prevent natural disasters.					
	I know about folktales that contain messages to deal with natural disasters.					
	I understand how traditional techniques of local communities help reduce the risk of disasters such as floods and landslides.					
	I believe that local wisdom is important to include in disaster mitigation education.					
	I understand the values contained in folklore or traditional ceremonies related to disasters.					
Social and Environmental Collaboration	I believe that keeping the environment clean through gotong royong can prevent flooding.					
	I think that planting trees on open land can reduce the risk of landslides in my area.					
	I am ready to participate in disaster simulation activities or evacuation drills at school.					
	I know how to communicate with authorities or family during a natural disaster.					
	I believe that cooperation between the community, school and government is important for more effective disaster mitigation in our area.					

Furthermore, this questionnaire was tested for validity and reliability to see the level of reliability of the instrument. The results of the validity and reliability tests are presented in the following figure.



**Figure 1.**  
Results of Validity and Reliability Test of Questionnaire on Basic Knowledge of Disaster Mitigation.

Based on figure 1, it is known that the item validity value is above 0.6 and reliability is 0.84, this questionnaire is proven to be valid and reliable to measure students' understanding of basic disaster mitigation knowledge, local wisdom, and social and environmental collaboration in the context of disaster mitigation. The reliability value of 0.84 was evenly applied to each category, indicating good consistency throughout the questionnaire. The colors on this heatmap reflect the level of reliability, with darker colors indicating higher reliability values.

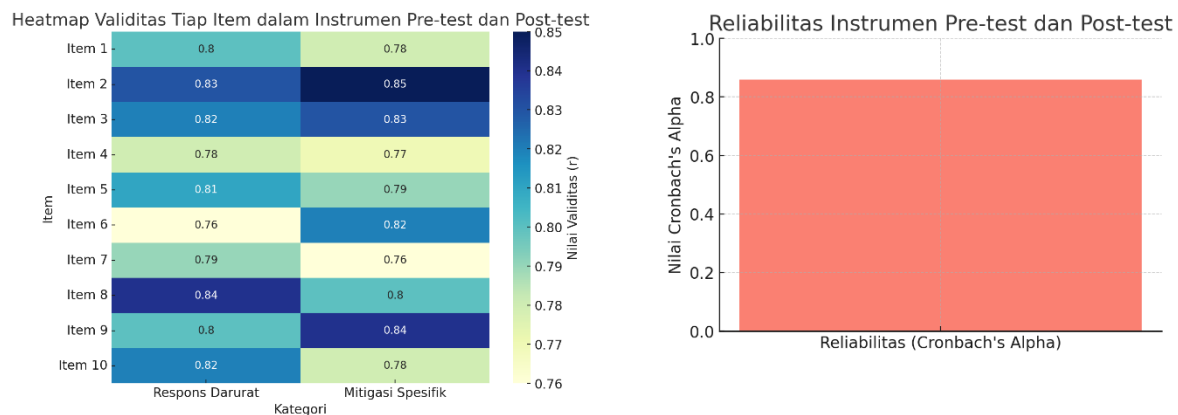
Furthermore, the pre-test and post-test instruments consisted of 20 multiple-choice questions, designed to measure students' understanding of emergency response actions and mitigation strategies specific to certain types of disasters, such as earthquakes, floods and landslides. With this instrument, researchers can compare students' understanding before and after the education program to see the effectiveness of the intervention.

