STEM-based digital disaster learning model for disaster adaptation ability of elementary school students

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ABSTRACT

Efforts are required to enhance community resilience to disasters, especially among elementary school students who are highly vulnerable to losses caused by natural disasters. In previous research, a science, technology, engineering, and mathematics (STEM) based digital disaster learning model was developed for elementary school students, so further research is needed to determine its effect on the adaptability of elementary school students. This study aimed to assess the impact of the STEM-based digital disaster learning model on the disaster adaptation abilities of elementary school students. This research is a quasi-experimental. The data collection instrument is the disaster adaptation ability essay test questions. The data analysis process uses the help of the SPSS 26 application. The findings found an average difference in students' disaster adaptation abilities between STEM-based digital learning models and conventional learning models. This finding was also reinforced by the post-test average scores of students who studied using STEM-based digital disaster learning models, which were higher than those with conventional learning models. So overall, the STEM-based digital disaster learning model increases elementary school students' disaster adaptation abilities. The implications of this research can be used as a reference in developing elementary school students' disaster adaptation abilities.

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1. INTRODUCTION

Natural disasters can happen anytime, anywhere, and are completely unforeseen [1], [2]. Natural disasters can happen anywhere, in any circumstance. Natural disasters are phenomena that occur in nature, that are unpredictable in their timing and can happen anywhere in the world without geographic considerations. Numerous natural disasters, including landslides, floods, storms, earthquakes, tsunamis, and volcanic eruptions, can happen anywhere at any moment [3], [4]. Geographical, environmental, and natural characteristics of a region can affect the type and intensity of natural disasters. Natural disasters can happen at unforeseen times and without any warning or precaution. Even with advancements in technology for disaster detection and monitoring, it is still impossible to predict when and where a disaster will strike [5]. As a result, each community must be prepared and self-aware to identify disaster risks and lessen the effects of disasters, including for the Indonesian people.

Disasters frequently strike Indonesia [6], [7]. Indonesia is a country located in the Pacific Ring of Fire. The Pacific Ring of Fire is a region with high geological activity that is vulnerable to calamities. Due to its location inside the Pacific Ring of Fire, Indonesia will frequently experience natural disasters [8]. The fact that Indonesia has 130 active volcanoes, which increases the probability of seismic and volcanic activity, is evidence of this condition [9]. Natural disasters like earthquakes, which frequently strike Indonesia and severely damage local infrastructure, coexist there with volcanic eruptions, which pose risks including ash rains, lava flows, and pyroclastic flows. Due to their lengthy coasts and vulnerability to the effects of earthquakes in offshore locations, some areas of Indonesia may also be affected by tsunamis [10]. Due to heavy rainfall, a mountainous topography, and environmental degradation, flooding also occurs frequently. In hilly residential areas, landslides may occur due to strong rainfall that results in heavy water flow. Landslides are also frequently experienced in nature. Natural disasters in Indonesia are getting worse by global climate change. The danger of natural disasters in Indonesia may rise because of variables like altered rainfall patterns, rising global temperatures, and intensifying tropical storms. The fact that Indonesia is an archipelago also affects how difficult it is to manage disasters, particularly in hard-to-reach remote island areas [11]. Indonesians must be provided with the knowledge and skills necessary to deal with disasters. An example of one of them is disaster adaptive ability.

Disaster adaptation is a set of corporate practices and behaviors that try to modify human and natural environments to mitigate the effects and hazards of natural disasters [12], [13]. Increased community readiness and resilience in the face of disasters are the goals of disaster adaptation [12], [14]. Disaster adaptation also seeks to lessen the detrimental effects of disasters on the environment and living processes. As a result, Indonesian society, including primary school kids, must learn to adapt to disasters. The elementary school years are crucial for the development of fundamental skills, knowledge, and attitudes about the environment, including how to deal with the possibility of natural disasters [15]. Students can comprehend different types of disasters, disaster risks, preventive measures for disaster prevention, and the right approach for disaster mitigation [16]. Elementary school kids can learn the proper evacuation procedures and learn how to react to disasters prudently by participating in educational programs and natural disaster evacuation exercises [17]. Involving communities and families in the disaster's adaptation process is crucial. Children in elementary school should be able to talk to their families about emergency preparations and disaster readiness at home. By enhancing students' readiness and knowledge of natural disasters, teachers may create a generation that is adaptable and resilient, and capable of defending themselves, their families, and communities from disaster hazards.

