The impact of sets education on disaster education on student mitigation skills and resilience

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ABSTRACT

Purpose: The high potential threat of disasters that will occur in Indonesia requires anticipation from various sectors including education. The concept of natural disasters will be easy to understand if applied in an integrated manner between natural disasters and science, environment, technology, and society. Therefore, it is very important for today's youth that it has a long-term impact and reaches a very wide population so that it is possible to minimize the risk in the event of a disaster. This study aims to 1) analyze the characteristics, 2) analyze the validity of the SETS-based disaster education model in disaster mitigation and resilience 3) analyze the effectiveness of the SETS-based disaster education model in natural disaster mitigation and resilience.

Design/Methodology/Approach: Participants in this study were elementary school students. The method used is development research from Borg and Gall. According to professional judgement, this study followed five of the ten procedures outlined by Borg and Gall to develop a viable product.

Finding: The results showed that 1) the SETS-based disaster education learning model has six stages; 2) the SETS-based disaster education model in disaster mitigation and resilience is valid and feasible to use; 3) The results of the effectiveness test show that the SETS-based disaster education model is effective in increasing students' fatigue and resilience skills.

Conclusion: This research contributes to the body of knowledge by informing the public about the importance of SETS-based disaster education for individuals to improve their mitigation and resilience skills in the event of natural disasters. Furthermore, the research findings are enhanced by the literature on SETS-based disaster education, which is currently understudied. The limitation of this study is that it was only done up till professional validation was done. Therefore, it is necessary to carry out further research with more complete and extensive stages.

Keywords: *Characteristics, Mitigation, Resilience, SETS.*

1. INTRODUCTION

In disaster education, schools as a component of society have a strategic role in preparing young people from an early age to better understand natural disasters, their mitigation, and resilience. Kamil, Utaya, and Utomo (2020); Ratten and Jones (2021) and Shah et al. (2020). If natural disasters are used in a method that integrates science, environment, technology, and society, the notion of natural disasters will be simple to grasp. This educational model is packaged and integrated into learning in schools carried out at the elementary school education level for the following reasons: (1) educational outcomes are durable and long-term, (2) reach a population that is large enough for the future of the nation, and (3) is a very appropriate time to instill socio-moral values for students (Rusilowati, Binadja, & Mulyani, 2012; Salawane, Supriyadi, Rusilowati, Indriyanti, & Binadja, 2020). This research produced a Science, Environment, Technology, and Society (SETS)-based disaster education learning model in Disaster Mitigation and Resilience. This model consists of natural disaster education that most often occurs in Indonesia, namely floods, landslides, earthquakes, and volcanic eruptions.

Due to the complexity of catastrophe problems, it is necessary to prepare or carefully plan how to handle them so that they may be put into action in a focused and integrated way. Tan, Guo, Mohanarajah, and Zhou (2021); Wu and Guo (2021); Feng and Cui (2021) and Cui (2020) explain that the facts collected and the significant amount of damage brought on by natural disasters lead to the conclusion that current disaster management practices are not ideal. This disaster management is not optimal because so far, the disaster management activities carried out have not been based on systematic and planned steps so there is often overlap and there are even important steps that are not handled properly. Law Number 24 of 2007 concerning Disaster Management stipulates in articles 35 and 36 that each region in disaster management efforts has a disaster management plan. In more detail, it is stated in Government Regulation Number 21 of 2008 concerning Disaster Management.

The government has carried out various programs in dealing with disasters, one of them is the disaster resilient village program. However, until now, only 38 villages have been handled with the establishment of disaster-resilient villages. To anticipate disasters, it is necessary to coordinate with relevant agencies to mitigate disaster risk reduction. The role of the community is quite large in disaster risk reduction. The hope is that the community can be independent in mitigating disaster risk reduction. This will reduce casualties when a disaster occurs. Coordinating the mainstreaming of disaster risk reduction mitigation offers a large part in the community's resilience and self-sufficiency, regardless of the catastrophe risk. Disaster management is important to do because it has many impacts (Méndez, Flores-Haro, & Zucker, 2020; Panwar & Sen, 2019; Rondeau, Perry, & Grimard, 2020).

Based on the regulation of the Head of the National Disaster Management Agency of the Republic of Indonesia Number: 4 of 2008 concerning Guidelines for Preparing Disaster Management Plans, education is one of the vehicles that can be used to instill knowledge and awareness about the disaster. The process of internalizing disaster management in the local content of education is a form of passive mitigation that can be done. Education-based mitigation falls under the category of non-structural active mitigation in addition to passive mitigation. Internalization of disaster management is admittedly difficult to do due to the unavailability of supporting learning resources (Atmojo, Rusilowati, & Dwiningrum, 2020). Learning materials utilised in classrooms simply cover the topic in general; they don't address how to prepare for disasters, which is a concern in student communities. (Enia, 2020). The high potential threat of disasters that will occur in Indonesia requires anticipation from various sectors including education. The education sector, especially elementary schools, has a long-term impact and reaches a very wide population, making it possible to minimize risks in the event of a disaster. Educational activities in elementary schools can be used as a mean of teaching the concepts of disaster, mitigation, and resilience. To properly teach disaster, mitigation, and resilience and get maximum benefits, a specific learning model is needed. Based on these various studies, it is necessary to conduct research to develop, and analyze the characteristics and analyzing validity of SETS-based disaster education learning models in natural disaster mitigation and resilience.

