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DEVELOPMENT OF DISASTER MITIGATION AND ADAPTATION LEARNING TOOLS WITH SETS VISION *(SCIENCE, ENVIRONMENT, TECHNOLOGY, SOCIETY)* GEOGRAPHY SUBJECT IN SMA NEGERI PALU

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Abstract: This research aims to develop teaching resources for disaster mitigation and adaptation that are integrated into geography subject with a focus on Science, Environment, Technology, and Society (SETS). Up until stage three define, design, and develop research and development processes are conducted using 4D models. Small-group product trials were conducted as an experimental class. The trial findings suggest that the designed learning gadget is valid, practical, and effective. Expert-validated items have a respectable qualification of 80% for their continued existence. Teachers rated the learning device's practicality at 89.93%, whereas students gave it a rating of 77.97% for SETS learning and 75.50% for courses on disaster mitigation and adaptation. With a score of 0.40, the effectiveness test findings were deemed effective in the medium category. Therefore, the prepared syllabus, lesson plans, modules, and assessments that are the result of learning tools for geography subjects in class XI social studies for Disaster Mitigation material with a SETS vision are appropriate for use as learning tools.

Keywords: Learning Tools, Disaster Mitigation, Experiment, Learning SETS

INTRODUCTION

September 28, 2018, an earthquake with a magnitude of 7.4 caused a tsunami that hit the coast of Palu Bay. Apart from causing a tsunami, the earthquake also caused liquefaction or soil melting in the Petobo and Balaroa sub-districts of Palu City which killed many people and materials. It was reported that the condition of the victims who died was very worrying, environmental damage, property loss, and psychological effects were caused by the disaster. The existence of liquefaction and public ignorance about the potential for an earthquake that could cause a tsunami on the coast of Palu Bay made the situation even worse. (Suryono, 2005) states that if society faces a threat in the form of a natural or artificial phenomenon, a disaster will occur because society has knowledge or abilities that are lower than the threat that might occur. As a result, people living in areas that are vulnerable to geological disasters must be made aware. Disaster mitigation can be defined as attitudes or actions taken to minimize the impact of future disasters (Prasad, 2010). By providing disaster education to people living in disaster-prone areas, they can gain knowledge, perspectives, and skills about disaster preparedness and emergency disaster response (Sunarto, 2010).

Based on the facts and results of interviews with the people of Palu City, their knowledge and preparedness regarding disasters is still very minimal

and they don't even know about the threat of earthquake disasters. This is reinforced by the condition of society facing threats in the form of natural or artificial phenomena. Disasters will occur because society has knowledge or abilities that are lower than the threats that may occur. As a result, people living in areas that are vulnerable to geological disasters must be made aware. Disaster mitigation can be defined as attitudes or actions taken to minimize the impact of future disasters and other school residents on the risk of disasters and the characteristics of disasters in their area. In this way, it is hoped that students in the future will be able to adapt to their living environment, especially in adapting to disasters in their area.

By providing disaster education to people living in disaster-prone areas, they can gain knowledge, perspectives, and skills about disaster preparedness and disaster emergency response. The basic competency learning tools for disaster mitigation for class XI in the Geography subject are limited to general knowledge and have not been contextually integrated (Putra, 2022). The results of interviews with Geography teachers at SMA Palu show that currently learning tools have not been developed contextually and the material provided is still general because all learning tools are still regulated by the curriculum (Curriculum 2013). According to (Zuhdan, 2013) learning devices are components or equipment that enable educators and students to carry out learning activities. The most effective teachers are those who create learning tools and teaching materials (Kurniasih & Sari, 2014). Therefore, learning tools for mitigating and adapting to natural disasters in the Palu Valley with a SETS (science, environment, technology, and society) vision are needed. By using learning with the SETS vision, which is an integration of Science, Environment, Technology, and Society, the concept of natural disasters will be easier to understand. Students' understanding of disaster problems can improve through SETS learning compared to students who take conventional learning or who have not implemented SETS (Maknun, 2015).

It is hoped that the creation of disaster mitigation and adaptation teaching modules with the SETS vision can improve students' concepts and contextual understanding (Nuryanto and Binadja, 2013). This is reinforced by increasing students' understanding of recognizing and dealing with disasters (Rusilowati, Binadja, 2012). The model used in developing this learning tool is the 4D model which was developed by (Thiagarajan, S., Semmel, D.S., & Semmel, 1974).

