

Implementation of physics learning media based on android integrated earthquake disaster education to enhance problem solving abilities and natural disaster preparedness

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Abstract. This research aims to determine the enhancement of problem solving abilities and natural disaster preparedness after implement learning with a physics learning media based on android integrated earthquake disaster education. This research uses a pre-experimental design with one group pretest-posstest. The subjects in this research were students of class X MIA 3 of SMA Negeri 1 Depok. This research data was collected through essay tests consisting of 4 items pretest and posttest and natural disaster preparedness questionnaire. The data obtained were analyzed descriptively and used N-gain to find out the enhancement of students' problem solving abilities and natural disaster preparedness. The results using N-gain analysis showed that the enhancement of problem solving ability for class X MIA 3 had a value of 0.57 in the medium category while the increase in natural disaster preparedness for class X MIA 3 had a value of 0.05 with the low category.

Keywords: *disaster education, earthquake, learning media, problem solving, natural disaster preparedness*

1. Introduction

Indonesia is a country that has a strategic place. Indonesia is located between two continents, Asia and Australia and two oceans, namely the Indian Ocean and the Pacific Ocean. Indonesia is also one of the countries most frequently hit by earthquakes because it is located at the meeting point of the earth's tectonic plates and is surrounded by volcanoes [1]. The Special Region of Yogyakarta is one of the provinces which frequently experiences earthquakes because it is located at a meeting between the Indo-Australian and Eurasian plates so that it has the potential for damage in the V-VII MMI intensity [2].

In disaster management to reduce the risk of natural disasters it is necessary to make a new paradigm about natural disaster preparedness [3]. Knowledge about natural disasters needs to be instilled early on so that people can prevent disasters caused by humans and can take action if a disaster occurs [4]. A natural disaster mitigation program must be carried out continuously for the community through schools and communities [5]. The planting of a disaster curriculum can be done by linking it to lessons in schools that are related to disasters [6], [7].

In the concept of 21st century learning, students are required to have abilities in learning and innovation, including problem solving, critical thinking, collaborating, integrated environments and using digital tools as learning [8], [9]. Learning physics is closely related to the problem solving process. Problem solving is a thought process. Problem solving in learning physics is to find problem solutions in physics. But there are still many students who have low problem solving abilities. The reason could



be from the subject matter being studied, learning activities in the classroom and the teacher's teaching style [10], [11].

In 21st century learning, students are requires to use digital tools as learning so it needs to be integrated with Information and Communication Technology [8], [12]. the use of ICT in learning in a country can be a positive indicator of the level of student individual ability [13]. The latest research on ICT integrated physics learning in Indonesia has been developed such as E-learning in the form of E-Modules and Android-based mobile learning on smartphones [14], [15]. The use of smartphones related to learning can make students get a high score [16]. Almost all smartphones in Indonesia have an Android system. As one of the mobile learning tools, smartphones with an Android system can make it easier for users to develop various learning applications that contain explanations, simulations and evaluation tests that can be accessed anywhere and anytime easily [17]-[19]. The ease of smartphone access to information can be used as a learning media in providing information relating to natural disaster mitigation [20], [21].

Based on the description above, this paper examines the use of physics learning media based on android integrated earthquake disaster education to enhance problem solving abilities and natural disaster Preparedness for class X Senior High School in simple harmonious motion subject.

2. Research method

2.1. The type of research

The aims of this research is to enhance the the student's problem solving ability and natural disaster preparedness after learning with physics learning media based on android integrated earthquake disaster education in Simple Harmonic Motion Subject. This research model is pre-experimental with one group pretest-posttest design as shown in figure 1. The reason for using this model is because the researches are only allowed to use two classes that have been determined by the school and then the other class has learned about simple harmonic material that can result in differences in initial abilities.

Some text.

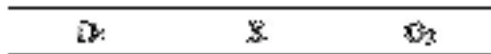


Figure 1. One group pretest-posttest design.

Where O_1 as pretest, O_2 as posttest and X as Implementation of physics learning media based on android integrated earthquake disaster education.