2. METHOD

This type of research follows the ten steps of development that were carried out to produce a valid product according to expert judgment. The activities carried out in this study were 1) preliminary study, 2) needs analysis of the SETS-based disaster education learning model, 3) model design consisting of a draft model and supporting features based on preliminary studies, 4) curriculum analysis and determining themes and sub-themes on learning in elementary schools related to natural disaster events, 5) Conducting Focus Group Discussion (FGD) and expert validation. While the components included in the model refer to the components of the learning model proposed (Joyce, Weil, & Calhoun, 2009), namely: (a) syntax, (b) social system, (c) the principle of reaction, (d) the support system, and (e) the impact of instructional and accompaniment. Data analysis technique using percentage descriptive analysis.

3. RESULTS AND DISCUSSION

3.1. Foundation for Development of Science, Environment, Technology, and Society (SETS) Based Disaster Education Learning Model

Indonesia is the largest archipelagic country in the world which is geographically located in a strategic position, namely at the crossroads of two continents (Asian Continent and Australian Continent), and two oceans (Indian Ocean and Pacific Ocean). Indonesia has 17,508 islands with a total area of about 5,180,053 km2. Of the total area of the region, 3,257,483 km2 is ocean and 1,922,570 km2 is land. In addition, there are 5,590 watersheds located between Sabang and Merauke. Based on these geographical conditions, Indonesia is a confluence area of three

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major tectonic plates, namely the Australian plate, the Eurasian plate, the Pacific plate and the Philippines. This causes Indonesia to be geologically vulnerable.

Indonesia's climate is strongly influenced by its location and geographical characteristics (Amri & Giyarsih, 2022; Sandel et al., 2020; Setyawan et al., 2020). The territory of the Unitary State of the Republic of Indonesia is one of the nations with a high risk of catastrophe threats due to its geographic location and being in one of the most active disaster zones in the globe. Geological disasters (earthquakes, tsunamis, volcanic eruptions, landslides), hydro-meteorological disasters (floods, flash floods, droughts, extreme weather, extreme waves, forest and land fires), and anthropogenic disasters (epidemics of disease outbreaks and technological failures-industrial accidents make up at least 12 of the disaster threats. According to statistics collected by the National catastrophe Management Agency, there were 13,729 catastrophe incidents between 1991 and 2021. The number of incidents was dominated by earthquakes followed by tsunamis (resulting in 174,101 people died), earthquakes (15,250 people died), floods and landslides (7,555 people died) and other disasters (28,603 people). This complex condition is further complicated by the impact of climate change caused by environmental damage. Climate change will continue to have a sizeable impact on humanitarian program interventions and development programs, and will continue to pose a challenge to the development and implementation of the education sector.

Related to efforts to protect its citizens against disasters, the Government of Indonesia has enacted Law no. 24 of 2007 concerning Disaster Management. According to the legislation, everyone has the right to receive instruction, training, counselling, and training in disaster management, whether a disaster really occurs or not. Through education, it is predicted that disaster risk reduction efforts can achieve broader goals and can be introduced earlier to all students, by integrating disaster risk reduction education into the school curriculum as well as into extracurricular activities. The rules and regulations that form the basis of the models created by academics to lower catastrophe risk support this, including:

1. The 1945 Constitution of the Republic of Indonesia, amendments to Article 28, Article 31, and Article 34 Paragraph 2.
2. Law No. 39 of 1999 concerning Human Rights.
3. SNI 03-1726-2002 Concerning Procedures for Planning Earthquake Resistance for Buildings.
4. Law Number 23 of 2002 concerning Child Protection.
5. Law Number 20 of 2003 concerning the National Education System (State Gazette of the Republic of Indonesia of 2003 Number 78, Supplement to the State Gazette of the Republic of Indonesia Number 4301).
6. Regulation of the Minister of Public Works No. 29/PRT/M/2006 concerning Guidelines for Building Technical Requirements.
7. Technical Guidelines for Earthquake Resistant Houses and Buildings, Directorate General. Cipta Karya (2006), which is equipped with Construction Improvement Methods.
8. Law Number 24 of 2007 concerning Disaster Management.
9. Regulation of the Minister of National Education Number 24 of 2007 concerning Standards of Facilities and Infrastructure for Elementary Schools/ Madrasah Ibtidaiyah, Junior High Schools/ Madrasah Tsanawiyah, and Senior High Schools/ Madrasah Aliyah.
10. Regulation of the Minister of Public Works No. 45/PRT/M/2007 concerning Technical Guidelines for the construction of State buildings.