**Table 4.**  
Instruments Pre-test and post-test instruments Pre-test and post-test instruments.

Section	No.	Question	Answer Options
Emergency Response	1	What to do first when you hear a disaster warning sign?	A. Hiding indoors B. Running without direction C. Following evacuation procedures D. Contact a friend
	2	What equipment should be prepared in a disaster emergency situation?	A. Books and stationery B. Flashlight, food, and water C. Toys and clothes D. Medicines and television
	3	What are the main objectives of disaster drills in schools?	A. Occupy free time B. Teaching students how to save themselves C. Increase physical activity D. Reduces anxiety
	4	What are the first steps in evacuation in the event of an earthquake?	A. Run out of the building B. Take cover under the table C. Standing by the window D. Waiting in place until the earthquake is over
	5	What to do when there is a fire at school?	A. Waiting for instructions from the teacher B. Run out of the building as fast as possible C. Search for the source of the fire D. Stay in the room
	6	Why is it important to follow the designated evacuation route?	A. In order not to get lost B. To get out faster C. For an organized evacuation process D. In order to find friends
	7	If there is an earthquake in the building, the safest move is?	A. Take shelter under a sturdy building B. Take cover under the table C. Run out D. Standing by the window
	8	What to do after a successful evacuation?	A. Waiting for help in a safe place B. Back to the building C. Run to find a friend D. Waiting at the evacuation site
	9	What is the main function of a flashlight in a disaster?	A. Save energy B. Keeping warm C. Guide the way in dark areas D. Entertaining yourself
	10	Why is it important to know the evacuation rally point at school?	A. In order to meet with friends B. So that all can be evacuated safely C. To be able to eat together D. To know when it's done
Disaster Specific Mitigation	1	What are the main causes of flooding?	A. Strong wind B. Heavy rain and clogged drains C. Earthquake D. Humid air
	2	What are effective ways to prevent landslides?	A. Cutting trees on slopes B. Planting trees on the hillside C. Building a house on a hillside D. Digging soil on slopes
	3	What to do during a volcanic eruption?	A. Looking directly at the direction of the eruption B. Evacuate to a safe place

			C. Closer to the river D. Waiting for instructions
4	What are the best precautions for flooding?		A. Raising the house B. Avoid living near rivers C. Storing tall items D. All right
5	How to anticipate the dangers of earthquakes?		A. Avoiding vulnerable buildings B. Building a house on vulnerable land C. Waiting indoors D. Standing by the window
6	What should be done if a landslide occurs around the house?		A. Hiding in the house B. Evacuate to a safe place C. Walk towards the landslide D. Stay indoors
7	What are the early signs of a volcanic eruption?		A. Sulfur odor and vibration B. Heavy rain C. Cloud color change D. Increased wind speed
8	What are the measures to prevent flooding in urban areas?		A. Littering, B. Regular gutter cleaning C. Widen the road D. Cutting down trees around the river
9	What is proper earthquake mitigation?		A. Take cover under the table B. Stay away from windows and glass C. Following evacuation procedures D. All right
10	What to prepare before a flood?		A. Packing up valuables B. Digging a trench around the house C. Raising the furniture D. All right

The results of the validity and reliability tests of the pretest and posttest instruments are presented in Figure 2.



**Figure 2.**

Results of Validity and Reliability Test of Pre-test and Post-test Instruments Pre-test and post-test instruments.

Based on the validity heatmap in figure 2, it can be seen that the validity value of each item in the "Emergency Response" and "Specific Mitigation" categories with a correlation of more than 0.6. Each value is displayed in a color gradation that reflects the correlation level of each item, confirming that the instrument has high validity for each component measured. In addition, the reliability graph shows that

