JPPIPA 11(11) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effectiveness of Using E-Comics as a Learning Medium for Tsunami Disaster Mitigation at SMA 1 Pertiwi Padang

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Received: August 01, 2025
Revised: October 03, 2025
Accepted: November 25, 2025
Published: November 30, 2025

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DOI: 10.29303/jppipa.v11i11.13315

Abstract: Padang City, located on the west coast of Sumatra Island, is one of the Region most vulnerable to tsunami disasters due to its position along the subduction zone between the Indo-Australian and Eurasian plates. This study aims to determine the effectiveness of using E-Comics as a learning medium for tsunami disaster mitigation at SMA 1 Pertiwi Padang City. The research employed a quasi-experimental method with a Non-Equivalent Group Design, involving two groups: the experimental class (XI IPS 2) using E-Comics and the control class (XI IPS 1) using conventional textbooks. Data were collected through questionnaires and documentation, and analyzed using normality, homogeneity, and t-tests with the aid of SPSS version 22.0. The results showed that the data were normally distributed and homogeneous, and there was a significant difference between the learning outcomes of the experimental and control classes, with a significance value of 0.95 > 0.05 and a t-value of 7.45. The average pre-test and post-test scores in the experimental class increased from 53.40 to 87.10, while the control class increased from 51.87 to 61.53. These findings indicate that using E-Comics effectively enhances students' understanding and motivation in learning tsunami disaster mitigation material. Therefore, E-Comics can serve as an innovative alternative in geography learning, particularly in disaster-prone areas, to improve students' literacy and preparedness for disasters.

Keywords: E-Comic; Geography; Learning media; Padang City; Tsunami disaster mitigation

Introduction

Padang City, located on the west coast of Sumatra, Indonesia, is one of the areas most vulnerable to tsunami disasters. This is due to its location along the subduction zone between the Indo-Australian and Eurasian plates, which frequently experiences high seismic activity. According to research by Zheng et al. (2023), this region has a significant potential for earthquakes that could trigger tsunamis, given the history of past disasters, such as the 2004 tsunami that devastated many parts of Sumatra. Furthermore, research by Ikhvan et al. (2021), shows that the geographical characteristics of Padang City—with its steep coastline and settlements located very close to the shoreline—further increase the risk of tsunami impacts. Therefore, it is essential for the people of Padang City to have adequate knowledge of disaster mitigation to reduce the risks and impacts that may be caused by tsunamis in the future. Based on preliminary observations in the geography subject for Grade XI Social Science students at SMA 1 Pertiwi Padang City, disaster mitigation learning has so far been conducted only through the use of textbooks and direct practice. According Gunada et al. (2020) and Tyas et al. (2025), to the subject teacher the learning process usually begins with an explanation of disaster mitigation, followed by direct practice with students, as the teacher believes that

How to Cite:
Indriana, Ernawati, & Fitri, A. (2025). The Effectiveness of Using E-Comics as a Learning Medium for Tsunami Disaster Mitigation at SMA 1 Pertiwi Padang . *Jurnal Penelitian Pendidikan IPA*, *11*(11), 516–522. https://doi.org/10.29303/jppipa.v11i11.13315

simulations can be more effective and create a longer-lasting impression on students (Chernikova et al., 2020; Kasperski et al., 2025). However, over time, with the repetitive use of the same teaching method, the teacher observed that students began to lose enthusiasm during disaster mitigation lessons. Students appeared less motivated to participate in practical activities and no longer showed the same level of engagement and excitement in the learning process (Teoh et al., 2025; W. Li, 2023).

Relying solely on textbooks in disaster mitigation learning for Grade XI Social Science students at SMA 1 Pertiwi Padang City presents several weaknesses that can affect student motivation and engagement. Although books are important sources of information, learning that depends entirely on textbooks tends to be less interactive, causing students to feel disconnected and less actively involved. Moreover, disaster mitigation is a practical topic that requires deep understanding of real-world situations; relying solely on books does not provide students with opportunities to directly explore situations they might face. Each student also has different learning styles, and those who do not learn effectively through reading may struggle to understand the material (Yotta, 2023; Sitorus et al., 2025). Monotonous learning methods can limit students' creativity; therefore, it is crucial to include variety in teaching approaches (Staneviciene & Žekienė, 2025; Marini et al., 2025). Additionally, disaster mitigation knowledge must be applicable in real situations, and direct experiences through simulations or field activities can help students connect theory to practice. Hence, to improve the effectiveness of disaster mitigation learning, it is very important to integrate various learning methods and media to create a more holistic and enjoyable learning experience, as well as to maintain students' motivation and engagement in the learning process.