3.2 *The Purpose of Developing a SETS-Based Disaster Education Learning Model*

The development of a SETS-based disaster education learning model aims to disseminate information and knowledge about disaster risk reduction. This model can be a standard reference for teachers and facilitators in conducting SETS-based disaster learning in elementary schools. In addition, this approach also offers chances for those who want to contribute to the dissemination of disaster information, particularly through the provision of SETS-based disaster education in primary schools.

3.3. Construction of the SETS-Based Disaster Education Learning Model

The SETS-based disaster learning model is based on constructivism theory. The theory of constructivism is defined as generative learning, namely the act of creating meaning from what is learned (Geels, 2020; MacDonald, Hill, & Sinclair, 2020; Popa, 2022). In constructivism theory, learning is an active activity in which students construct new knowledge and understanding, seek meaning based on what is learned. According to this theory, one fundamental principle is that teachers do not just impart knowledge to students, but students must also construct their own knowledge. In this case, the teacher can provide opportunities for students to discover or apply their own ideas. The teacher develops learning opportunities for students to climb the steps that bring students a higher understanding, which was originally done with the help of the teacher but is increasingly becoming more independent. From this description it can be concluded that constructivism is an active activity, where students build their own knowledge, and develop new concepts and ideas with their cognitive abilities. In relation to constructivism, there are two learning theories that form the basis for the development of this model, namely the learning theory developed by Jean Piaget and Vygotsky.

The development of learning models must be based on needs analysis and theoretical studies (Rapanta, Botturi, Goodyear, Guàrdia, & Koole, 2020; Sun, Wang, & Ye, 2021; Valverde-Berrocoso, Garrido-Arroyo, Burgos-Videla, & Morales-Cevallos, 2020). The development of the developed model analyzes the advantages and disadvantages of similar models that have been developed previously. This SETS-based disaster learning model is explained based on disaster studies and thematic learning in elementary schools. The goal of this model is to immerse students in real-world disaster issues through integrated observation and understanding of disaster concepts through SETS-based learning, observation of disaster-prone areas as part of an investigation, and inviting them to create solutions on disaster-related problems. was produced. So, Students in one class can work together to examine catastrophes from the perspectives of science, the environment, technology, and society. Joyce and Weil (2009) state that at the same time, students gain a healthy respect for knowledge and may learn about the limitations of current and reliable knowledge. The planned and executed efforts are also appropriate for mitigating the effects of natural disasters.

3.4. Syntactic

This SETS-based disaster education learning model has six stages of activity. The first stage is initiation, organization, and orientation, the second stage is concept development, the third stage is application and implementation of the concept, the fourth stage is adapting the concept, the fifth stage is planning and decisions making, and the sixth stage is Evaluation. In the six syntactic activities, this model consists of ten phases or steps in learning activities which can be referred to as the ten Ms, the steps in detail can be explained in Table 1 as follows:

Table 1. Activity stage in the SETS-based disaster learning model.

Stage 1 Initiation, organization, and orientation	**Stage 4 Adapting concepts**
Link observe	Simulating concepts
Stage 2 Concept development	Stage 5 Planning and deciding
Gathering information Ask	Plan actions to overcome disaster difficulties Responding to a disaster based on the concept
Stage 3 Application and concept implementation	Stage 6 Evaluation
Associate communicate	Assess / Evaluate understanding of concepts

Based on Table 1, it can be seen that in the six stages of learning activities using the SETS-based disaster learning model, there are phases in each of the activities. A detailed explanation of each phase of SETS-based disaster learning activities can be seen in Table 2.

3.5. Reaction Principle

In this model, the teacher's task is to create and maintain a scientific atmosphere by emphasizing the discovery process and inviting students to reflect on their findings. Teachers should urge students to link the SETS parts rigorously and consider the catastrophe of the four SETS elements, taking care to avoid making fact identification the primary concern. Teachers must develop/invite students to express ideas, ideas, and develop the SETS concept in the context of disaster mitigation and resilience.

3.6. Social System

In this model, the teacher must maintain control over the intellectual structure, because this is important for connecting disaster learning materials with SETS elements. In the second to fourth steps the learning situation must be more interactive, as students need to be designed to ask questions and provide responses. To implement this model, an atmosphere is needed so that students can carry out SETS-based learning activities, namely connecting

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disaster material with each of the SETS elements. This atmosphere is necessary because students will be in a community as someone who uses the best techniques in science to do something important related to disaster mitigation. Students must hypothesize correctly, (Laciok, Sikorova, Fabiano, & Bernatik, 2021; Meyer & Norman, 2020; Wiziack & Dos Santos, 2021).

Table 2. Phases in SETS-based disaster learning.

