



Enhancing Students' Earthquake and Tsunami Preparedness Through Comic Media Health Education: A Quasi-Experimental Study

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ABSTRACT

Background: Indonesia is located in the Ring of Fire area at the meeting point between the Eurasian Plate, the Indonesia-Australian Plate, and the Pacific Plate. This meeting was the source of the megathrust earthquake in the East Java region. This makes Indonesia vulnerable to earthquakes and tsunamis along the southern coast of Java. As a vulnerable group to facing potential earthquakes and tsunamis, the level of preparedness of children in Indonesia needs to be increased. **Aim:** To determine the effect of comic media health education on the Earthquake and Tsunami Preparedness level of students at SDN Sumberejo 09 Ambulu Jember. **Method:** The sample of this study was students in SDN Sumberejo 09 Ambulu Jember. The research design used a quasi-experiment using the non-equivalent control group design and probability sampling with the proportionate stratified random sampling approach. Data collection used a characteristic questionnaire and an earthquake and tsunami preparedness questionnaire by LIPI-UNESCO 2006. **Result:** The result of the study shows differences in the level of preparedness before and after the intervention in the intervention group with a p-value of 0.000 (<0.05). At the same time, there was no difference in preparedness between the data before and after in the control group, with a p-value of 0.101 (>0.005). **Conclusion:** Comic media has been proven to increase elementary school students' preparedness. **Keywords:** Comic Media, Earthquake, Health Education, Preparedness, Tsunami

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I. INTRODUCTION

Indonesia is located in the Ring of Fire at the meeting point between the

Eurasian Plate, the Indonesia-Australian Plate, and the Pacific Plate (Adventari et al., 2021). The meeting of plates in the sea

south of Java Island has the potential to be a source of megathrust earthquakes in the East Java region (Widiyantoro et al., 2020). So, an earthquake and tsunami threatened along the southern coast of Java (Widiyantoro et al., 2020). The lack of community knowledge and preparedness for disasters triggers high risks or impacts of disasters (Yustisia et al., 2019). The results of a preliminary study based on teachers at Sumberejo 09 Ambulu Elementary School said that Sumberejo 09 Ambulu Elementary School was 350 meters from the south coast of Ambulu District. Schools have not implemented a school disaster preparedness program (SSB) in the learning curriculum and have never carried out health education using comic media about earthquake and tsunami disaster preparedness.

The research results in Iran showed that after being given the intervention, there was a 25% increase in the knowledge of the intervention group compared to the control group, from 13.53 ± 2.23 to 12.66 ± 2.65 (Ghezaljah et al., 2019). The research results in Central Maluku showed that 83.3% of respondents were in the not-ready category before the intervention was given. In contrast, after the intervention, there was an increase to 27.3% in the ready category and 48.8% in the almost ready category (Khair et al., 2021). The results of

a literature study of the earthquake and tsunami on the southern coast of East Java (1994) impacted the Banyuwangi coastal community in the form of 221 mortalities, 887 residents' houses damaged, and many injured victims. They damaged fishing boats (BMKG, 2019). Coastal residents of Payangan Ambulu District also felt this impact in the form of 9 fishermen drowning, 56 residents' houses being damaged, and 57 fishing boats being damaged (BMKG, 2019). Based on BNPB Jember data, on December 16, 2021, an earthquake measuring 5.1 magnitude occurred in Ambulu, Tempurejo, Silo, Puger and Wuluhan sub-districts, causing 6 injuries, 48 residents' houses damaged, 1 public facility and 4 schools damaged.

The lack of socialization, counseling, and disaster simulations influences the lack of knowledge and community preparedness for disasters (Khair et al., 2021). The low level of public knowledge results in weak public anticipation of the impact of disasters, resulting in death, property loss, and damage to the fabric of society's life (Pudjiastuti, 2019). The low level of community knowledge and preparedness for disasters has an impact on a large number of fatalities, with the majority of victims being children (Simandalahi et al., 2019). Children are the most vulnerable group in disaster

situations due to limited knowledge regarding disaster risks obtained without disaster preparedness (Rosida & Adi, 2017). Comic media has a positive role in developing children's interest in reading (Handayani & Koeswanti, 2020). Rahmawati's research (2022) states that an effective learning process for children is carried out by reading (Rahmawati, 2022).