Through this, students can be invited to discuss SETS from various directions based on their basic knowledge. Additionally, students can improve their response to natural disasters that occur in the area if they better understand what they are doing. According to research conducted by (Wirawan, 2013), teaching materials or learning devices with 4D models must be created to solve learning problems. This device must be able to help teachers be creative, active, and inspiring when teaching. The use of learning variations can also increase students' spatial intelligence as a compound skill, especially in geography learning (Putra et al., 2020).

LITERATURE REVIEW

According to the NSTA position statement, SETS focuses on real-world problems that have a science and technology component from the student's perspective. They can explore, analyze, and apply those concepts and processes to real-world situations (Nur Khasanah, 2013). SETS approach (science, environment, technology, and society) or in Indonesian terms *SaLingTeMas* stands for *sains, lingkungan, teknologi dan masyarakat*.

In the SETS acronym, it can be seen that education with the SETS vision will cover topics and concepts related to science, environment, technology, and matters related to society. SETS's vision is to look at everything that is considered to have aspects of science, environment, technology, and society as a whole. These four components influence each other and are interrelated.

The SETS vision hoped that science would be used to help society, including in technology. It is hoped that its practices and products will not harm the environment or society itself. Learning with the SETS approach builds relationships between students and the real world. This method encourages students to be more creative, active, and think critically in solving problems in their environment (Pralisaputri, 2016).

The stages of the SETS approach begin with an apperception carried out by the educator, then continue with the formation/development of concepts from the material taught (in this research the focus is on disaster mitigation and adaptation material).

Next is the application of theory development and concept consolidation. The final stage of the SETS approach is assessing. Central Sulawesi Province, which is in the subduction zone of the Palu Koro plate, especially Palu City, is a crucial location for familiarizing knowledge regarding ways to mitigate disasters and adapt to disasters.

This is confirmed by research (Fitransyah & Supardi, 2022) which states that learning the SETS Model on mechanical wave materials can improve understanding of disasters. The resulting N-gain value, which is categorized as high, is 0.73. This is because students are asked to recognize the problems that exist around us, especially related to natural disasters that occur around the environment itself.

RESEARCH METHODS

This research is part of the 4 Dimensional model development (Four D Models). According to (Thiagarajan, S., Semmel, D.S., & Semmel, 1974), the use of this 4-dimensional model includes 4 stages, namely the definition, design, development, and dissemination stages. The first stage is called defining to include local elements in providing ways to adapt to disasters, especially earthquakes and tsunamis. In the second stage, the process of designing relevant learning is carried out in developing knowledge in disaster mitigation, especially in geography learning. The final stage is to develop products that suit the needs of information related to disaster mitigation and adaptation. However, this research has reached the third stage, namely product development and testing in small groups in the experimental class. The fourth stage

has not been implemented in the hope that it will be implemented by other researchers. Data collection was carried out using the experimental method and product development using sampling was carried out using purposive sampling. This research focuses on product development with the SETS vision.

RESULTS AND DISCUSSION

Definition Stage (Define)

The initial stage in this research series is a learning needs analysis. Based on the results of interviews with geography subject teachers collected in the MGMP geography subject forum, show that the learning sequence carried out on disaster mitigation material has not been integrated contextually according to natural disasters in Palu City (Afadil, September 2019). The results of the analysis of the curriculum and learning media, as well as geography teacher learning tools (Syllabus, RPP, Textbooks, and Tests) in the MGMP forum show that the learning tools used are still centered on textbooks that are not integrated with natural disasters in Palu City, and the learning media used does not yet describe the natural disasters in Palu City.

Data from pretest results or before the implementation of the learning process with the SETS vision of natural disaster mitigation integrated with natural disasters on September 28, 2018 shows that many students have low knowledge of natural disasters in their region and mitigation. Based on the scores obtained from the pre-test on students' knowledge before being implemented, the results of the development of disaster mitigation and adaptation learning tools were 10 out of 32 students obtained scores/values of less than 50. This shows that the respondents' knowledge about natural disasters in Palu City is still low.