One innovation that can be applied is the use of electronic comics (E-Comics). The term "comic," derived from the French word comique meaning "funny," refers to a visual medium with strong potential to attract students' interest. According to Fatimah et al. (2019) and Alwi et al. (2024), comics in education can motivate students because of the natural human attraction to image. Wewengkang et al. (2024) and Rizcallah et al. (2025), also state that comics are effective for school-aged students, as the combination of visuals and text facilitates easier understanding of the material. Furthermore, Mustaqim et al. (2024), in his book Understanding Comics, explains that comics are a medium capable of attracting attention from people of all ages, as they are easy to understand. Simple drawings combined with everyday language make comics accessible to everyone. Fitria et al. (2023), notes that comics were initially created for entertainment purposes, not for educational activities. Saltzman, (2023) and Farinella (2018), highlights several advantages of comics: they can assist teachers in classroom teaching activities; they can describe information or learning materials that are difficult to explain verbally, making the material more concrete and comprehensible; and their easy-to-understand language and alignment with students' characteristics can generate better responses.

SMA 1 Pertiwi is one of the schools that promotes disaster preparedness as a core strength and has also served as a "Pilot Project" school for implementing local curricula on disaster preparedness and mitigation. Therefore, this study focuses on the application of E-Comics as a learning medium for tsunami disaster mitigation at SMA 1 Pertiwi, with the aim of identifying its strengths and weaknesses as well as examining whether the use of E-Comics has an effect on students' learning outcomes. Thus, this research is expected to contribute to the development of more effective and engaging learning methods and to raise students' awareness of the importance of disaster mitigation in disaster-prone areas such as Padang City.

Method

The research method used is quantitative research, because the final results of this research are in the form of numbers or figures that are analysed using statistical programs. The type of research is quasi-experimental (simulated experiment). Li (2021), states that experimental research is research that seeks to find the influence of certain variables on other variables under controlled conditions. Furthermore, quasi-experimental research has a control group, but it cannot fully control external variables that influence the conduct of the experiment. Quasi-experimental research is one type of experimental research where the researcher is not allowed to select the research subjects, but the results achieved are meaningful, both in terms of internal and external validity. This quasi-experimental research design uses a Non-Equivalent Group Design. This design uses a pretest before the treatment for the experimental group XI IPS 2 and the control group XI IPS 1.

The pretest results will serve as the basis for determining changes. Additionally, it can minimise or reduce selection bias. The post-test administered at the end of the activity will indicate the extent of the treatment's effects. This study aims to determine the extent of the effectiveness of using E-Comics as a learning medium for tsunami disaster mitigation at SMA 1 Pertiwi by comparing the learning outcomes of the experimental and control classes. The experimental class was given treatment (X) by conducting tsunami

disaster mitigation learning activities using E-Comics as a learning medium, while the control class was taught using conventional media, namely books. Subsequently, both classes were given a post-test.

Tabel 1. Research Design

Group	Pre-test	Treatment	Post-test
Experiment	O1	X	O2
Control	O3	-	O4

Information:
O1 : Experimental class pre-test
O3 : Control class pre-test
X : Treatment in this case the activity of using E-Comic as learning media tsunami disaster mitigation
O2 : Experimental class post-test
O4 : Post-test of control class

The data collection techniques used in this study were questionnaires and documentation. Quantitative data analysis techniques were used to process or analyse data in numerical form. Data analysis was needed to determine or obtain overall conclusions from the research data collected by the researchers. Additionally, data analysis techniques aim to propose and explain research data so that it can be understood by others. The data analysis technique used in this study is to compare the differences between two mean values, which is done using a t-test. However, before conducting the t-test, prerequisite tests (normality test and homogeneity test) must be performed: H1: There is a significant effect of the development of E-Comic usage as a learning medium for tsunami disaster mitigation with a significance level of 0.05; H0: There is no significant effect of the development of E-Comic usage as a learning medium for tsunami disaster mitigation with a significance level of 0.05. The researcher used the t-test to test the hypothesis because the data obtained was normally distributed and had homogeneous variance. The researcher used the t-test with the help of SPSS version 22.0. The decision was made based on the following values: If the sig value was < 0.05, hypothesis H1 was accepted. If the sig value was > 0.05, hypothesis H1 was rejected.

