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Using e-Worksheet Integrated with PBL-STEM Activities to Improve Disaster Literacy of Junior High School Students

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Abstract: The purpose of this study was to develop a PBL-STEM-based e-worksheet to improve students' disaster literacy using Microsoft Sway. This study uses the Research and Development (R&D) method with 4d (four-D). The 4D development model consists of 4 stages, namely define, design, develop, and disseminate. The instrument used is a needs questionnaire, test instrument. The results of the study stated that the attractiveness of e-LKPD was 88.20%, convenience was 87.52%, and usefulness was 90.96%. The result of Effect Size on PBL-STEM-based e-worksheet on disaster literacy is 0.72 in the high category. PBL-STEM-based e-worksheet is used to grow literacy effectiveness, especially earthquake threat materials in areas with an N-gain value of 0.68 and moderately qualified. Teachers and students stated that the use of letters, sentences and language in the e-worksheet was easy to understand, indicating that the PBL-STEM-based e-LKPD used to study the threat of earthquake disasters in areas was interesting, useful and the language used was easy to understand and could improve disaster literacy. junior high school students.

Keywords: e-Worksheet, PBL-STEM, disaster literacy, Microsoft Sway.

Abstrak: *Tujuan dari penelitian ini adalah mengembangkan e-LKPD berbasis PBL-STEM untuk meningkatkan literasi bencana siswa dengan menggunakan Microsoft Sway . Penelitian ini menggunakan metode Research and Development (R&D) dengan 4d (four-D). Model pengembangan 4D terdiri dari 4 tahap, yaitu define, design, develop, dan diseminate. Instrumen yang digunakan adalah instrumen angket kebutuhan, tes. Hasil penelitian menyatakan bahwa kemenarikan e-LKPD sebesar 88,20%, kemudahan sebesar 87,52%, kemanfaatan sebesar 90,96%. Hasil Effect Size pada e-LKPD berbasis PBL-STEM terhadap literasi kebencanaan adalah 0,72 dalam kategori tinggi. e-LKPD berbasis PBL-STEM digunakan menumbuhkan efektifitas literasi khususnya materi ancaman gempa bumi di daerah dengan nilai N-gain 0,68 dan berkualifikasi sedang. Guru dan peserta didik menyatakan bahwa penggunaan huruf, kalimat dan bahasa pada e-LKPD mudah dipahami, menunjukkan bahwa e-LKPD berbasis PBL-STEM yang digunakan untuk mempelajari ancaman bencana gempa didareh menarik, bemanfaat dan bahasa yang digunakan mudah dimengerti serta dapat meningkatkan literasi kebencanaan siswa SMP.*

Kata kunci: *e-LKPD, PBL-STEM, literasi kebencanaan, Microsoft Sway.*

▪ INTRODUCTION

Literacy is one of the 21st century skills that is a strategic issue in education. Disaster literacy is individual capacity to read, understand, and use disaster information (Brown & Peterson, 2014). Indonesia is an earthquake-prone area because it is traversed by the confluence of 3 tectonic plates, the Indo-Australian plate, the Eurasian plate, and the Pacific plate. The movement of the earth's plates produces pressure that leads to earthquakes, and Indonesia has 127 active volcanoes. Therefore, Indonesia is part of a group of active volcanoes known as the ring of fire. Disaster literacy needs to be

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introduced in Indonesia, especially in Lampung as an effort to provide understanding to students and the community about disasters to minimize disaster risk (Mufit et al., 2020). In order for countries to be protected from disasters before natural disasters, to know how to behave during natural disasters, and then to normalize life in the fastest way and to overcome this situation with minimum harm, a serious disaster education should be given in pre-school and primary education period starting from family (Tuker & Sozcu, 2021). To improve the preparedness, the act of disaster literacy would equip the community to face disaster.