Design Stage

1. Syllabus Draft

Minister of Education and Culture Regulation No. 22 of 2016 regulates the components of the syllabus. The syllabus consists of components that indicate the identity of the subject, which includes educational units, classes, semesters, subjects or themes, number of meetings, and core competencies. Beside that, the syllabus matrix consists of basic competencies determined by the National Education Ministerial Regulation, learning materials, assessments, time allocation, and learning resources.

Students must have basic competency regarding natural disaster mitigation material in the cognitive domain or knowledge competency to be achieved, namely understanding the types and methods of mitigating natural disasters through education, local wisdom, and the use of advanced technology.

By utilizing maps or images, students can show the results of reports through their psychomotor skills. They can show a map of Palu City's disaster potential and disaster mitigation strategies based on this map. Several indicators were then developed based on these basic competencies. Achievement of graduates to achieve learning goals. Competency achievement indicators consist of basic competencies for knowledge (cognitive), character (affective) and skills (psychomotor). Written tests are used for cognitive competency and psychomotor

assessment sheets are used during presentations. The design results show that the syllabus is complete and meets the requirements (needs) for geography learning activities regarding natural disaster mitigation material.

2. Lesson Plan (RPP)

The Lesson Plan (RPP) is designed systematically, which includes the components of writing the RPP and follows the procedures set out in the 2013 curriculum "Permendikbud Number 103 of 2014 and Permendikbud Number 22 of 2016". The learning steps are adapted to the SETS vision learning stages which are modified with the Snow-Balling learning model at the first meeting, the Group Investigation learning model at the second meeting, and the Talking Stick learning model at the third meeting. Researchers made lesson plans for three meetings. The RPP is adjusted to the main material and time allocated for each meeting.

3. Disaster Mitigation and Adaptation Module Design

The module design is adapted to basic competencies which are then developed into several competency achievement indicators. The first part is general instructions which contain an overview of the material, module information map, instructions for using the module, and learning objectives. The second part of the content contains material descriptions, summaries, exercises, feedback and follow-up. The third section contains worksheets with questions related to disaster mitigation learning material and answer keys, as well as a bibliography. The module is planned for three meetings, and learning activities are adapted to basic competencies and disaster mitigation material that is integrated with the September 28, 2018 disaster in Palu City. Furthermore, to attract students' attention, practice questions are given to encourage students to think critically, find concepts, and solve problems by utilizing material descriptions and learning media in the form of information about the September 28, 2018 natural disaster and its mitigation.

The practice questions consist of 3 description questions and 5 multiple-choice questions. The questions are designed using a lower-order thinking skills (LOTS), middle-order thinking skills (MOTS), and higher-order thinking skills (HOTS) assessment design. The feedback contained in the module design makes it easier for students to analyze each student's knowledge abilities, with feedback students can measure their level of knowledge in each learning activity.

4. Preparation of Assessments

Assessment is adjusted to competency achievement standards. The assessment design includes a cognitive and psychomotor assessment design to determine the level of students' knowledge of natural disasters in Palu City and disaster mitigation. The cognitive assessment design is in the form of a written test in the form of 20 multiple-choice questions with a LOST, MOTS, and HOTS assessment design.

Psychomotor or skills assessment using an assessment rubric and focused on when student activities take place in the learning process. Student skills assessment rubric when carrying out question and answer activities during presentations (Aris M., Enok Maryani., Dede Rohmat., 2019).

Developing Stage (develop)

The aim at the development stage is to obtain learning device products that have been validated by experts and limited field trials, namely in experimental classes, to determine the effectiveness of implementing learning devices in the classroom learning process, including measuring student learning outcomes. Draft learning tools, consisting of syllabus, lesson plans, modules, and tests, have been created before field trials and first validated by expert validators.

1. Validity of Learning Tools

These three validators produce a finished learning tool that has been adjusted according to expert input with a score of 3 or 4 for each learning tool. It has been designed by the components contained in the syllabus, components in the learning implementation plan, components in the module, and the assessment instrument is a multiple choice written test.

Table 1. Validation Results from Expert Validators

Information	Achievement Rate (%)	Qualification	Test Decision
Content/Material Validation	75	Worthy	No Revision Required
Validation of Learning Technology	95	Very Worth It	No Revision Required
Practitioner Validation	70	Worthy	No Revision Required
Average Percentage	80	Worthy	No Need to Revise

Source: processed by researchers, 2023

The feasibility of products that have been validated by experts is shown in the test decision column. Learning devices validated by expert validators and practitioners are classified as quite valid with an average percentage of 80% and are in the proper qualifications. So, the decision to test learning device products does not need to be revised. Learning tools can still be used well before being tested in small groups.