Activity phase	Teacher activities	Student activities
Associate	The teacher identifies the themes in learning materials that can be used to explain disaster-related concepts.	Students prepare to take part in learning activities designed by the teacher by observing areas where they live that are prone to disasters.
Observing (Observation)	The teacher designs an activity that involves students' active participation while observing natural conditions in the student's environment.	In order to gather knowledge about potential disasters, students actively study the local environmental conditions in their surroundings: In order to gather knowledge about potential disasters,
Ask	The teacher provides several opportunities for students to express questions related to the results of observations in disaster-prone areas.	Students ask for anything related to the results of observations in disaster-prone areas.
Gathering information	The teacher gives assignments to students in groups and individually to collect various information through various sources related to natural disasters and their relationship to learning and SETS elements.	Students collect various information through various sources related to natural disasters and their relationship to learning and SETS elements.
Associating / processing Information / reasoning	The teacher provides an opportunity for each group to explore how to digest knowledge about potential catastrophes and how those disasters relate to SETS components.	Students process information about various disasters that may occur and their relation to SETS elements.
Communicating	The teacher allows each group to convey the results of various information and ideas about disaster events and their relation to SETS elements.	Students convey the results of various information and thoughts about events and disasters and their relation to SETS elements.
Simulating concepts	The teacher designs disaster simulation activities through SETS-based learning activities.	Students simulate a disaster through active SETS-based learning activities.
Planning actions to overcome disaster difficulties	The teacher gives examples of activities that students can do to be able to live and live in disaster-prone areas.	Students position themselves and take measures before the disaster, during the disaster, and after the disaster.
Responding to disasters based on concepts	The teacher describes the things students can do in response to disasters.	Students respond and respond to a catastrophic event.
Evaluating understanding of concepts	The teacher makes a test that measures practical understanding and SETS-based disaster learning theory.	Students have a thorough comprehension of both the SETS-based disaster learning theory and practical application.

3.7. Support System

To implement this model, flexible and skilled guides and instructions are needed in the learning process, disaster simulation, before the disaster, during the disaster, and after the disaster. To improve mitigation and resilience capacities, it is vital to have access to sources and support systems for simulations and observations.

3.8. Instructional and Accompaniment Impact

This SETS-based disaster learning model is designed to teach disaster mitigation methods in disaster-prone areas. Thus, the instructional impact is scientific knowledge and processes in disaster mitigation. In addition to the learning impact, this model also has other impacts (companions) that arise, namely: students' commitment to disaster vulnerability, a sensitive attitude towards disasters, and students' ability to postpone decisions and consider alternative actions when a disaster occurs. The two impacts can be charted as shown in Figure 1.

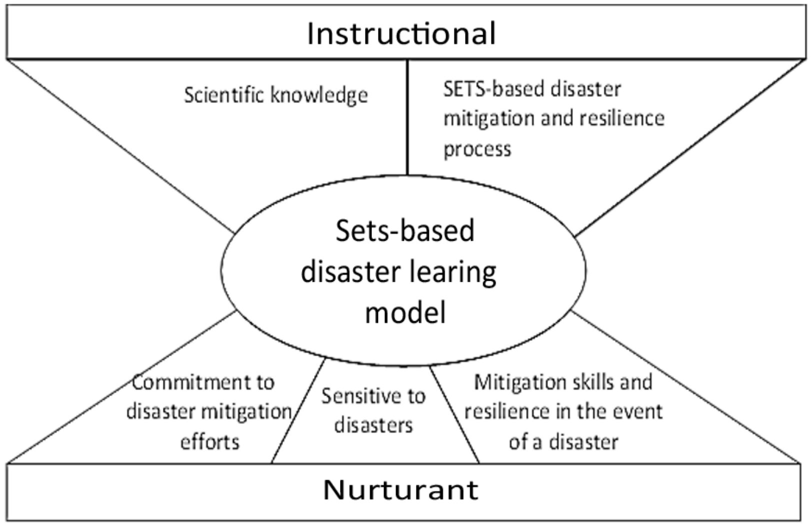

Figure 1. Instructional impact and accompanying impact in SETS-based disaster learning.

Based on Figure 1 it is known that the SETS-based disaster learning model has an instructional impact and an accompanying impact. The instructional impact consists of students' scientific knowledge about disasters linked to the SETS elements, besides that the instructional impact on this learning model is the process of disaster mitigation and resilience. The accompanying impact of this model consists of a commitment to disaster mitigation efforts, sensitivity to disasters, and students' abilities in disaster mitigation and resilience.

In addition to instructional impact this model also consists of syntactic, reaction principles, support systems, and social systems. Comprehensive linkages and model relationships can be seen in Figure 2.