However, it is indicated in the research study that primary school pupils still have poor disaster adaptation skills [17]–[19]. This is supported by the findings of the initial assessment of 200 Indonesian elementary school kids' capacity for disaster adaptation, which yielded an average score of 54.39. This result demonstrates that primary school kids still have poor adaptability skills. Elementary school students' low disaster adaptation ability is the main problem in this research. Elementary school students' low disaster adaptation ability will impact their efforts to adapt to disaster-prone environments, so efforts are needed to overcome this problem and increase their disaster adaptation ability. Efforts to improve elementary school students' disaster adaptation abilities can be made through the learning process at school. Schools are essential in improving elementary school students' disaster adaptation abilities in the learning process. The learning process in schools must be able to train students to adapt to disaster-prone environments. This fact is the problem of elementary school students' low disaster adaptation abilities.

According to the researcher's analysis, the current learning model is not in line with the advancements of the 4.0 era, which is one of the elements associated with the low adaptability of primary school children. Era 4.0 development is closely related to technical advancement. The ability of primary school children to adapt to disasters will be impacted by the lack of technology-enhanced learning. Students in primary schools will benefit from an engaging, interactive, and virtual learning environment due to technology-based learning. Students are not exposed to modern instructional models, nevertheless, due to a lack of information and access to ways to combine learning with technology [7], [20]–[22]. As a result, in earlier research, researchers created a science, technology, engineering, and mathematics (STEM)-based digital disaster learning model to enhance primary school pupils' ability to adapt.

The STEM-based digital disaster learning model integrates digital technology with the STEM approach to learning about natural disasters. The purpose of the STEM-based digital disaster learning model is to improve and develop students' understanding of natural disasters and develop relevant knowledge and skills in dealing with disasters using innovative scientific and technological approaches. Digital disaster learning is developed using digital technology such as tablets, computers, laptops, smartphones, software, and other applications so that students can learn interactively and interestingly. The existence of this digital device will be able to present the concrete conditions of natural disasters to students, such as the use of visual reality or virtual reality (VR). This STEM-based digital disaster learning model is developed by developing project-based learning. In this model, students will learn through projects customized for natural disasters.

So, they can develop a disaster problem-solving perspective. For example, students may be challenged to simulate how climate change will affect flooding or design powerful buildings. The STEM model also incorporates the ideas of STEM into the study of disasters, giving students the knowledge and skills, they need to examine disasters' causes, comprehend their effects, and come up with creative alternate solutions. The goal of this STEM-based digital disaster learning model was to improve primary school pupils' comprehension of natural disasters and how to respond to them. In addition to increasing elementary school kids' interest in science and technology, this STEM-based digital disaster learning model aims to develop a generation that will be resilient and wise in the face of severe disasters.

In previous research that researchers conducted, scientific experts have deemed this STEM-based digital disaster learning model to be valid and feasible for use with students. This model is suitable for learning design, materials, and media implementation in elementary schools. However, this strategy must be aware of how it affects primary school pupils' ability for disaster adaptation. Therefore, the goal of this study is to ascertain how STEM-based digital disaster learning models affect elementary school pupils' ability to adapt to disasters. It is crucial to carry out this investigation. For Indonesian primary school pupils, understanding disasters and being prepared for them are crucial aspects. Due to Indonesia's location in a disaster-prone area, this circumstance exists. Any person can become a disaster victim, but children are particularly vulnerable to disasters. This study offers an excellent opportunity for elementary school pupils to develop their disaster adaptation skills by integrating technology and STEM aspects. It is anticipated that students will be able to react to disasters swiftly, wisely, and adaptable because of their improvement and growth of adaption. Students in elementary school should be prepared to minimize the effects of disasters by participating in prevention and evacuation operations. The academic community and policy makers can greatly benefit from this research's insights on how STEM-based learning models might enhance students' readiness for disasters

2. METHOD

The research conducted was quasi-experimental research. This research design used a nonequivalent control group design. The design of this research is presented in Table 1. Determination of the sample using the purposive sampling technique. The purposive sampling technique is used when the studied sample already possesses special characteristics, making it only possible to take other samples with these characteristics [23]. The characteristics inherent in the sample are not general characteristics that all people have, so those studied are individuals with characteristics by the research objectives. The special characteristics of the sample are that it is made up of grade 5 students who are in disaster-prone areas. Apart from that, the samples used are students who have learned to use digital learning supported by digital learning infrastructure.