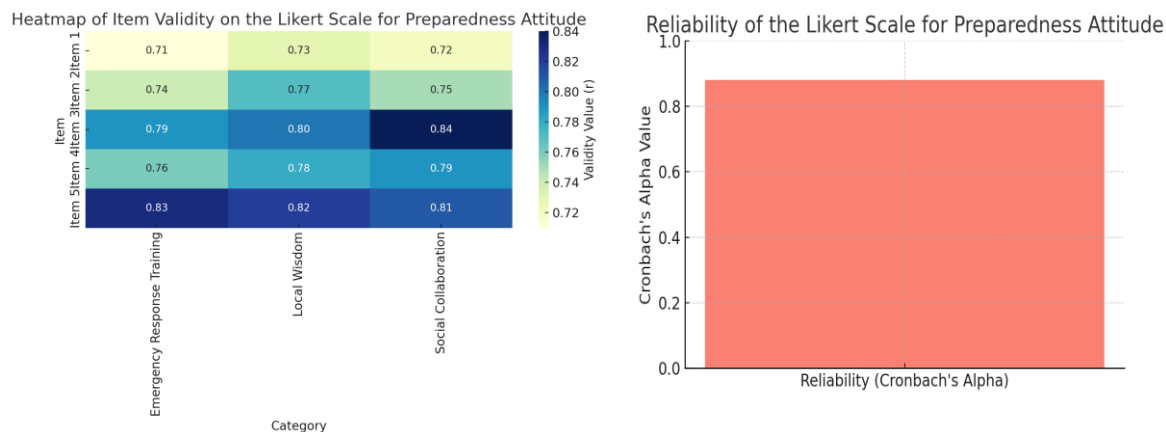
the instrument has a Cronbach's Alpha value of 0.86, signifying excellent internal consistency among the measurement items. This value indicates that all items in the instrument are strongly related, ensuring stable and reliable results when the instrument is used in measurement.

Furthermore, Table 5 shows a questionnaire containing 15 statements assessing students' attitudes towards the implementation of emergency response drills, their perception of the role of local wisdom in mitigation, and the importance of social collaboration and environmental management in disaster preparedness. This scale allows the measurement of students' level of agreement with statements that reflect their disaster preparedness attitudes.

**Table 5.**  
Preparedness Questionnaire.

No.	Statement	1	2	3	4	5
Attitude Toward Emergency Response Training						
1	I feel that the emergency response drills conducted at school help me to be better prepared for disasters.					
2	I believe that conducting evacuation simulations periodically is important for students' safety during disasters.					
3	Emergency response drills are useful to reduce panic when a disaster occurs.					
4	I always feel enthusiastic when participating in disaster drills at school.					
5	Schools should provide more disaster simulation sessions to improve student preparedness.					
Perception of Local Wisdom in Mitigation						
6	I believe that traditional ceremonies can help reduce the impact of disasters in my community.					
7	I felt it was important to learn folklore related to how to deal with disasters.					
8	Traditional techniques from local wisdom can help reduce the risk of natural disasters.					
9	Using local wisdom methods in disaster mitigation should be taught in schools.					
10	I support the use of local wisdom as part of disaster mitigation strategies in my neighborhood.					
Social and Environmental Collaboration						
11	Working with communities is essential in reducing disaster risk.					
12	Good environmental management, such as planting trees, can help reduce the impact of disasters.					
13	I believe that effective communication between citizens is essential during a disaster.					
14	I feel that every citizen, including students, should be actively involved in disaster mitigation efforts in their neighborhood.					
15	Active participation in disaster-related mutual aid activities can help create a safer environment.					

Furthermore, the results of the validity and reliability test of the preparedness questionnaire are presented in Figure 3.



**Figure 3.**  
Validity and Reliability Test Results of the Preparedness Attitude Questionnaire.



Figure 3 shows that the validity and reliability values of the Preparedness Attitude Questionnaire show significant results. The heatmap shows the correlation between each item in the categories of Emergency Response Training, Local Wisdom, and Social Collaboration, showing correlation values above 0.6. This result emphasizes the strong relationship between the items in each category, which is interpreted visually through the intensity levels in the heatmap, demonstrating consistent internal validity in this scale. In the reliability evaluation, Cronbach's Alpha analysis yielded a value of 0.88. This value indicates an excellent level of reliability, reflecting the high internal consistency of the instrument used. This high reliability value indicates that the preparedness attitude scale has excellent stability and reliability in measuring individual responses to aspects of preparedness, thus strengthening the validity of the overall research results.

#### 2.4. Data Analysis

In this study, data analysis was conducted using several statistical techniques to evaluate the effectiveness of the local wisdom-based disaster mitigation education program and measure the relationship between students' understanding of local wisdom and disaster preparedness. Before conducting the main analysis, a prerequisite test was conducted to ensure that the data met the necessary assumptions.