Result and Discussion

Results
Normality Test

The normality test in a regression model examines whether the residual values of the regression are normally distributed. In other words, it is conducted to determine whether the data distribution analyzed is normal or not. Normally distributed data assumes that the data represents the population; therefore, conducting a normality test is essential. The normality test was carried out using the One-Sample Kolmogorov-Smirnov Test by observing the significance value (Asymp. Sig 2-tailed) under the following criteria: If the significance value (Asymp. Sig 2-tailed) > 0.05, the data are normally distributed; If the significance value (Asymp. Sig 2-tailed) < 0.05, the data are not normally distributed.

Table 2. Normality

		Test of Normality					
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
Learning outcomes	Experiment Pretest	.116	35	.200*	.976	35	.636
	Experiment Posttest	.112	35	.200*	.960	35	.235
	Pretest Control	.136	35	.103	.939	35	.050
	Posttest Control	.114	35	.200*	.976	35	.643

Based on the Tests of Normality table, the obtained significance value is greater than 0.05, indicating that the tested data are normally distributed. Therefore, the next stage of testing, the homogeneity test, can be conducted.

Homogeneity Test

The homogeneity test, or variance equality test, aims to italics, no bold, remove numbering a, b, c, fix the others determine whether the two datasets have homogeneous variances by comparing their variances. This test was conducted on the data distribution of both classes—the experimental class (class 1) and the control class (class 2)—to determine whether the variances of both classes are homogeneous. The test used is the Test of Homogeneity of Variances, performed through SPSS version 26. The criteria for homogeneity are as follows: if the probability value (Sig.) > 0.05, the data are homogeneous; if the probability value (Sig.) < 0.05, the data are not homogeneous.

Based on the Test of Homogeneity of Variance table, the significance value (Sig.) based on the mean is 0.959 > 0.05, indicating that the data variances of the experimental and control classes are homogeneous. Therefore, one of the assumptions (though not absolute) for conducting the independent sample t-test is fulfilled, and hypothesis testing can proceed.

Table 3. Homogeneity

Test of Homogeneity of Variance					
Learning outcomes		Levene Statistic	df 1	df2	Sig.
	Based on Mean	.003	1	68	.959
	Based on Median	.015	1	68	.902
	Based on Median and with adjusted df	.015	1	67.20	.902
	Based n trimmed mean	.003	1	68	.960

Hypothesis Test

The results of the Independent Sample t-test show a significance value of 0.95 > 0.05, indicating a significant difference between the learning outcomes of students who used the E-Comic learning media and those who did not. With a t-value of 7.45 and an average difference of 14.68 points, the E-Comic media proved to be effective in enhancing students' understanding of tsunami disaster mitigation material. These findings reinforce that the integration of digital media can improve learning quality and is highly recommended for use in schools located in disaster-prone areas. Therefore, the hypothesis proposed in this study is accepted.

Table 4. Ranks

		Levene's test of equality of Variances		t-test for Equality of Means						
									95% Confidence interval of the Difference	
		F	Sig.	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Learning outcomes	Equal variances assumed	.003	.959	7.45	68	.000	14.68	1.97	10.75	18.61
	Equal variances not assumed			7.45	67.59	.000	14.68	1.97	10.75	18.61

Discussion

The main objective of this study was to determine the effectiveness of using E-Comics. The researchers conducted a pre-test to assess the students' initial abilities. Based on the data obtained and processed using SPSS, it was found that there was a significant difference between the experimental class and the control class in the pre-test data. This indicates that the research classes were selected from a homogeneous population. In such cases, observing students' progress and abilities during the learning process becomes highly beneficial. The research data showed differences in student learning outcomes between those who used the E-Comic learning model and those who used conventional methods (books). Students who learned using E-Comics demonstrated better understanding and learning outcomes in the Disaster Mitigation subject compared to those who learned through conventional methods. The development of e-comics containing disaster mitigation material was designed to be engaging and interactive (Nafiqoh & Nurcahyani, 2025; Yani et al., 2023). This engaging presentation is expected to foster students' enjoyment of learning through play, motivating them to be more creative. According to Kline, as cited in Rusticus et al. (2023) and Van De Wetering et al. (2022), learning becomes effective when conducted in a pleasant environment; when children are highly interested in learning, the material is more easily absorbed. E-Comics or digital comics are a new learning medium for students, which increases their interest and motivation to learn (Salsa Dika et al., 2023).