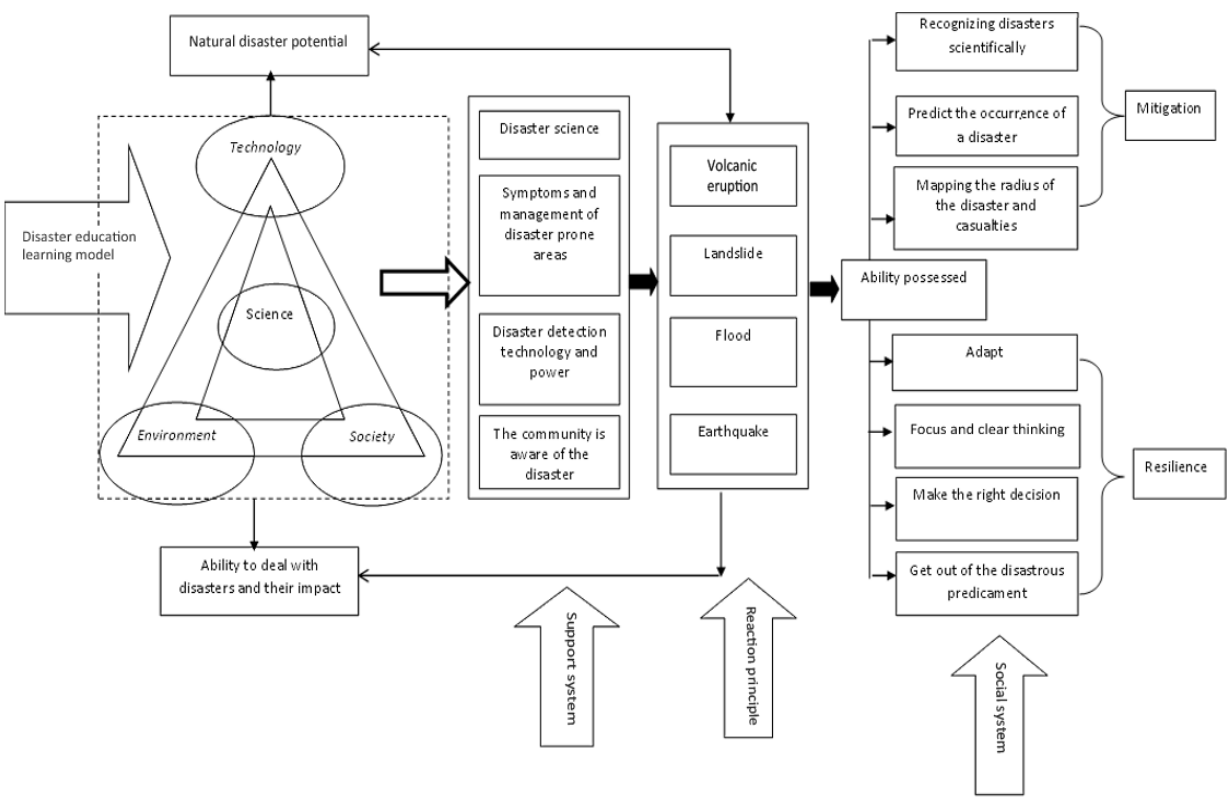

Figure 2. SETS based disaster education learning model.

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3.9. The Validity of the SETS-Based Disaster Education Learning Model

To find out the validity of the SETS-based disaster education learning model in the mitigation and resilience of elementary school students, a validation process was carried out. Validation is an act of proving appropriately, that each material, process, procedure, activity, system, equipment, or mechanism used in production and control will be able to achieve the desired results (Abassi, Ben Chehida Douss, & Sauveron, 2020; Abbaszadeh Shahri, Shafizadeh, & Soleimani, 2021; Mehmood, Iqbal, & Khalily, 2021). The validity data from the learning model created results were based on the findings of the validation test. Data was obtained using a validation questionnaire filled with four learning model development experts. The results of the validation questionnaire analysis can be seen in Table 3.

Table 3. Results of analysis of the validity of the SETS-based disaster education learning model.

Rating indicators	Validators				Average of each indicator
	I	II	III	IV	
Model supporting theory	4.3	4.1	4.1	4.2	4.17
Model development background	4.1	4.2	4.1	4.2	4.15
Model development goals	4.1	4.1	4.2	4.1	4.16
model description	4.3	4.5	4.4	4.1	4.33
Syntax models	4.2	4.4	4.5	4.2	4.33
Social systems model	4.3	4.2	4.2	4.2	4.23
Model support system	4.0	4.1	4.6	4.1	4.20
Average of each validator	4.18	4.23	4.3	4.16	4.21

Based on Table 3, it is known that the results of the validity data analysis show that the developed model obtained an average validity score of 4.21 which is in the very valid category. This validity criterion is used as a basis for continuing to the next development stage (Kusumah et al., 2020; Supriyatno, Susilawati, & Hassan, 2020; Zahro & Mitarlis, 2021). As for the input from the validator during the FGD, it can be seen in Table 4.