These prerequisite tests include normality to test data distribution, homogeneity to ensure similarity of variance between groups, independence test to ensure that the samples in each group are not interdependent, linearity test to evaluate the linear relationship between variables, and multicollinearity test to ensure there is no high correlation between independent variables that may interfere with regression analysis. After fulfilling the prerequisite tests, to determine the significant difference between the pre-test and post-test results in each group (experimental and control), the paired t-test was used. This test aims to assess whether there is a significant increase in students' understanding and preparedness for disasters after participating in a local wisdom-based intervention program.

In addition, the comparison of pre-test and post-test results in the control group was done to ensure that the changes that occurred in the experimental group could be attributed directly to the program provided, rather than other external factors. To compare the post-test results between the experimental group and the control group, an independent t-test was used. This test aims to determine whether there is a significant difference in the level of understanding of disaster mitigation between students who participated in the local wisdom-based program and students who did not participate in the program. If the test results show a significant difference, then this program can be considered effective in improving student preparedness.

Finally, to identify the relationship between students' understanding of local wisdom and their disaster preparedness, a linear regression analysis was conducted. This analysis aims to evaluate the extent to which understanding of local wisdom affects students' preparedness, with understanding of local wisdom as the independent variable and preparedness as the dependent variable.

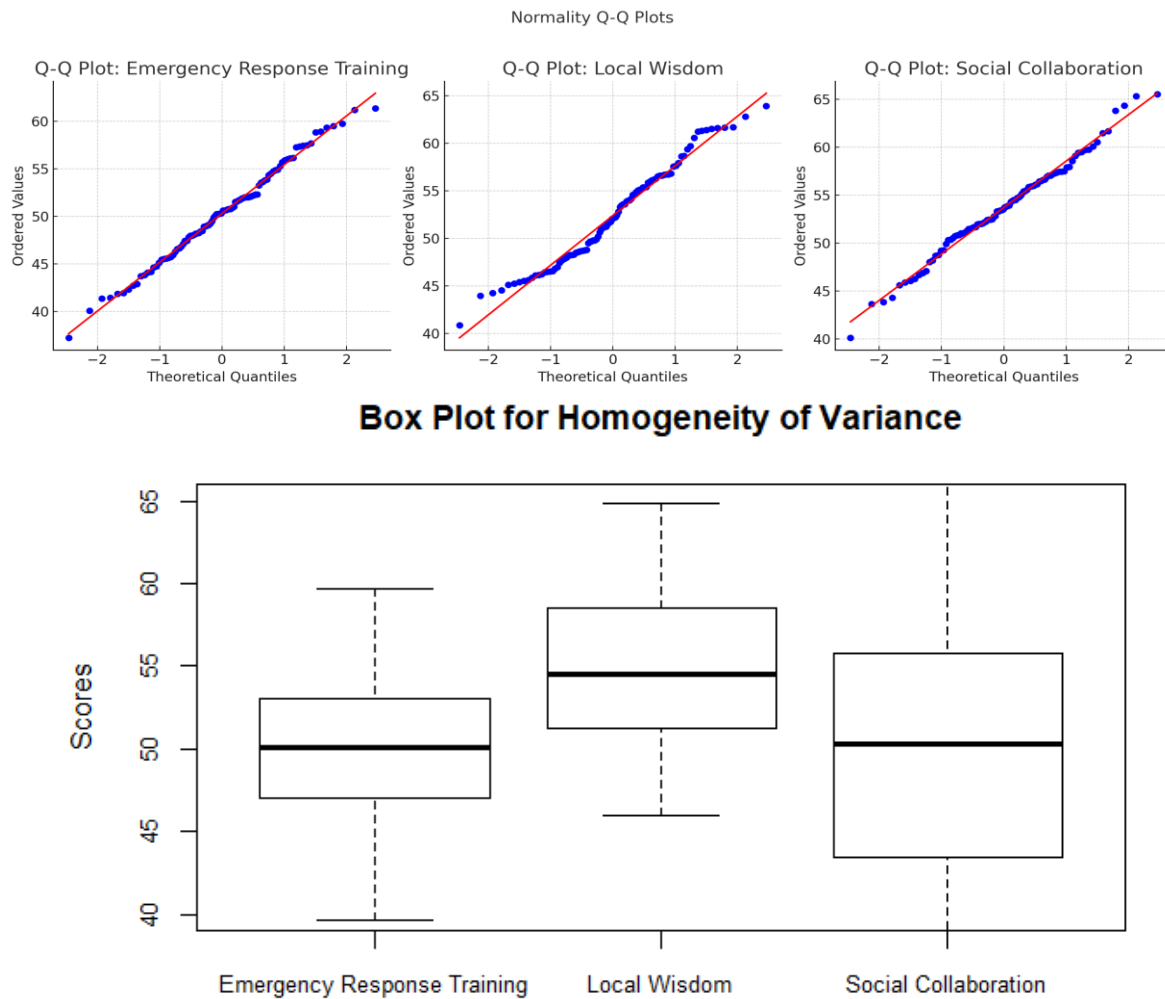
### 3. Results

#### 3.1. Pre-requisite Test

Before analyzing the pretest and posttest results, a prerequisite test was conducted to ensure the data met the required statistical assumptions, namely normality, homogeneity of variance, independence, linearity, and multicollinearity tests. This test is important to ensure the validity and reliability of the analysis results, so that the comparison of pretest and posttest scores can be interpreted accurately in evaluating the effectiveness of local wisdom-based disaster mitigation education programs. The prerequisite test results are presented as follows.

### 3.1.1. Normality and Homogeneity Test Results

The normality test was conducted using the Shapiro-Wilk test, while the homogeneity of variance test was conducted using the Levene test. These two tests were used to ensure that the data had a normal distribution and homogeneous variance, thus fulfilling the statistical assumptions required before proceeding to the next stage of analysis. The results of the normality and homogeneity tests are presented in the following figure 4.