Disaster literacy, especially in risk and mitigation, is a best starting point at this moment to involve the society (Priyowidodo & luik, 2014). Currently, the level of knowledge of the community including students in schools about disaster and disasters literacy is still low (Asshiddiqi et al., 2021). Although many school locations are in disaster-prone areas, the level of awareness in terms of knowledge is not sufficient (Firaina et al., 2019). Studies in literature that investigate the disaster literacy levels of communities address various aspects, such as disaster information literacy. This has highlighted the importance of high levels of awareness in maintaining "human security" and "safety and peace of mind" in all cycles of disaster, because large-scale disasters affect wide areas, making their management more complex (Kanbara et al ., 2016). Suggested that low cognitive, education and literacy are factors that negatively affect safety during and after disasters. The results of the United Nations Educational, Scientific and Cultural Organization (UNESCO) study show that the level of risk is higher because most people in disaster-prone areas have low knowledge, which is associated with low disaster preparedness (Khon et al ., 2012). However, efforts to minimize the hazards caused by natural disasters and preparations for disasters can be done consciously (Sozcu,2020).

Disaster literacy is an individual's ability to read, understand and use information that will later be used as an information policy by following instructions in the context of mitigation, preparedness, response, and recovery from disasters that occur (Brown et al., 2014). Disaster literacy is defined as the ability of individuals to read, understand, and use information to make informed decisions and follow instructions in the context of mitigation, preparation, response and recovery from a disaster (Sampurno et al., 2015). Disaster literacy involves knowing which area is prone to natural disaster and whether area where one living is prone to natural disaster. Disaster literacy should be introduced as early as possible, for example being introduced at school, to improve the preparedness of students. It is expected that disaster literacy can minimize the impact caused by natural disaster. Having had knowledge about natural disaster literacy, students will be able to decide what they are supposed to do when natural disasters strike. (Susanto et al., 2016).

The results of observations that have been carried out in 10 public and private junior high schools include: results Based on the needs analysis, 60% of teachers have provided insight to students in disaster mitigation, preparedness, response and recovery. As many as 77% of students' residences experienced natural disasters such as floods, earthquakes. As many as 70% of students do not know how to act before, during and after a disaster occurs. This proves that mitigation education to instill disaster literacy in schools is currently still very low. evaluation in disaster prevention, mitigation and response preparedness education is needed to be able to provide valuable experience

and development in the future (Chou & Ren, 2016). The small impact resulting from critically evaluating information on community preparedness in dealing with disasters is caused by a lack of public understanding of the information obtained (Marloyo et al., 2016). However, there are limited studies on earthquake literacy assessment. The previous study found the low level of earthquake preparedness of Lebanese student (Baytiyeh & Naja, 2015). The result shows that the disaster literacy level, especially in an earthquake, reaches a sufficient level with the best achievement in skill dimension, and knowledge dimension is in the lowest achievement (Fadillah et al., 2020). Emphasized that school-based disaster education is very crucial in reducing the damages of natural disasters after the Wenchuan earthquake. Teachers must instill the required knowledge, awareness, and skills about natural disasters in students, especially during their undergraduate studies, in order for them to achieve natural disaster literacy (Zhu & Zhang,2017)

Disaster literacy can be taught in 7th grade science subjects through the basic competency "Explaining risk reduction actions before, during, and post-disaster according to the threat of disaster in the region". The emphasis is on the threat of disaster in the student environment, because the disaster literacy taught must be adjusted to the background of the student's age, education, school location, disaster, and the location of the student's residence as well as the potential for disasters that occur. .

PBL learning model as a way to improve the quality of learning in the classroom because students are required to understand a learning concept based on problems that occur everyday. The focus of learning in the PBL model lies in the problems that must be solved by students using appropriate material concepts. Students are trained to analyze and solve these problems with their own abilities, while teachers only guide and assist students in the learning process (Meilasari et al., 2020). In PBL activities students are directed to conduct investigations, integrate theory and practice, and be able to use the concepts of knowledge and skills they have to find appropriate problem solving solutions (Savery,2018). In addition to the PBL learning model, using an integrated learning approach that can encourage student learning to keep up with the times, one of which uses Science, Technology, Engineering and Mathematics (STEM).