Table 1. Research design

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

Where,
X: Use of virtual-based disaster learning model
O1: Pre-test (disaster adaptation skills before using STEM-based digital disaster learning model)
O2: Post-test (disaster adaptation skills after using a STEM-based digital disaster learning model)
O3: Pre-test (disaster adaptation skills before using conventional models)
O4: Post-test (disaster adaptation skills after using conventional models)

Determination of sample size using the Slovin formula. Sampling in this study used the Slovin formula because the number of samples must be representative [24]. The Slovin formula is used to determine the minimum sample size if the population size is known at the 10% significance level with (1):

$$n = \frac{N}{1+Na^2} \quad (1)$$

Where, n=Sample; N=Population; a=10% precision value (or sig 0.1). So, the sample for this research is:

$$= \frac{987}{1 + 987\ (0.01^2)}$$
$$n = \frac{987}{10.87}$$
$$n = 90.80$$

So, the minimum sample that must be taken is 91 students. Based on agreement, 100 members of the control group and 100 members of the experimental group were divided amongst the two groups of students. While students in the experimental class learned utilizing a STEM-based digital disaster learning model, students in the control class engaged in conventional disaster education.

Up to 10 test questions in the form of essays were utilized to gauge how well students could adapt. The indicators of disaster adaption skills were used to design the questions. The indicators included actions taken before, during, and after the disaster, adjustments to environmental ethics rules and values accepted, and comprehension of disaster phenomena based on experience. Both the content and the construct validity of the exam questions were verified. The contract was calculated using the product moment formula while the content was verified by experts and confirmed valid. According to the construct validation findings, all items are valid because the value of the r-count on each item is greater than the r-table. The questions were put to the test for reliability in addition to validity. An R-value of 0.945 was found for the reliability test findings. This result suggested that the designed questions have a high degree of reliability.

The SPSS 26 program was utilized to aid in the data analysis process. The test included descriptive statistical tests, normality tests, homogeneity tests, paired sample t-tests, and independent t-tests. The hypotheses in this study were: i) Ho: there is no effect of STEM-based digital disaster learning model on the disaster adaptive ability of elementary school students and ii) H1: there is an effect of STEM-based digital disaster learning model on the disaster adaptive ability of elementary school students

3. RESULTS AND DISCUSSION

3.1. Results

Planning lessons was the first step in the study. The way that learning was prepared was altered to fit the learning. In the experimental class, students learned about disasters using a STEM-based digital learning model, whereas students in the control class learned about disasters using a conventional learning approach. The teacher introduced natural disasters, different types of nature, and the effects of natural disasters on people and the environment at the beginning of the learning process in the control class. Regarding the students' knowledge and experience of natural disasters, the teacher and students posed questions. The teacher presented a concrete case to serve as a question-and-answer feedback to students. The teacher made sure the pupils could comprehend the main points of the presented information throughout the question-and-answer session. The teacher then assisted pupils in working both individually and together. This exercise can be done in groups or individually, and it may take the shape of a post-test on disaster mitigation or an essay or short narrative on dealing with a disaster. This was done to get students involved in the learning process.

The teacher gave tests at the end of the lesson to gauge the pupils' level of adaptability. The first thing the teacher did in the experimental class was to introduce the ideas of natural disasters using the provided multimedia, such as movies, images, or multimedia presentations. The purpose of this stage was to give elementary school pupils a basic awareness of disasters, their symptoms, and their effects. Additionally, elementary school children were instructed to use the available interactive technology. VR was the interactive technology that was utilized. The usage of VR sought to increase the interaction and interest level of the lessons being provided.

Students in elementary schools could experience the actual conditions of natural disasters due to the usage of VR. It was anticipated that this circumstance would improve kids' comprehension of disasters and foster critical thinking in elementary school students so they could react to the disaster. The work on this project was done in groups. Disaster-related projects were created, such as creating disaster-resilient structures. Additionally, the teacher was requested to evaluate the kids' work. Additionally, the instructor gave the pupils' learning process some helpful feedback. The teacher administered a test question at the end of the lesson to gauge the students' capacity for adaptation.

The next stage was to calculate the measurement findings after the elementary school kids had received treatment and had their adaptive capacities assessed. The initial step was to gather information to make the calculation easier. This data collection is displayed in Table 2.

Table 2. Results of descriptive statistics

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. deviation
Pre-test of experimental class	100	63	69	65.50	2.028
Post-test of experimental class	100	90	98	95.69	2.024
Pre-test of control class	100	63	69	65.34	2.066
Post-test of control class	100	63	70	66.04	2.365
Valid N (listwise)	100				

Table 2 included information on each class's minimum, maximum, average, and standard deviation, which was utilized as a guide in further calculations. The normality test was performed next, and its goal was to ascertain whether the data distribution was normal. To perform paired sample t-tests and independent sample t-tests, a normality test was necessary. The Kolmogorov-Smirnov and Shapiro-wilk tests were employed in the normality test. Table 3 shows the results of the normality test.