In the development of the digital era, children tend to be more interested in audiovisual media, such as videos and games on gadgets, so there is a risk of reducing children's interest in reading (Rahmawati, 2022). The use of audiovisual media also has weaknesses. Not all students can follow the information presented, so it requires quite a long time to present it repeatedly, and the presentation of audiovisual media must use facilities and infrastructure such as laptops, projectors, speakers, and other facilities (Nugraheni, 2017; Putra et al., 2022). This makes audiovisual media inflexible, and students cannot learn it over time compared to comic media. The advantages of comic media include an attractive visual presentation that can create students' interest in reading, pictures and text tell each other a story so that it arouses students' emotions and imagination, easy to carry and read, comic time runs at the reader's speed, and can

develop students' thinking abilities (Subroto et al., 2020).

As a creative and innovative disaster education media, comic media needs to be studied further as a form of research in disaster preparedness. Researchers are interested in knowing specifically the influence of comic media health education on the earthquake and tsunami disaster preparedness level of students at Sumberejo 09 Ambulu Elementary School, which is located very close to the southern coast of East Java.

2. METHODS

The research is quantitative and uses a quasi-experimental design with a non-equivalent control group design approach using the Probability Sampling method with a Proportionate stratified random sampling approach. This research starts from February to June 2024.

The population in this study were all students in grades 3, 4, 5, and 6 of Sumberejo 09 Ambulu Elementary School, totaling 112 students. Calculation of sample size using the Slovin formula (Amin et al., 2023). The sample obtained was 87.5 respondents, and then 10% was added to anticipate student dropout. The research sample obtained was 96 respondents and then divided into 2 research groups (intervention and control group). The

inclusion criteria were active students registered in grades 3, 4, 5, and 6 at SDN Sumberejo 09 Ambulu Jember, aged 9-14 years, and willing to be respondents. The

exclusion criteria are students unwilling to become research respondents and students who have not completed the educational process.