**Figure 4.**  
Normality and Homogeneity Test Results.

Figure 4 displays the results of the normality and homogeneity tests for the three categories of variables: *Emergency Response Training*, *Local Wisdom*, and *Social Collaboration*. At the top of the figure, there is a Q-Q plot graph for each variable that shows the normal distribution of the data. Based on the Q-Q plot, the data points on the three variables tend to follow the diagonal line, indicating that the data is close to normal distribution in each category. This distribution meets the assumption of normality, which is important for the validity of the statistical tests to be applied to the data.

Furthermore, the bottom part of the figure displays the *box plot* for the homogeneity of variance test, which shows the distribution of scores in each category. The *box plot* results show that the variability of scores among the three categories is relatively uniform, although there are some outliers in the *Social*

*Collaboration* category. The outliers did not significantly affect the homogeneity of variance, as indicated by the consistent range and distribution of data among the categories. Overall, these results indicate that the data meet the assumption of homogeneity of variance, which allows the use of further statistical analysis without any bias from differences in variance between groups. With the assumptions of normality and homogeneity met, this data is valid for further testing in order to evaluate the effects of local wisdom-based disaster mitigation education programs.

### 3.1.2. Independence Test Results

The results of the independence test were carried out using the Durbin-Watson Test for multiple linear regression models. The test results are presented in Table 6.

**Table 6.**  
Independence Test Results.

Model	Durbin-Watson Value
Multiple Linear Regression	1.98

Table 6 shows a value of 1.98. This value is close to 2, which indicates the absence of autocorrelation in the residual data. Thus, the independence assumption is met, so that the multiple linear regression model used can be relied upon for further analysis without any bias due to autocorrelation between residuals.

### 3.1.3. Linearity Test Results

Table 7 presents the results of the linearity test which aims to confirm the existence of a significant linear relationship between the independent variables (*Emergency Response Training*, *Local Wisdom*, and *Social Collaboration*) and the dependent variable. This test is important as one of the prerequisites in linear regression analysis, where a linear relationship is required for model validity. The F value and significance (p) displayed in the table indicate the level of strength of the linear relationship of each independent variable to the dependent variable in the model used.