2.2. The place and time research

The location of this research is in SMA Negeri 1 Depok. This research was conducted in the even semester of the school year in March 2019.

2.3. The subject of research

Subjects in this research were students of class X SMA Negeri 1 Depok, 2018/2019 school year. Subjects were selected by purposive sampling. Class X MIA 3 was selected as a sample class with a total of 29 students.

2.4. The variable of research

The independent variable in this research is learning by using physics learning media intergrated earthquake disaster education. The dependent variable in this research is problem solving abilities and natural disaster preparedness.

2.5. The instrument and data collection techniques

The learning tools, learning media and research instruments used in this research have been validated by expert judgment. The results of the validation analysis show that the learning tools, learning media and research instruments are valid and feasible to use. Examples of display in physics learning media based on android are shown in figure 2 and figure 3.



Figure 2. Display of simple harmonic motion subject in physics learning media based on android integrated earthquake disaster education.



Figure 3. Display of earthquake disaster preparedness in physics learning media based on android integrated earthquake disaster education.

This research begins with giving a pretest. The next stage is learning by using an in physics learning media based on android integrated earthquake disaster education on Simple Harmonic Motion. The learning model used is Problem Based Learning. This learning is adjusted to the indicator of problem solving ability with steps consisting of 4 phases according to WISE, namely (1) What's Happening, (2) Isolate the Unknown, (3) Subtitles, (4) Evaluate [22]. Posttest is used after learning ends. Data in this research were collected using essay tests consisting of 4 items to measure students' problem solving abilities. Indicators of problem solving to represent the problem solving ability can be seen in table 1.

The natural disaster preparedness questionnaire is used to collect data for students' natural disaster preparedness. Natural disaster preparedness is assessed based on the parameters of natural disaster preparedness provided by the BNPB (National Disaster Management Agency). These parameters are the institutional, early warning, education, mitigation and preparedness [23].

Table 1. Indicator of problem solving ability test.

Problem solving steps	Indicator
What's happening	Write down the quantities known and unknown.
	Identify and use the units needed.
Isolate the unknown	Choose the equation for the problem
Substitute	Make calculations by entering the value of quantities and units
Evaluate	Re-evaluate the problem solving result
	Make conclusions based on problem solving results

2.6. The data analysis technique

Enhancement of problem-solving skills and natural disaster preparedness were analyzed using N-gain [24] from the pretest and posttest results data. The N-gain formula used is shown in equation 1.

$$N_{gain} = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (1)$$

The results of the N-gain analysis are then categorized to obtain the enhancement categories shown in table 2 [24].

Table 2. The categories of the result of n -gain analysis.

The N-gain value	Category level
$x \geq 0.7$	High
$0.7 > x > 0.3$	Medium
$x \leq 0.3$	Low