Based on Table 4 it is known that there are several suggestions and inputs given by experts on the model that is being developed. These suggestions and inputs are used as material for improving the learning model for the empirical effectiveness trial process (Burkhardt & Schoenfeld, 2021; Firestone, Cruz, & Rodl, 2020; Lin, Zhou, & Wijaya, 2020).

This SETS-Based Disaster Education Learning Model is part of the development product used to manage students. This model aims to improve the ability of lecturers to teach disaster material in courses. Apart from the lecturer's side, this model can also be used to increase student disaster mitigation, resilience knowledge and skills. In principle, this model is designed according to the characteristics of college students. This learning model consists of learning about natural disasters such as earthquakes, volcanic eruptions, landslides, and floods. This disaster is the dominant disaster, causing many casualties, losses. Through the SETS-based disaster education learning model, the concept of natural disasters will be easier to understand. This is because the SETS-based disaster education learning model combines science, environment, technology, and society. This learning model will complement existing products by integrating disaster in an integrated manner into the themes of Science, the Indonesian Language, Social Studies, Civics, and Religion. Apart from focusing on how to teach disaster material, this product also contributes to efforts to improve students' mitigation abilities and resilience to disasters. The products developed are focused and implemented on students with various learning methods. The first feature that distinguishes the product being developed from similar existing products is that this product has a broader level of integration than existing similar products, not only on the theme of Natural Sciences but also on the themes of Indonesian Language, Social Sciences, Civics, and Religion. Because these two items were created using the most recent curricula, their qualities have a higher level of practical application for use in lectures.

Table 4. Results of focus group discussion learning model development results.

Models background	Model supporting theory	Models' syntax	Social system	Reaction principle	Support system	Instructional and Accompaniment Impact
It is necessary to strengthen the reasons for choosing the stem approach, what are the advantages of the stem approach compared to other approaches, for example, SETS, the scientific approach. What about steaming in the middle of a pandemic?	You can add a philosophical approach, for example, the theory of progressivism in education.	Each stem syntax should be given a time allocation so that lecturers carrying out stem learning can run according to the allocation. The activities of each syntax should be able to measure the achievement of the learning process.	It needs to be designed so that there are two-way interactions between lecturers and students.	There is lecturer feedback	Adequate infrastructure is needed to carry out the stem approach in lectures.	It should have more of an impact on increasing the social, pedagogic, professional, and individual competency of prospective teachers.
Has a needs analysis been carried out? What sort of learning paradigm is desired by the teacher?	Enough. The theory of integration is part of constructivism learning theory? or more precisely combined with the nature of elementary student learning (Thematic)	If it is also prepared for blended learning it will be more useful.	Enough	Enough	It is necessary to add facilities/infrastructure related to disaster mitigation.	Clearly state the impact of instructional and accompaniment when using the model, you developed. For example, increasing knowledge about the disaster, being able to take preventive actions to minimize disaster risk, etc. which are relevant to the material being taught and indicators of achievement of defined competencies.
Appropriate	Already contains the supporting theory of the model of supporting theory.	The model syntax for making RPP needs to be the same as the model syntax being developed. Following the creation of instructional materials, it must then be incorporated once again when creating the evaluation tool.	Already includes a social system in the development of teaching materials.	In the student book, there are already student activities according to the model developed.	Supporting pictures taken in the book being developed, if taken from the internet, then you should comply with decency in taking pictures.	Need to be adjusted between the model book and the model guide.
The model background is good. In my opinion, the importance of disaster education needs to be added considering that Indonesia is located in the "ring of fire" so it has a lot of potential for volcanic eruptions. Indonesia has a tropical climate and is also vulnerable to various disasters such as floods, tornadoes, and even drought. You can also add data on the impact of disasters on school-age children. the importance of disaster education "because in elementary schools there is no lesson about the disaster, disaster education is integrated into learning through the SETS model.	In my opinion, 21st-century learning theory can be added to critical thinking, problem-solving, metacognition, communication, collaboration, innovation and creativity, and information literacy.	It's fine, it can be implemented.	It's fine, it can be implemented	Already well	Already well	Already well

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The third characteristic is that this model is more specific and focuses on one type of disaster so that it has a more in-depth study and provides more detailed and complete information on mitigation and student resilience efforts in disaster-prone areas. The third characteristic is that this model is more specific and focuses on one type of disaster so that it has a more in-depth study and provides more detailed and complete information on mitigation and student resilience efforts in disaster-prone areas. The third characteristic is that this model is more specific and focuses on one type of disaster so that it has a more in-depth study and provides more detailed and complete information on mitigation and student resilience efforts in disaster-prone areas.

3.10. Testing the Effectiveness of the SETS-Based Disaster Education Learning Model in Natural Disaster Mitigation and Resilience

Descriptive analysis presentation is used to present the data obtained based on the results of natural disaster mitigation and resilience measurements which were carried out using descriptive statistics SPSS software version 25. After analyzing the data between the experimental group and the control group it was found that the results of the descriptive analysis of mitigation and resilience obtained an average value -the average value in the experimental group is higher than the average value of the control group. This can be seen in Figure 3.