The results of this validation were used to test Draft II on students with high, medium, and low abilities. The results of the learning test trial in the form of multiple choice questions totaling 20 numbers show that the multiple choice test evaluation instrument can be used by all students with low, medium, and high levels of ability with a maximum score of 75 totaling 1 person and a minimum score of 35 totaling 1 person of 10 people.

The learning outcomes test was carried out outside the trial class, namely class XII of SMA AL-Azhar Mandiri Palu. The purpose of this trial is to determine whether the test created should be changed or not. The results of this test obtained an average value = 0.12 (high level of validity) using the Point Biserial formula. Based on the results of calculating the reliability of test questions, it was obtained that r11 = 97 was

greater than 0.70 in the reliable category. The results showed that students could use all the test questions on learning outcomes without changing anything to measure students' level of understanding of Disaster Mitigation and Adaptation material.

The evaluation process above shows that Draft II is a learning tool that is adapted to the input and recommendations of the validators and tests the validity and reliability of the learning outcomes test questions. Next, it was tested in class XI social of SMA Negeri 1 Palu, the field trial was carried out in 5 meetings, namely pre-test, device 1 trial, device 2 trial, device 3 trial, and post-test.

This trial was carried out by partner teachers and involved 2 observers whose task was 1 person observing teacher activities and 1 person observing student activities. This was done to see the practicality of the product for developing learning tools with the SETS vision of disaster mitigation and adaptation materials.

2. Practicality of Learning Tools

Assessment of the practical level of development of learning tools is carried out on every aspect of the implementation of learning activities by teachers/educators at each meeting, including in the very good category.

Table 2. Mean Practicality Score of SETS Learning Tools by Teachers

Observed aspects	Rating result			
	Average P1	Average P1	Average P1	Criteria
Clarity of Instructions for Using RPP	84.38%	84.38%	78.13%	Very worthy
Achievement of Competencies and Learning Objectives	96.88%	84.38%	87.50%	Very worthy
Student Response	83.33%	95.83%	91.67%	Very worthy
Difficulty level in Implement	83.33%	87.50%	91.67%	Very worthy
Sufficiency of Time	100%	100%	100%	Very worthy
Amount	89.58%	90.42%	89.79%	Very worthy
Total Average Score for All Meetings			89.93%	Very worthy

Source: processed by researchers, 2023

The practicality of each aspect of the implementation of learning activities by the teacher at each meeting, including in the very good category, was obtained using a teacher response questionnaire regarding the practicality of learning tools during three meetings.

The level of results from two geography teachers who gave the average value of the practicality of learning tools during three meetings was 89.93%.

Based on the results of teacher observations in the learning process using mitigation and adaptation modules for aspects observed during the learning process, ¾ of students can follow the learning well. Thus it can be concluded that the modules used in learning help students in the learning process and can motivate learning so that the learning process is interesting and can be followed by all students.

The practicality of the device learning is also obtained by using a student response questionnaire on the practicality of the device learning and percentages of average value practicality of the module from 32 students of class XI IPS 5 SMA Negeri 1 Palu. Obtaining practicality scores for learning tools with the SETS vision is 77.97% while the practicality of the module is 75.50%. Based on these data, it can be said that learning about disaster mitigation and adaptation with the SETS vision using modules in the category is suitable for use. The percentage of practicality scores by teachers and students allows class geography material for disaster mitigation and adaptation XI IPS SMA which is designed to be categorized as practical and can be used widely.

3. Effectiveness of Learning Tools

The results of the assessment of the effectiveness of learning tools were carried out during field trials. The effectiveness of learning tools can be seen in student activities during the learning process by assessing student skill abilities and student cognitive abilities. Learning outcomes not only increase knowledge but also improve thinking skills.