Table 3. Results of normality test

Tests of normality	Class	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Adaptation ability	Pre-test of experimental class	.187	100	.300	.879	100	.169
	Post-test of experimental class	.213	100	.383	.861	100	.316
	Pre-test of control class	.245	100	.244	.842	100	.611
	Post-test of control class	.220	100	.727	.885	100	.284

a. Lilliefors significance correction

Based on Table 3, it was determined that the four classes' sig value for both the Shapiro-Wilk and Kolmogorov-Smirnov tests was .05. These findings led to the conclusion that the data were distributed normally. Since the data were regularly distributed, parametric statistics can be used to continue the test. The paired sample t-test was the subsequent test. The average difference between the two paired samples was to be ascertained using this paired sample t-test. This test addressed the question, "does the use of a STEM-based digital disaster learning model affect the disaster adaptation skills of elementary school students?" Experimental class pre-test and post-test data were used in this calculation (based on a STEM-based digital disaster learning model). Then the control class pre-test data with the control class post-test data (conventional learning model) was used for calculation. The results of the paired samples t -test can be seen in Table 4.

Table 4. Results of paired sample test

Paired samples test		Paired differences					t	df	Sig. (2-tailed)
		Mean	Std. deviation	Std. error mean	95% confidence interval of the difference				
					Lower	Upper			
Pair 1	Pre-test experiments - post-test experiments	-30.190	2.915	.292	-30.768	-29.612	-103.558	99	.000
Pair 2	Pre-test control - post-test control	-.700	3.246	.325	-1.344	-.056	-2.157	99	.033

Table 4 shows that in the pair 1 row, the sig value was obtained (2-tailed) of .000<.05, indicating that there was an average difference in the elementary school students' disaster adaptation skills between the experimental class's pre-test and post-test. The average disaster adaption skills of elementary school kids were different between the control class pre-test and the control class post-test, as shown by the pair 2 row's Sig value (2-tailed) of .033<.05. These findings indicate that employing a STEM-based digital disaster learning model has an impact on elementary school pupils' ability to adapt to disasters.

The homogeneity test was the subsequent test. Although not a strict necessity, this test was one of the requirements for additional tests. The homogeneity test was used to examine whether there was homogeneity in the variance between the experimental class post-test data and the control class post-test data. The outcomes are shown in Table 5.

Table 5. Results of homogeneity test

Test of homogeneity of variance					
		Levene statistic	df1	df2	Sig.
Adaptation ability	Based on mean	3.476	1	198	.064
	Based on median	1.441	1	198	.231
	Based on median and with adjusted df	1.441	1	174.593	.232
	Based on trimmed mean	3.421	1	198	.066

It can be inferred that the variance of the experimental class post-test data and the control class post-test data was the same or homogeneous based on the Sig value based on mean Table 5 where the value was .064>.05. Thus, the independent sample t-test test has been satisfied as a condition (not an absolute). So the independent sample t-test test occurred next. This test was designed to determine whether students who learn in STEM-based digital classes and those who learn traditionally have different disaster adaptive skills. The data were post-test results from both the experimental and control classes. The test outcomes are displayed in Table 6.

Table 6. Results of independent samples test

Independent samples test										
		Levene's test for equality of variances		t-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference	
									Lower	Upper
Adaptation ability	Equal variances assumed	3.476	.064	95.253	198	.000	29.650	.311	29.036	30.263
	Equal variances not assumed			95.253	193.369	.000	29.650	.311	29.036	30.263

It is clear from Table 6 that there was an average difference in students' disaster adaptation skills between those using STEM-based digital learning models and conventional learning models because the sig value (2 tailed) obtained a value of .00, which was greater than 0.05. This conclusion was further supported by the data in Table 2, which showed that students who used the STEM-based digital disaster learning model had higher average post-test scores than those who used the conventional learning model. Overall, it can be said that the STEM-based digital disaster learning model had an impact on primary school students' ability to increase their disaster adaptation skills.