**Table 7.**  
Linearity Test Results.

Independent Variable	F Count	Significance (p)	Interpretation
Emergency Response Exercise	12.58	0.001	Significant linear relationship
Local Wisdom	9.76	0.003	Significant linear relationship
Social Collaboration	15.23	0.000	Significant linear relationship

Based on table 7, the F-test results show that each independent variable has a significant linear relationship with the dependent variable, characterized by a significance value (p) that is smaller than 0.05 (Emergency Response Training:  $p = 0.001$ ; Local Wisdom:  $p = 0.003$ ; Social Collaboration:  $p = 0.000$ ). This indicates that all independent variables meet the assumption of linearity, making them valid for inclusion in linear regression analysis.

### 3.1.4. Multicollinearity Test Results

The next prerequisite test is the multicollinearity test to ensure that the independent variables do not have a high linear relationship with each other. This test aims to identify potential multicollinearity, which can affect the stability and interpretation of regression coefficients. The multicollinearity test results for the independent variables are presented in Table 8.

**Table 8.**  
Multicollinearity Test Results.

Independent Variable	VIF	Tolerance
Emergency Response Exercise	1.85	0.54
Local Wisdom	2.10	0.48
Social Collaboration	1.92	0.52

Based on table 8, it is known that the *Variance Inflation Factor* (VIF) values for the three variables are below the threshold of 10 (i.e. 1.85, 2.10, and 1.92), and the *Tolerance* value is above 0.1, which indicates that the three independent variables are free from significant multicollinearity. Based on the results of the prerequisite test, all assumptions are met so that they can be tested further in order to evaluate the effects of local wisdom-based disaster mitigation education programs.

### 3.1.5. Pre-test and Post-Test Results

#### 3.1.5.1. Description of Findings

Analysis of the pre-test results in both groups showed that the students' level of understanding of disaster mitigation was at a low level, with an average score below 50% of the maximum score. These results indicate that before the intervention, both the experimental and control groups had a limited understanding of disaster mitigation. After the three-month local wisdom-based education program in the experimental group, the post-test showed a significant increase in the mitigation understanding score of the group compared to the control group. The experimental group obtained a significantly higher average score than the control group, which showed only a slight improvement. Statistical tests using *paired t-test* on the experimental group showed a significant improvement between the pre-test and post-test results. In addition, an *independent t-test* between the experimental and control groups on the post-test showed significant differences, supporting the effectiveness of the local wisdom-based mitigation program in improving students' understanding.

**Table 9.**  
Pre-test and Post-test Results of Experimental and Control Groups.

Group	Average Pre-test	Post-test Average	Paired t-test (p-value)
Experiment Group	45.2	78.4	< 0.001
Control Group	46.0	52.3	0.08

Table 9 shows a significant difference in disaster mitigation understanding between the experimental and control groups. In the experimental group, the average pre-test score of 45.2 increased significantly to 78.4 in the post-test, with the paired t-test results showing a p value < 0.001. This indicates that the local wisdom-based disaster mitigation program provided a substantial increase in understanding. In contrast, in the control group, the average pre-test score of 46.0 only increased slightly to 52.3 in the post-test, with *paired t-test* results showing a p value = 0.08, which is not significant. This confirms that without the program intervention, students' understanding of disaster mitigation did not increase significantly.

### 3.2. Effectiveness of Local Wisdom-Based Disaster Mitigation Education Program

To assess the success of the local wisdom-based disaster mitigation education program, a program effectiveness analysis was conducted by comparing the post-test results between the experimental and control groups. This analysis aims to determine the extent to which the local wisdom-based program is able to improve students' understanding of disaster mitigation compared to groups that do not receive similar interventions. The results of the program effectiveness analysis are presented in the table 10.

**Table 10.**

Test Results of the Effectiveness of the Disaster Mitigation Education Program.