Students' psychomotor abilities help teachers in assessing the learning process and make students actively involved in the learning process because each stage in the learning activity is assessed by the teacher using a question-and-answer assessment rubric, while cognitive assessment is based on learning outcomes using a written test assessment in the form of multiple-choice questions. totaling 20 numbers. Based on the results, students' psychomotor scores at each meeting increased with an average psychomotor score of 3.61 (scale 4). Psychomotor or student skill scores at the first meeting were 3.50, increased at the second meeting, namely 3.66 and the third assessment with an average of 3.69 students were active in asking questions and giving logical answers according to facts and concepts, a psychomotor assessment carried out during the learning process using a question and answer assessment rubric.

Besides that, at the last or third meeting, students were more active in responding because they were able to provide arguments based on learning experiences at the previous meeting. So that, students understood the learning material better.

The product effectiveness test was carried out by looking at the difference in student achievement scores on disaster mitigation basic competence before and after being given treatment, namely 0.40 in the medium category based on the g Index criteria. Analysis of students' cognitive competence increases at each meeting with a completion percentage of 79% marks on module work.

Apart from that, students' cognitive abilities were also proven by the results of the pre-test before the learning process was carried out using learning device development products, getting an average score of 52.81 with a percentage of 6.25% of students completing the study. Meanwhile, the post-test score obtained an average score of 71.88 with a classical learning completion percentage of 75%.

Based on the results of the post-test cognitive assessment, although not 100% of students' scores met the minimum completeness criteria (70), all students

experienced increased learning outcomes in both the cognitive and psychomotor domains. Classical student learning outcomes have increased. During the pre-test, students previously studied with available teaching materials such as worksheets and textbooks. While, during the post-test, students were treated with the results of the development of teaching materials.

Increased cognitive competence occurs because students can understand the learning material well and the questions prepared in the tests and modules designed based on indicators and learning objectives to be achieved in learning (Putra, 2022).

Apart from that, students better understand the conditions of natural disasters in their area because the tools developed are contextual, while the textbooks and worksheets that students study are in the general context of the material.

In this way, learning tools can improve students' cognitive abilities, help students achieve complete learning outcomes (individual and classical), and achieve the minimum completeness criteria that have been set by geography teachers and school and better understand disaster conditions in their area (Putra, 2017).

Based on the results of testing learning devices, data from observations of the implementation of learning activities, data from observations of student activities, pre-test and post-test data, data on student psychomotor abilities, and student response data. The results of the trial analysis were used as a basis for revising Draft III into a valid, practical, and effective learning tool.

CONCLUSION

The learning tools were declared feasible with the average score obtained from expert validators and practitioners, namely 80%. The assessment was carried out by material expert validators to assess the depth of material in the disaster mitigation and adaptation module.

Learning tool design validators to assess the up-to-dateness of the syllabus, lesson plans, tests, and disaster mitigation and adaptation modules, as well as assessments by practitioner validators, namely geography teachers, to assess the completeness of syllabus components, lesson plans, tests, and disaster mitigation and adaptation modules.

The learning tools for disaster mitigation and adaptation with the SETS vision were declared practical based on the results of the questionnaire on the practicality of learning with the SETS vision by teachers, namely 89.93% in the very practical or feasible category and the results of the questionnaire on the practicality of learning with the SETS vision by students were 77.97%, while for the practicality of the module it was 75 50%, thus the results of observations of the implementation of learning by teachers and student activities in participating in the learning process are declared good

The results of the effectiveness test were declared effective by looking at the difference in student achievement scores in disaster mitigation basic competence (KD) before being given treatment and after being given treatment, namely 0.40 in the medium category, the average student score in the cognitive domain was 70.78 and in the psychomotor domain 3.61 (scale 4), overall students' metacognitive abilities

have increased in both cognitive and psychomotor domains. Furthermore (Putra, 2021) proves that students' thinking abilities can adapt to learning conditions.

The application of learning with the SETS vision can increase students' knowledge in building concepts and connecting science, technology, and their relationship with benefits in society and the impact on the environment. Developing contextual learning tools for disaster adaptation can increase students' understanding of the threat of natural disasters and disaster mitigation in Palu City. Therefore, this learning tool is very practical for use by students and teachers, making learning tools refer to this learning tool.

In the learning process, teachers must teach students/learners by connecting them to the real world so that they can build their knowledge (Nisa, 2015). It is recommended that future researchers develop learning tools to the stage of widespread distribution to see the effectiveness of learning tools in all classes

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