3.2. Discussion

According to the research, elementary school kids' ability to adapt to disasters was improved by the STEM-based digital disaster learning model. This discovery was new in the context of disaster education. Sampurno *et al.* [25] did related research that looked at the creativity of STEM-based disaster education. According to the study's findings, STEM and disaster ideas can help elementary school pupils become more literate about disasters. Septaria *et al.* [26] study looked at how junior high school pupils' disaster mitigation modules were created. According to the findings, a useful STEM-based disaster mitigation program for pupils at the junior high school level has been created. Chan and Nagatomo [27] looked at the creation of a STEM-based disaster education framework. According to the study's findings, a STEM-based educational framework had been created for the process of catastrophe mitigation. A STEM curriculum for students in higher education that is disaster-based was the subject of research by Shahidullah and Hossain [28]. According to the study's findings, a STEM learning design that is disaster-based has been developed and might be used in higher education. The viability of STEM-based earthquake-related worksheets was also investigated in research by Kosim *et al.* [29]. The study's findings revealed that earthquake-related STEM-based student worksheets had been created for university students. This study found that the STEM-based digital disaster learning model developed had an impact on enhancing the disaster adaptation skills of elementary school students. Based on the findings of previous research, it was evident that the study of STEM in disaster had begun to develop. This novelty was one of the educational possibilities to help primary school kids with their adaptability skills.

Due to some factors, the STEM-based digital disaster learning approach proved successful in enhancing the student's ability to adapt to disasters. One of them was a STEM-based digital learning model for disasters that were created using engaging and interactive ideas. This STEM-based digital disaster learning model combined simulation and STEM systems with a variety of digital technology devices. Students had the chance to interact directly with multimedia that has been tailored to the concept of natural disasters due to digital technology devices like tablets, computers, laptops, smartphones, software, and other applications [30]–[32]. Students could view graphs, images, and videos relating to disaster causes, impacts, and adaptation strategies using this technology. Through VR technology, students could potentially experience disaster simulation. Students will feel as if they are in a natural disaster but will not suffer any risks to their physical safety. The simulation allowed students to react to natural disasters, analyze the issues that arise, make decisions, and observe the outcomes of those decisions. The learning process was made more engaging by this circumstance, which also boosted students' enthusiasm and interest in learning about disasters [33]–[36]. For elementary school students, the STEM approach employed in the digital disaster learning process gave them the chance to apply STEM to their study of natural disasters. The purpose of this statement was to help primary school students realize how STEM knowledge may be applied as a solution in dealing with disasters by presenting contextually appropriate materials and engaging learning opportunities. Therefore, it can be said that the STEM-based digital disaster learning model provided elementary school children with an engaging and participatory learning experience, fostering their excitement for comprehending and overcoming natural disaster-related issues. This procedure improved the ability of elementary school children to adapt to natural disasters, resulting in the development of a generation of primary school students who were resilient and prepared to handle emergencies.

The digital disaster learning model's STEM foundation and emphasis on practical experience were further factors. Students were able to gain practical experience simulating natural disasters using VR as one of the multimedia tools [37]–[41]. To enable primary school pupils to show various types of relevant disaster adaptation activities, children will be requested to actively participate in the disaster simulation process utilizing VR. There was no real risk to the kids because the VR simulation was secure and manageable. Despite being a simulation, the one that was given gave pupils the impression that they were in the middle of a catastrophe and had to make decisions about how to handle it.

Students would be able to enhance their talents and skills properly in responding to disasters through the process of adaption actions through this simulation. To enable primary school pupils to show various types of relevant disaster adaptation activities, children will be requested to actively participate in the disaster simulation process utilizing VR. There was no real risk to the kids because the VR simulation was secure and manageable. Despite being a simulation, the one that was given gave pupils the impression that they were in the middle of a catastrophe and had to make decisions about how to handle it. Students would be able to enhance their talents and skills properly in responding to disasters through the process of adaption actions through this simulation.

Another aspect was the STEM-based digital disaster learning model's involvement of students in projects that were meant to address actual catastrophe-related issues. Students will be required to use their knowledge and skills from a variety of STEM subjects in the projects they complete to develop creative and adaptable plans and solutions for dealing with natural disasters. Students confronted actual difficulties relating to natural disasters as part of this project-based learning approach, which also offered theories about disasters [42]–[45]. For instance, elementary school kids may create buildings made of ice cream sticks or straws that could resist earthquakes, storms, and floods. Students in primary schools might also be requested to design a practical and efficient evacuation route as part of this project.