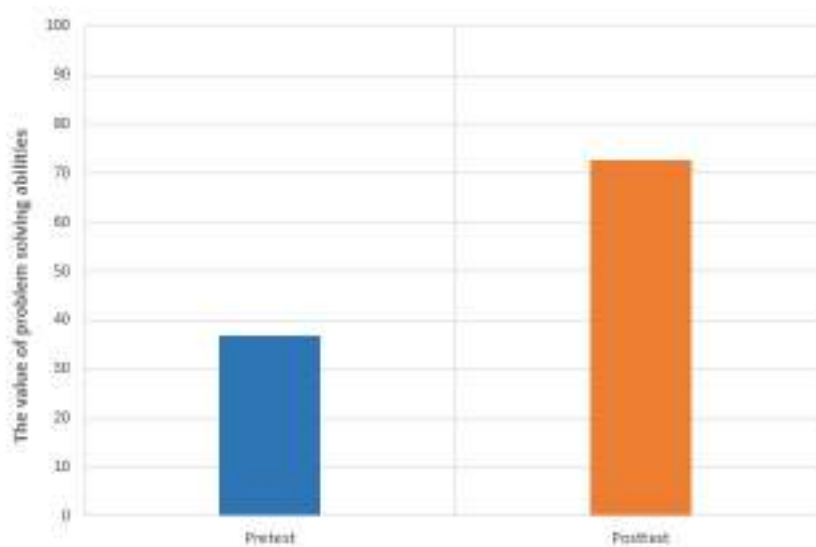
3. Results and Discussion

Physics learning in simple harmonic motion is carried out with the Problem Based Learning model with an experimental that is doing mathematical pendulum experiments. The syntax of the Problem Based Learning model is then integrated with the indicator of problem ability according to WISE. The first stage, students are given a problem. The teacher asks students to create groups of 5-6 students to solve problems. The second and third stages of the model teacher help define and organize existing problems and encourage students to look for in the learning media based on android. The fourth stage, after students have completed the experiment, students prepare the data analysis results of the experiments that have been conducted and answer some evaluation questions. The fifth stage, after the report is finished, the group present the results of their experiments in front of the class and evaluate the problem solving process that is carried out.

The problem solving ability of students can be seen from the results of the pretest and posttest. The result of descriptive and N-gain analysis to measure problem solving abilities before and after learning by using physics learning media based on android integrated earthquake disaster education from the pretest and posttest values are shown in table 3.

Table 3. The average value of students' problem solving abilities.

	Pretest	Posttest
Lowest	36.4	52.7
Highest	49.1	81.8
Average	36.9	72.6
Average value of n-gain	0.57	

**Figure 4.** The average value of students' problem solving abilities.

The average pretest for class X MIA 3 is 36.9 and the posttest average is 72.9. Using the N-gain analysis the value of enhance the problem solving abilities for class X MIA 3 is 0.57 with the medium category. Students carry out learning with the Problem Based Learning model in accordance with the expected learning indicators. By linking the pendulum mathematical experiments such as one of the earthquake measuring instrument mechanisms and integrating with android learning media can motivate students to solve the given problem.

The natural disaster preparedness of students can be seen from the results of filling out the natural disaster preparedness questionnaire. The results of the percentage value of the earthquake disaster preparedness questionnaire for students are shown in table 4.

Table 4. The percentage value of the earthquake disaster preparedness.

	Natural Disaster Preparedness Parameters (%)				
	Institutional	Early warning	Education	Mitigation	Preparedness
Pretest	22.73	15.91	11.36	32.72	55
Posttest	22.73	19.7	52.57	33.67	73.67
Average value of N-gain	0.05				

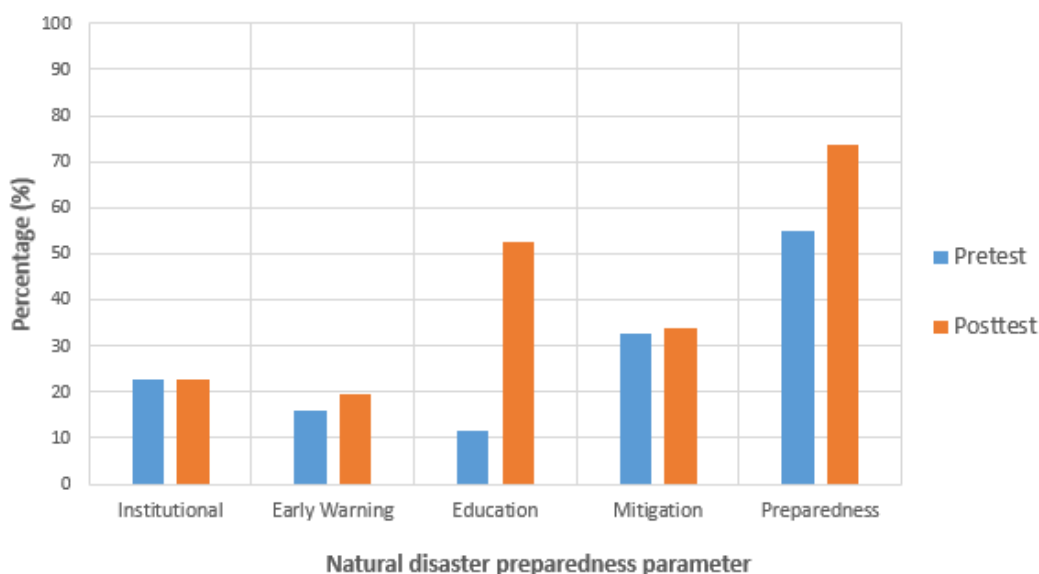


Figure 5. The percentage value of the earthquake disaster preparedness parameter.