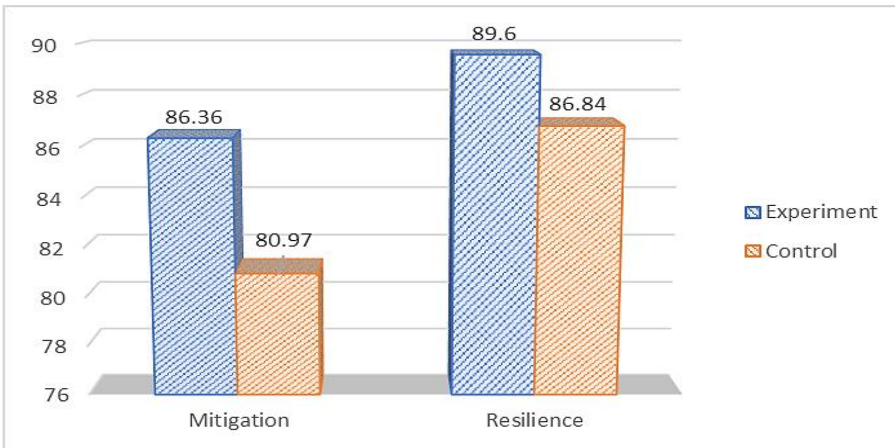

Figure 3. Mitigation and resilience average score chart.

3.11. Experiment Group Students and Control Group Students

Based on Figure 3 above, shows the acquisition of the average value of mitigation skills using the SETS vision of disaster education model (experimental group) of 86.36 where this figure is greater than the average of students who do not use the SETS vision of disaster education model (control group) which is 80.97. The average acquisition value of student resilience in the experimental group using the SETS vision of disaster education model is 89.60, which is higher than the average for students in the control group using a different disaster education model, which is 86.84. Regarding this, it can be concluded that in general the mitigation skills and student resilience achieved by the experimental group are better than the controlled group.

The Manova test was used to further analyze the discrepancies between these values and evaluate the hypothesis. Before evaluating the hypothesis, the precondition analysis is tested. The prerequisites used in this study include the normality test and homogeneity test as follows:

This data normality test was carried out on natural disaster mitigation and resilience data in each treatment group, namely in the experimental group and in the control group. A summary of the normality test can be seen in Table 5.

Table 5. Normality test results for mitigation and resilience data scores group experiment and control.

Units of analysis	Class	Sig.	Sig level.	Information
Mitigation	Experiment	0.063	p > 0.05	Normal distribution
	Control	0.055		Normal distribution
Resilience	Experiment	0.064	p > 0.05	Normal distribution
	Control	0.078		Normal distribution

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Based on Table 5 shows that the results of the Kolmogorof-Smirnov Tests of Normality with Lilliefors Significance Correction on the score mitigation group the experiment is normally distributed with a significant number of 0.063 > 0.05 and a score mitigation group controls are normally distributed with a significant number of 0.055 > 0.05. Then, on to the score-resilience data group the experiment is normally distributed with a significant number of 0.064 > 0.05, and a yield score-resilience data group controls are normally distributed with a significance value of 0.078 > 0.05. According to the findings of this research, the distribution of scores derived from data on natural disaster mitigation abilities and resilience in each group experiment and group control is normally distributed, hence satisfying the need of the normality test as a precursor test.

A homogeneity test was carried out to find out whether the two groups of data studied had homogeneous variants or not. Variance homogeneity was tested using Levene's Test of Equality of Error Variance. A summary of the homogeneity of the variants can be seen in Table 6.

Table 6. Results of homogeneity test score data mitigation and student resilience.

Units of analysis	Method	Levene statistics	Df1	Df2	Sig.
Mitigation	Based on means	0.521	1	156	0.471
	Based on median	0.485	1	156	0.487
	Based on the median and with adjusted df	0.485	1	155,666	0.487
	Based on trimmed mean	0.493	1	156	0.484
Resilience	Based on means	0.735	1	156	0.392
	Based on median	0.656	1	156	0.419
	Based on the median and with adjusted df	0.656	1	154,927	0.419
	Based on trimmed mean	0.773	1	156	0.381

Based on Table 6 the results of Levene's Test of Equaty or Error Variances show that the data on the mitigation skills score is homogeneous with a Based Mean significance number of 0.471 > 0.05 and the resilience score data is homogeneous with a Based Mean significance number of 0.392 > 0.05.

After carrying out the normality test and homogeneity test it is said to be normal and homogeneous, then proceed with conducting the Manova test (Multivariate Analysis of Variance) to see the effectiveness of using the SETS vision disaster education model for improving student mitigation and resilience skills with the testing criteria for a significance level of p = 5%. If the significance value of p count is less than 0.05 then the null hypothesis is rejected and Ha is accepted. The test calculations are presented in Table 7.