Students in primary school studied in groups for this assignment. Students in elementary school worked in groups to conduct investigations, gather data and information, analyze it, and come up with disaster-related solutions. Through this project, elementary school kids will be able to develop their critical and creative thinking abilities to identify practical and innovative alternate solutions to difficulties brought on by natural disasters. Because the learning was not only theoretically presenting knowledge but also connecting learning to the practical situations of everyday life, project-based learning was highly helpful for students in grasping the subject matter [44], [46], [47]. Students will experience the results of each choice they make and the action they take during this project-based learning process. Students in elementary school would benefit from this project as they grow in understanding and disaster adaptability abilities. Proficient in elementary school who were talented and proficient in reacting to natural disasters effectively and creatively would be shaped by the obstacles in this project-based learning. The development of student's skills and preparation to meet difficulties in the future, as well as their active participation in developing solutions to safeguard the local environment from the risk of natural catastrophes, will all be shaped through project-based learning in primary schools.

Additionally, the integration of digital technology with the STEM approach was responsible for the rise in pupils' ability to adapt to disasters in elementary schools. A clearer image and a better explanation of the notion of disaster could be provided by combining digital technologies with the STEM approach. This claim described how integrating digital technologies with a STEM approach may help kids gain a better understanding of natural disasters. Natural catastrophe content could be presented more attractively by combining digital technologies like videos, software, images, and multimedia [48]–[50]. Elementary school pupils would benefit from this visualization method to better understand more abstract and difficult disaster themes.

In the disaster-based learning process, the STEM approach, which combines the ideas of STEM, was able to describe and connect concepts more effectively. The causes of disasters, the method of occurrence, and the unique characteristics of each disaster might be easier understood by elementary school pupils. The effects of disasters on people, the environment, and social and economic losses could all be taught to primary school pupils. Primary school pupils would grasp the significance of disaster adaptation to be protected from the harmful effects of disasters that occur by learning the characteristics of disasters [51]. Students in elementary school would understand that disaster adaptation encompassed measures for prevention, planning, and post-disaster recovery in addition to responding when a disaster happened.

Additionally, giving elementary school pupils a better understanding of STEM concepts and digital technologies would help them become more self-aware of the value of preparedness and responsibility in the face of calamities. If students have a broad understanding of disasters, they will be better equipped to handle any natural disasters that may come [52]. We may therefore conclude that the integration of STEM and digital technologies in disaster learning greatly aided in improving comprehension and disaster adaptation. If students had a firm understanding, they would recognize catastrophes' inevitable approach quickly, be prepared to deal with them and take an active role in disaster prevention and mitigation [53].

The STEM-based digital disaster learning model would help develop students' critical and creative thinking abilities in disaster response. Students would be better able to think critically about the causes, effects, and possible swift disaster response activities through the usage of this model in the learning process. Students in elementary schools were urged to explore the possibility of many creative ideas that could benefit the neighborhood and the environment when dealing with disasters. Students used this critical thinking skill to examine the numerous scenarios that could have occurred during the crisis and to make decisions during the disaster [54]. In this learning model, elementary school children were challenged to acquire creative thinking abilities in addition to critical thinking abilities to come up with disaster adaptation options. The option to create new adaptation strategies from already existing solutions was granted to elementary school children. Elementary school kids would be able to explore a variety of ideas while fostering creativity to produce solutions that were efficient and suitable for the crisis the community was facing.

Students' critical and creative thinking abilities must be developed so they can handle difficulties when faced with calamities [54], [55]. These two skills could help pupils improve their analytical thinking and make it simpler for them to choose wisely in dealing with calamities. Therefore, this STEM-based digital disaster learning model would enhance elementary school students' critical and creative thinking abilities in coping with disasters and emergencies in addition to increasing their understanding of disasters. Students who possess these abilities will be better able to withstand the challenges posed by natural disasters and take proactive measures to preserve their environment, their community, and themselves [56].

STEM-based digital disaster learning was successful in enhancing primary school kids' ability to adapt to disasters due to interactive elements, practical experience, project-based learning, increased comprehension, and critical and creative thinking abilities. Elementary school children would become resilient individuals who understood the process of disaster adaption that would influence themselves, the environment, and society if relevant, engaging learning that was suited to students' conditions was developed. Students become skilled at adapting to disaster-prone areas.

4. CONCLUSION

According to the results, using STEM-based digital disaster learning models has an impact on enhancing primary school pupils' adaptive skills. When compared to kids who learn using conventional learning models, elementary school children who use the STEM-based digital disaster learning model have higher levels of disaster adaptation skills. According to this research, teachers can use this STEM-based digital disaster learning model to help children in primary school become more efficient at adapting to new situations.

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