Aspects	Experiment Group	Control Group	Statistical Test	Interpretation
Average Post-test Score	78.4	52.3	<i>Independent t-test</i>	The increase in understanding in the experimental group was significantly higher than the control group ( $p < 0.001$ ).
Program Effectiveness	Effectively improves student understanding	No significant improvement	$p < 0.001$	Local wisdom-based education is effective in improving students' understanding of disaster mitigation.

The Table 10 shows that the local wisdom-based disaster mitigation education program significantly improved students' understanding of disaster mitigation strategies. The average post-test score in the experimental group that participated in this program was 78.4, much higher than the control group which had an average post-test score of 52.3. The *independent t-test* results with a p value of  $< 0.001$  showed a significant difference between the two groups, confirming that the increase in understanding in the experimental group did not occur randomly. The effectiveness of this local wisdom-based program is reflected in the increase in student understanding, while the control group that did not receive the intervention did not experience significant changes. Thus, these results support that local wisdom-based education is not only relevant but also effective in improving students' disaster mitigation preparedness and knowledge.

### 3.3. The Effect of Understanding Local Wisdom on Student Preparedness in Facing Disasters

A regression analysis was conducted to assess the impact of understanding local wisdom on students' disaster preparedness. The analysis evaluates the degree to which students' comprehension of local wisdom can explain variations in their preparedness levels. The findings are summarized in the Table 11.

**Table 11.**

Regression Analysis Results.

Aspects	Analysis Result	Interpretation
Coefficient of Determination ( $R^2$ )	0.42	42% of the variability in student preparedness can be explained by the understanding of local wisdom.
Significance (p-value)	$< 0.001$	The relationship between understanding local wisdom and preparedness is significant.
Relationship	Significant positive	A higher understanding of local wisdom correlates with better preparedness.

The results in table 11 indicate that students' understanding of local wisdom is significantly and positively correlated with their disaster preparedness. The  $R^2$  value of 0.42 suggests that 42% of the variability in students' preparedness can be attributed to their understanding of local wisdom. With a p-value of less than 0.001, the relationship is highly significant. This finding underscores the value of incorporating local wisdom into disaster preparedness education as an effective approach to enhancing students' preparedness.

## 4. Discussion

### 4.1. Improving Students' Understanding of Disaster Mitigation

The results of this study demonstrated a significant improvement in students' understanding of disaster mitigation following the implementation of the local wisdom-based education program. The experimental group exhibited a notable increase in their average post-test score, rising to 78.4, compared to the control group, which achieved an average score of 52.3. This difference, confirmed by

an independent t-test with a p-value of  $<0.001$ , underscores the effectiveness of the local wisdom-based disaster mitigation education program in enhancing students' disaster preparedness.

The increased post-test scores in the experimental group suggest that the integration of local wisdom—an approach incorporating cultural elements and practices familiar to students—enhances their comprehension of disaster mitigation. This method makes it easier for students to connect disaster preparedness concepts to their daily lives, thus promoting better application of the knowledge. These findings further highlight the value of local wisdom-based education as an effective tool for improving disaster preparedness from an early age.

This outcome aligns with previous studies that stress the positive impact of local-context-based education on disaster preparedness [42, 44]. Research has shown that incorporating local cultural values into disaster education strengthens students' understanding of risks and mitigation strategies, as it makes the content more relatable and applicable to their environment [45, 46]. By embedding local wisdom into learning materials, students are better equipped to recognize risks and apply suitable mitigation measures [47–50]. This study reinforces the idea that local wisdom-based education is not only relevant but also essential in enhancing students' disaster knowledge and preparedness, making it a valuable approach in Indonesia's educational context.

#### *4.2. Effectiveness of Local Wisdom-Based Programs*

The effectiveness of the local wisdom-based disaster mitigation program was further evidenced by the significant difference in post-test scores between the experimental and control groups, with a p-value of  $<0.001$ . This finding confirms that students who participated in the local wisdom-based program showed a greater improvement in disaster mitigation knowledge compared to those in the control group. The program's success lies in its practical relevance, as it provides students with knowledge directly applicable to their daily lives, delivered through a culture-based approach that is familiar and meaningful to them.