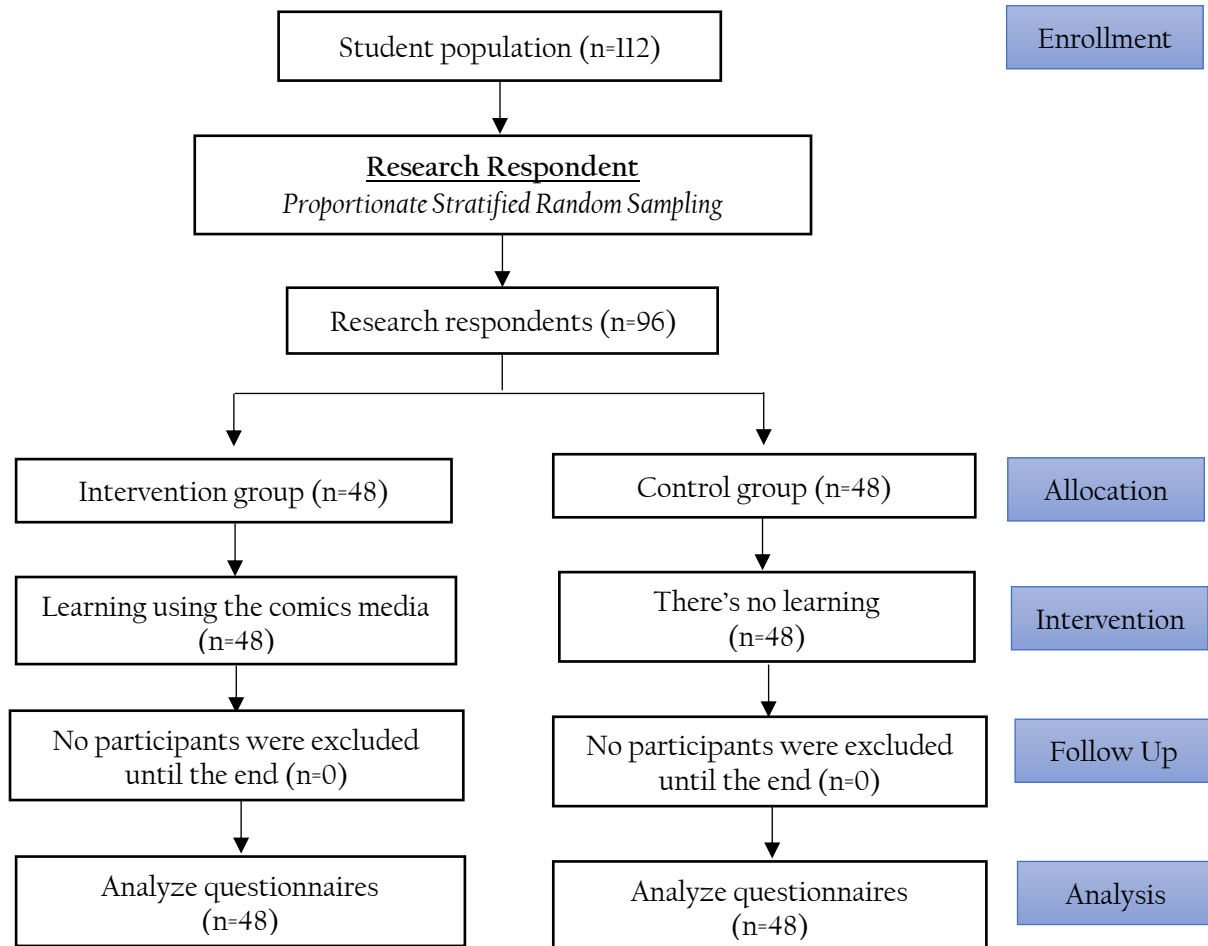


Figure 1. Consort Flow Diagram Sample Determination

Table 1. Research Implementation Stages

Session	Topic	Objective	Time
1	Pretest	To determine students' initial abilities before being given intervention	30 minutes
2	Knowledge about earthquake disasters	To learn the meaning, causes, and risks of earthquakes and their preparedness	30 minutes
3	Knowledge about tsunami disasters	To learn the meaning, causes, signs of tsunamis and their preparedness	30 minutes
4	Knowledge of disaster warnings, preparedness plans, and resource mobilization	To learn preparedness action plans when listening for early warning signs and mobilizing resources	30 minutes
5	Post-test	To determine students' final abilities after being given intervention	30 minutes

The research was conducted over 5 learning sessions consisting of 3 treatment sessions for the intervention group and 2 sessions for the pretest and posttest for both research groups. Each research session was not conducted on the same day with each session lasting around 30 minutes. According to previous research, providing intervention using comic media for 3 meetings with a duration of around 30 minutes showed that there was a difference in the level of knowledge before and after the treatment was given (Pratiwi Hartono et al., 2015).

Comic media health education instrument from earthquake comics created by BNPB in 2014 in Jakarta. This instrument was adopted as a health education instrument for disaster resilience comic media which contains knowledge about disasters, disaster activity plans, disaster warnings, and resource mobilization. The instrument used was the earthquake and tsunami preparedness questionnaire developed by LIPI & UNESCO 2006 which was published in the earthquake and tsunami disaster preparedness monitoring and evaluation guidebook issued by LIPI in 2011 which contained 4 indicators, namely disaster knowledge, disaster activity plans, and resource mobilization with a total of 31 questions with closed answer choices

yes/no/don't know with a score of 1 for each question with a final score of 31.

Data analysis used SPSS software (version 25). Data categories such as gender, the experience of facing earthquake and tsunami disasters, the experience of hearing about earthquake and tsunami disasters, distance from house to beach, and sources of information on earthquake and tsunami disasters are displayed in frequency distributions and percentages. Numerical data such as age is displayed in median, minimum, and maximum values. The normality test on the pretest and post-test data for the intervention and control groups using Shapiro Wilk showed a p-value <0.05 , the data was normally distributed so the Paired Sample t-test was used to determine pretest and post-test preparedness in the intervention and control groups. An Independent t-test was carried out to determine differences in preparedness between the intervention and control groups (Sugiyono, 2013).

This research has been declared ethically appropriate by KEPK, Faculty of Nursing, Jember University with No. 049/UN25.1.14/KEPK/2024.

3. RESULTS

The characteristics of respondents are shown in Tables 2 and 3 in the form of data on age, gender, data on students'

experiences in facing or hearing about earthquakes and tsunamis, distance from house to beach, and sources of earthquake

and tsunami information in the following frequencies and percentages.