Table 7. Multivariate test results.

Method	Value	F	Hypothesis Df	Df errors	Sig.	Partial eta squared
Pillai's trace	0.103	8.894	2,000	155,000	0.000	0.103
Wilks' lambda	0.897	8.894	2,000	155,000	0.000	0.103
Hotelling's trace	0.115	8.894	2,000	155,000	0.000	0.103
Roy's largest root	0.115	8.894	2,000	155,000	0.000	0.103

Based on Table 7, the results of the study show that the F calculated Pilae Trace (F calculated = 8.894), Wilk Lambda (F calculated = 8.894), Hotelling's Trace (F calculated = 8.894), Roy's Largest Root (F calculated = 8.894), all has a significance of 0.000 <0.05, so the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted, meaning that it indicates that there is a significant influence of the independent variable (X) on all dependent variables (Y1 and Y2). So that it can be interpreted that the use of the SETS visionary disaster education model can improve students' natural disaster mitigation and resilience skills. The results of the Manova (Multivariate Analysis of Variance) test as a whole show that the SETS visionary disaster education model has proven effective in increasing student mitigation and resilience skills. This can be seen in the influence that occurs through ingroup the experiment that was given the treatment of the SETS vision of the disaster education model was superior to that group control that does not use the SETS visionary disaster education model.

This is in line with the findings (Indrawati, Fatmaryanti, & Maftukhin, 2019) that the learning model for natural disasters that are integrated into science with the SETS vision is suitable for understanding natural disaster material and can increase students' understanding of natural disasters. Continuing with his opinion (Rusilowati et al., 2012)

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that the concept of natural disasters will be easily understood if explained using the SETS vision learning model, namely the integration of science, environment, technology, and society. The attitude of disaster response is needed by students when facing natural disasters. By using the disaster learning model, students will be able to involve in the cognitive, affective, and psychomotor domains as disaster learning places more emphasis on how to prevent disaster problems (Salsabila & Dinda, 2021).

Disaster risk reduction can be integrated into the subject matter, one of which is science subjects. The importance of implementing disaster mitigation education in schools needs to be carried out since elementary school (Desfandi, 2014; Pahlaviannur, 2019) to provide deep knowledge and readiness for actions that need to be taken before/at the time of an unexpected natural disaster to minimize any impacts that will occur. This is in line with his opinion (Hayudityas, 2020) that the implementation of disaster mitigation education in schools from an early age will help students understand the knowledge of natural disasters, attitudes in dealing with natural disasters, the importance of protecting the environment to prevent disasters from occurring and finding alternative ways of mitigation efforts. With disaster awareness from an early age, it is hoped that in future Indonesia will have a society that is aware and responsive to natural disasters. Furthermore, Mantasia and Jaya (2016) explained that disaster mitigation includes planning and implementing actions to reduce the risk of the impact of a disaster that was carried out before the disaster occurred, including preparedness and long-term risk reduction measures, actions that must be taken to reduce the risk of disaster. Disaster mitigation acts as a comprehensive system for dealing with disasters quickly, precisely, and accurately (Zulfa, Widyasamratri, & Kautsary, 2022).

Apart from mitigation, the concept of resilience can also be used in understanding disaster management and how to minimize risks from disasters. In disaster studies, resilience does not only mean assisting victims but also how their capacities and abilities are in dealing with disasters (Puspitasari, Aini, & Satriani, 2019). In line with the opinion (Fitri, 2014) that resilience is defined as a pattern of positive adaptation related to experience, attitude, skill, and internal and external resources to overcome unpleasant conditions (adversity). Further, research Sasmita and Afriyenti (2019) found that student resilience is very important to be improved and developed. Therefore, students need provisions in improving their resilience abilities. For example, in Japan, disaster education has been included in the education curriculum at all levels so that people have a high awareness of disaster response from an early age (Nugroho, 2018). Teachers as educators who interact directly with students have a strategic role to instill disaster mitigation and resilience skills through the application of the SETS visionary disaster education model in schools.

4. CONCLUSION

According to the study's findings, the SETS-based disaster education learning model for resilience and mitigation has features that include six stages of action. The first stage is initiation, organization, and orientation, the second stage is concept development, the third stage is application and implementation of the concept, the fourth stage is adapting the concept, the fifth stage is planning and making decisions, and the fourth stage is *six th*is Evaluation. Meanwhile, based on the results of the validity data analysis, it is known that the SETS-based disaster education learning model in the developed mitigation and resilience obtained an average validity score of 4.21 which is in the very valid category. The results of the effectiveness test show that the SETS visionary disaster education model is effective in increasing student mitigation and resilience skills as seen from the acquisition of sig. 0.000 < 0.05.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception and design of the study.

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