The application of e-comics in life skills learning is expected to develop various aspects of student growth, including cognitive, affective, and psychomotor domains (Ulandari et al., 2023). The cognitive aspect enables students to think rationally through the stories presented in the e-comics (Bimawati Rumapea et al., 2025; Benabbes et al., 2024). The affective aspect involves the moral and life-skill values embedded in the stories, which can indirectly shape students' character and personality (Muhammad et al., 2023). The psychomotor aspect relates to students' interaction with e-comics on laptops or computers, helping develop their hand–eye coordination and fine motor skills. The development of this e-comic involved analyzing its objectives, identifying its capabilities, implementing development procedures, and conducting expert validation (Fahreza et al., 2022; Apostolou & Linardatos, 2023). The goal of developing this e-comic media was to produce a suitable and effective tool for teaching disaster mitigation concepts. The e-comic was developed to increase student motivation and enhance learning outcomes. As multimedia, e-comics provide more concrete and visually appealing representations of content. This aligns with Abdulrahaman et al. (2020) and Kassa et al. (2024), who argue that the value of multimedia lies in its ability to attract attention and interest while delivering information quickly. The presentation of material in e-

comics combines illustrations with narrative text and dialogue to enhance comprehension. E-comics, as a form of digital learning media, function as a tool to convey information effectively. The use of comic-based learning media can motivate students because comics combine images and text in a structured storyline, making it easier for readers to grasp the material (Astuti & Lestari, 2024; Rusmaini, 2023).

This finding supports research by Febriyanti et al. (2020), who explain that when presenting educational comics, it is essential to consider students' age characteristics, as they tend to enjoy colorful illustrated books that enhance their learning interest. However, no matter how engaging the educational media is, it cannot replace the vital role of teachers in guiding and educating students. This aligns with Lohmann et al. (2021), who emphasize that teachers are the primary agents of education and must be equipped with professional competencies and positive attitudes. In education, it is important to select instructional media based on certain indicators: learning objectives, understanding the characteristics of the media to be used, and comparison with other available media (Fotopoulos, 2023). Considering its alignment with learning objectives, e-comics are particularly suitable for students, as illustrated books or comics with memorable visuals can capture their attention and stimulate positive thinking and imagination (Mantulenko, 2020). Moreover, comics can foster curiosity and enhance students' interest in reading. Therefore, using e-comic learning media offers an engaging and accessible way to present learning material that is easier for students to understand.

Conclusion

Based on the research results and data analysis, it can be concluded that the use of E-Comics as a learning medium for tsunami disaster mitigation at SMA 1 Pertiwi Padang City is effective in improving students' learning outcomes. This medium successfully attracts students' interest and learning motivation by combining visual and textual elements interactively, thereby facilitating a more concrete understanding of disaster mitigation concepts. The t-test results showed a significant difference between the class that used E-Comics and the class that used conventional learning media (textbooks), with a higher average score increase in the experimental class. Furthermore, E-Comics support the development of students' cognitive, affective, and psychomotor aspects through enjoyable and contextual learning experiences. Thus, implementing E-Comics can serve as an innovative solution to enhance the effectiveness of geography learning, especially on disaster mitigation topics in disaster-prone regions such as Padang City. This study is expected to provide a foundation for the development of other digital learning media that are more interactive and relevant to 21st-century educational needs.

Acknowledgments
Thanks to all parties who have supported the implementation of this research. I hope this research can be useful.

Author Contributions
Conceptualization; methodology.; validation; formal analysis; investigation; resources; I.; data curation; writing—original draft preparation; E.; writing—review and editing.; visualization: A. F. All authors have read and agreed to the published version of the manuscript.

Funding
The research and writing of this article were funded by personal funds.

Conflicts of Interest
The researchers funded this research independently.

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