Table 1. Characteristics of Respondents

Characteristics of Respondents	Intervention Group		Control Group	
	Frequencies (n)	Percentage (%)	Frequencies (n)	Percentage (%)
Age	Median	Min-Max	Median	Min-Max
	10	9-14	10	9-13
Gender				
Male	22	45.8	26	54.2
Female	26	54.2	22	45.8
Experiencing an Earthquake Disaster				
Yes	48	100	47	97.9
No	0	0	1	2.1
Hearing the Earthquake Disaster				
Often	14	29.2	13	27.1
Rarely	34	70.8	32	66.7
Never	0	0	3	6.3
Experiencing a Tsunami Disaster				
Yes	1	2.1	0	0
No	47	97.9	48	100
Hearing the Tsunami Disaster				
Often	5	10.4	6	12.5
Rarely	22	45.8	18	37.5
Never	21	43.8	24	50.0
Distance from house to the beach				
<1 km	31	64.6	23	47.9
1-10 km	17	35.4	21	43.8
>10 km	0	0	4	8.3
Source of Earthquake and Tsunami Information				
Mass media	6	12.5	11	22.9
Social media	38	79.2	32	66.7
Don't know	4	8.3	5	10.4

Table 1 presents data on the age characteristics of respondents which are displayed in median and minimum-maximum values because the age normality test shows a p-value of 0.000 (<0.05), the data is not normally distributed. The median age and minimum age of the

intervention and control groups have the same values of 10 years and 9 years, while the maximum value of the intervention group is 14 years and the control group is 13 years.

Gender characteristics, the majority of respondents in the intervention group

were female and those in the control group were male with a percentage of 54.2%. Most respondents in the intervention and control groups indicated that they had experienced earthquakes and rarely heard of them. Then, both the intervention and control groups showed that most respondents had never experienced a tsunami and had never heard of a tsunami.

Most respondents in both research groups had houses <1 km from the beach, 64.6% in the intervention group and 47.9% in the control group. The majority of respondents in both research groups got information from social media such as YouTube, Instagram, TikTok or WhatsApp) with a percentage more than 50%.

Table 2. Differences in student preparedness levels in the intervention and control groups

	Group	Mean	Std. Deviation	95% CI	<i>p-value</i>
Intervention	Pretest	15.99	4.11		
	Posttest	22.07	3.73	-7.30 - -4.86	0.000
Control	Pretest	16.66	3.55		
	Posttest	15.57	3.03	-0.221- 2.399	0.101

Table 2 presents comparative data on students' preparedness levels in the pretest and post-test intervention and control groups. The results of the paired sample test for the intervention group showed a *p*-value of 0.000 (<0.05), indicating a

significant difference between the pre and post-test results. The results of the Paired Sample Test in the control group showed a *p*-value of 0.101 (>0.05), indicating no significant difference between the pretest and post-test results.

Table 3. Differences in preparedness levels in the intervention and control groups

	Group	Mean	Std. Deviation	95% CI	<i>p-value</i>
Pre and Post Intervention	Intervention	22.07	3.73		
	Control	15.57	3.03	5.12 - 7.88	0.000

Table 3 presents comparative data on the level of preparedness of students in the intervention and control groups after being given comic media health education in the intervention group. After carrying out the independent sample test, the *p*-value was 0.000 (<0.05), indicating that there was a

significant difference in the level of student preparedness between the intervention and control groups after being given the post-test.

4. DISCUSSION

This research aims to determine students' preparedness at Sumberejo 09 Ambulu Elementary School before and after being given comic media health education. The research results show that comic media health education can increase student preparedness. Compared with the control group, which was not given any intervention, the intervention group students who were given comic media health education had better results (See Table 2).

Previous research stated an increase in the average score between students' pretest and post-test after being given disaster preparedness comic media, namely 11.4 (Nasrullah et al., 2021). The results of other research also show that there is an influence before and after being given disaster preparedness comic media education on students' knowledge and disaster preparedness, with an average increase in knowledge of 14.52 and an increase in preparedness scores of 19.83 (Lestari et al., 2023). Previous research also stated that the application of mathematical comics in schools could increase students' awareness of disasters, including the urban experimental class doing better on 3 of the four disaster indicators, compared to the control class and the rural experimental class doing better on one of the four

disaster indicators, compared to the control class (Mailizar et al., 2023).