Figure 5 shows the change in the value of the percentage of natural disaster preparedness for each parameter. Institutional parameters indicate the policy towards natural disaster preparedness, especially in schools. There is no increase in the percentage value because school policies need to be changed through certain procedures. The low value of institutional parameters indicates that school policies have not yet implemented policies related to natural disaster preparedness such as socialization of parents and students. The Early Warning parameter shows about the early warning system and preparation in schools when an earthquake occurs. This parameter has a small percentage value. This shows that students do not know about planning if an earthquake occurs at school. This ignorance can occur because schools do not have good planning such as there is no evacuation route and evacuation map. Educational parameters show that there is a fairly high increase. This improvement shows that students have never before learned subject matter that is integrated with natural disaster preparedness. Mitigation parameters indicate actions in response to earthquakes such as disaster simulations, first aid training and emergency preparation. There is no significant increase in the percentage value of the mitigation parameters because in this research simulation is not done. Percentage value that is not maximal shows that students have never done natural disaster simulation activities. But some students have done first aid training. The preparedness Parameter shows the knowledge of disaster risk in their school. The percentage value for the parameter readiness shows the greatest value among the other parameters. This shows that students still understand natural disaster preparedness in the form of theory only. The percentage value which is still around 50% before learning using integrated earthquake disaster education media shows that there are still many students who do not yet know the potential danger of earthquake disasters in their locations. In addition, many students do not know about prevention to minimize casualties such as taking refuge in the "triangle of life" if around there is no strong object to protect or avoiding glass when an earthquake occurs.

From all parameters of natural disaster preparedness, it is obtained an enhance value for earthquake disaster preparedness using N-gain analysis is 0.05 with low category. Earthquake disaster learning is integrated in learning by linking earthquake to the Simple Harmonic Motion phenomenon and displaying videos about earthquake preparedness from pre, during and after an earthquake. Due to time constraints in learning, subject matter about earthquakes and videos about actions to deal with earthquakes are read by students at home. By using learning media based on android, students can access learning information anytime and anywhere [25]. But this also results in reduced teacher supervision. The use of smartphones which are not monitored can reduce concentration due to disturbances such as

games and social media [26]. Improvement of students' low preparedness is possible because some students have not read and there are some smartphone students that cannot be installed integrated learning media for earthquake disaster education. The absence of an earthquake disaster simulation in learning also results in a less than optimal increase. In addition, actions related to regulations and policies in schools require considerable consideration and time.

From the results of enhancing problem solving abilities and natural disaster preparedness, the physics learning media based on android integrated earthquake disaster education is suitable for learning. Some research on the development of tools, media, or learning models that are integrated with information and communication technology can improve critical thinking skills, problem solving, understanding concepts and interest in learning [15], [27]-[29]. Learning physics by using learning media based on android can improve creative thinking and problem solving ability [30]. Disaster education is integrated in schools in disaster prone locations making students have a good understanding in dealing with natural disasters [31].

4. Conclusion

Based on the results of this research, the conclusion was that the enhancement of problem solving abilities after using physics learning media based on android integrated earthquake disaster education was quite good. Enhancement of earthquake natural disaster preparedness after learning using physics learning media based on android integrated earthquake disaster education is still low. For further research there needs to be supervision in using smartphones so that students are only used to open learning media instead of opening other applications. Additional simulations about earthquake disasters can be included in learning to maximize students' natural disaster preparedness.

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