These results are consistent with previous research that emphasizes the importance of context-specific education in disaster preparedness. Several studies have highlighted that mitigation education that incorporates local cultural elements not only improves practical preparedness but also strengthens community identity and fosters a collective responsibility for disaster prevention [44, 45]. This approach also enables students to incorporate local wisdom into mitigation strategies, as highlighted by studies such as those by Rai and Khawas [40] and Zulfadrim, et al. [43] which demonstrate that local wisdom provides valuable insights for recognizing natural warning signs. In summary, the findings from this study confirm that local wisdom-based disaster mitigation education is both effective and relevant. The program demonstrates that integrating local values with mitigation practices provides a sustainable strategy for preparing young people for future disasters, particularly in the context of their own cultural and environmental background.

#### *4.3. The Role of Understanding Local Wisdom in Improving Preparedness*

Further analysis revealed a significant relationship between students' understanding of local wisdom and their disaster preparedness. The linear regression results showed that 42% of the variance in students' preparedness could be explained by their understanding of local wisdom ( $R^2 = 0.42$ ), with a highly significant p-value ( $<0.001$ ). This positive relationship underscores the critical role of local wisdom in enhancing disaster preparedness. Students who demonstrated a deeper understanding of local wisdom showed better preparedness levels.

This significant relationship supports the theory that incorporating local culture into disaster mitigation education not only enhances students' knowledge but also raises their awareness of the importance of disaster preparedness. Cultural practices, such as recognizing natural signs and engaging in local rituals related to disaster mitigation, increase students' sensitivity and readiness for potential disasters [51, 52]. This supports the disaster mitigation framework proposed by Macaranas [53]; Malik, et al. [54]; Coetzee, et al. [55] and Hao and Lun [56] which highlights the essential role of

integrating scientific knowledge with local wisdom to enhance disaster resilience at the community level.

Thus, this research strengthens the argument that understanding local wisdom not only provides a more relevant learning context, but also has a direct impact on disaster preparedness. The integration of local wisdom in disaster mitigation education is a viable and effective strategy, especially in areas with high disaster risk and rich cultural diversity, such as Indonesia.

## 5. Conclusion

The results of this study showed a significant increase in the understanding of disaster mitigation in students who attended the local wisdom-based program, with the average post-test score of the experimental group reaching 78.4, much higher than the control group which only reached an average score of 52.3. This significant difference, with a p value of  $<0.001$ , indicates that local wisdom-based education is not only effective in improving students' theoretical understanding, but also provides a practical basis relevant to their daily lives. An approach that integrates local cultural knowledge allows students to be more responsive to disaster risks in their environment, as supported by previous research showing that local wisdom-based education strengthens resilience through contextual understanding.

These findings imply the importance of developing disaster mitigation education policies that are inclusive and based on local contexts. By integrating cultural values in the disaster mitigation curriculum, education policies can support not only student preparedness, but also the preservation of local wisdom that contributes to disaster mitigation. As a long-term strategy, local wisdom-based education at the primary school level is highly relevant to implement, especially given the increasing frequency of disasters due to climate change. Culturally appropriate mitigation education can shape a more responsive generation, with preventive behaviors that support community resilience.

While the results of this study are promising, there are limitations in that the sample size is limited to two cities, Medan and Yogyakarta, which may limit the generalizability of the results to the rest of Indonesia. In addition, the quantitative approach used did not fully capture the perceptions of students and teachers regarding the understanding of local wisdom in disaster mitigation. Therefore, further research with a wider sample coverage and the use of qualitative methods such as in-depth interviews are needed to deepen the understanding of the effectiveness of this program. Longitudinal research is also recommended to evaluate the long-term impact of local wisdom-based programs in shaping communities that are more responsive and resilient to disasters.

## Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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