Student learning outcomes are influenced by several internal and external factors (Marlina & Sholehun, 2021). Internal factors come from physiological factors (sight and hearing) and psychology (talents, interests, motivation, and ways of learning). External factors come from the school environment, family, and community. Apart from that, the condition of forgetting influences student learning outcomes. Factors causing forgetting are. First, there is a conflict between items of information, pressure on existing items, changes in environmental situations between learning and when remembering, no interest and good attitude towards the material, and someone sick has memory problems. (Hanim et al., 2022). The level of preparedness that did not increase after being given comic media intervention was caused by several factors, such as the limitations of comic media, psychological factors, and forgetting factors. The limitation of comic media is that the language is still formal, making some of the content in comics difficult for respondents to understand.

The study results showed significant differences in earthquake and tsunami preparedness levels between the post-test in the intervention and control groups (see

Table 3). The results of this research align with previous research that the application of disaster response comic media effectively increases students' earthquake disaster preparedness knowledge (Aulia et al., 2021). Other research also shows the effectiveness of using comic-based disaster smart book health media on students' knowledge regarding earthquake disaster preparedness (Aditya et al., 2024).

According to Kroh's theory, children aged 9 to 12 years are in a realistic and critical observation period because they have reached the maturity of reason and insight (Pratiwi, 2019). The appropriate health promotion media at this stage of development is comic. Comic media is a visual media that attracts children's attention to receiving information. It is closely related to the brain's memory, especially the rational brain, because it combines images, colors, and writing (Pratiwi, 2019). The colors in comics can attract children's interest in reading and have physiological effects on the brain. The images, colors, and writing in comics are read by the sense of sight (eyes), which is then transmitted to the brain, namely the frontal lobe in the celebrity cortex, which plays a role in thinking, planning, and conceptualizing activities. Information in comics, which is only packaged in the form of words or writing, will only be stored in

the left brain, specifically the Wernicke and Brocca areas (verbal communication). In contrast, with information packaged in colorful images, the right brain will also store the information (Pratiwi, 2019). Information presented in the form of a combination of words and images will be more quickly absorbed and stored by the brain due to balancing messages from the left and right brain by activating connecting nerve cells.

Comic media has a great attraction for children, so it creates feelings of joy when children read comics. This feeling of joy can stimulate the release of endorphins from glands in the brain and activate acetylcholine at the synapses. Activating acetylcholine improves memory storage (Pratiwi, 2019). Feelings of joy also affect how the brain processes, stores, and recalls previously stored information. Increasing a child's memory can influence the child's level of knowledge and preparedness for earthquake and tsunami disasters. Learning comic media was created to encourage and arouse students' interest in learning. Comics help students develop language skills, creative storytelling activities, dramatization, reading, and writing, as well as interpreting and remembering material in reading (Nafala, 2022). Comic media has several strengths, the first is that learning motivation is

humans' natural attraction to images so that it can maintain students' interest in reading. Second, the visual elements connect readers to the storyline because the images and text in comics are interconnected to form a story. Third, permanent, namely the pace of comics is different from video or film media, where the pace depends on the reader's speed. Fourth, simple comic language can explain a concept that is very difficult to understand. Fifth, comics can encourage students to become critical readers of the messages (Nafala, 2022).

Overall, this research shows the influence of comic media health education on the earthquake and tsunami disaster preparedness level of students at SDN Sumberejo 09 Ambulu Jember. This effect can be seen where there is a significant difference in the final level of preparedness between the intervention group and the control group, where the intervention group that was given comic media health education had a higher level of preparedness than the control group.

5. CONCLUSION

The study results showed that comic media health education effectively increased the earthquake and tsunami disaster preparedness of students at Sumberejo 09 Ambulu Elementary School,

compared to the control group who were not given any intervention. Further research suggestions can be developed regarding health education media, as well as provide comparisons with other media given to the control group to further determine the media's effectiveness.

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AUTHOR CONTRIBUTIONS

Rahayu PP designing research, formulating concepts, methodology, writing manuscripts, collecting data, and analyzing data. Syaharani GA designing research, formulating concepts, methodology, writing manuscripts, collecting data, and analyzing data. Setioputro B read and approved the final manuscript. Yunanto RA approved the final manuscript, reviewed the manuscript and revised the manuscript. Haristiani R reviewed the manuscript and revised the manuscript.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

DATA AVAILABILITY STATEMENT

The data are not publicly available due to privacy or ethical restrictions.

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