STEM education as an interdisciplinary approach, in which students are required to have knowledge and skills in the fields of science, technology, engineering and mathematics (Revee, 2013). STEM is an approach that refers to the fields of science, technology, engineering, and mathematics whose use initiatives began as a way of advancing education, STEM which stands for science, technology, engineering, and mathematics, but each of these categories can include instruction in several fields of study. The following table outlines general STEM lessons in education (Asmuniv, 2015). Multidisciplinary integration requires students to connect components of the various subjects taught at in different classes at different times, whereas interdisciplinary integration can begin with real world problems. Combining cross-curricular components with critical thinking (Wang, 2012). Research conducted by dwi and merlin (2020) says that STEM-based multimedia fosters student's ability to solve problems in disaster mitigation materials. It can be concluded that students experienced an increase in STEM literacy between before and after the implementation of the earthquake theme teaching material (Hikmawati et al ., 2020).

Entering the 21st century today, the need and importance of computer technology is indispensable for the development and improvement of learning. One of the media that can be used to improve the creation of e-worksheet is Microsoft Sway. The results of research from Sudarmoyo (2018) state that the Sway application can easily add text, images, documents, videos, charts, or other types of content, Sway is very suitable for teachers, students and students who will make reports, resumes, presentations, or to make the subject matter more enjoyable. One of the advantages of this application is that after you finish creating and saving you don't have to worry about losing your data. The Sway application will reformat the presentation slides when the presenter opens them via devices such as smartphones, tablets, or laptops or computers (Ferdiana et al, 2013); The Sway application is equipped with Apps that make it easier for teachers to collaborate with other teachers to create Sway projects (Istiqomah, 2016) so that they can be a solution for teachers who want to develop media with a few easy steps (Dwianto, 2016). Teaching materials in the form of e-learning bridge the gap between preparation and academic practice as an effort to facilitate the availability of teaching materials for students in digital form which is also still limited in availability (Smith & Greene, 2013).

Seeing these problems, the authors try to provide an alternative by making Electronic Student Worksheets to function as a tool that provides convenience for students and teachers in the learning process. The e-worksheet was developed based on PBL-STEM to improve students' Disaster Literacy on Disaster Threat material in the region in an interesting, logical, systematic, innovative and easy to use manner so that it can be useful for students.

▪ METHOD

The population of this study was all class VII at SMP 4 Xaverius Bandar Lampung, the sample in this study was class VII A with 25 people and class VII B with 23 people, the sampling technique was purposive sampling. Design the research that will be used in this study is a development model 4D(four-D). The 4d development model consists of 4 stages, define, design, develop, and disseminate. The research design is descriptive quantitative with experimental with one group pretest and posttest.

The instrument used is a questionnaire, analysis of the needs of teachers and students, and tests. The pretest and posttest questions are 10 questions to measure disaster literacy, namely knowledge, attitudes and skills. the instrument was developed by itself with reference to literacy indicators based on Chou & Ren (2016). The validity of the questions using the SPSS 17.00 software. The reliability test was carried out using the Alpha Cronbach formula.

Pre-study analysis data, questionnaire data analysis, validity and reliability test data analysis of pretest and posttest questions, calculating N-gain, Effect size. The N-gain category is if the N-gain value is less than 0.3 then the category is low, the N-gain value is 0.3 to 0.7 then the medium category is, then if the N-gain value is more than 0.7 then the high category. The effectiveness of the e-worksheet developed to improve disaster literacy is also measured based on the interpretation of effect size according to Cohen, Manion Morrison, 1988. The effect size is small when the value is below 0.2, 0.3 to 0.5 category Effect size is moderate, 0.6 to 2.0 high Effect size value category.

▪ RESULT AND DISSCUSSION

The results of the needs questionnaire analysis obtained information that none of the teachers used e-worksheet in the learning process. As many as 40% of teachers have made worksheet with 30% inquiry model and 10% contextual model, but in the manufacture and use of worksheet with PBL-STEM model none of the teachers have used it. As many as 60% have taught natural disaster mitigation efforts before, when and after a disaster occurs.

The product produced in this development research is PBL-STEM-based e-worksheet to improve disaster literacy. The product that will be produced is an e-worksheet with a PBL learning model. e-worksheet is also equipped with STEM content such as, science as a concept, science as a process, technology as the application of science, engineering as science engineering, and mathematics as a tool. earthquake hazard information.

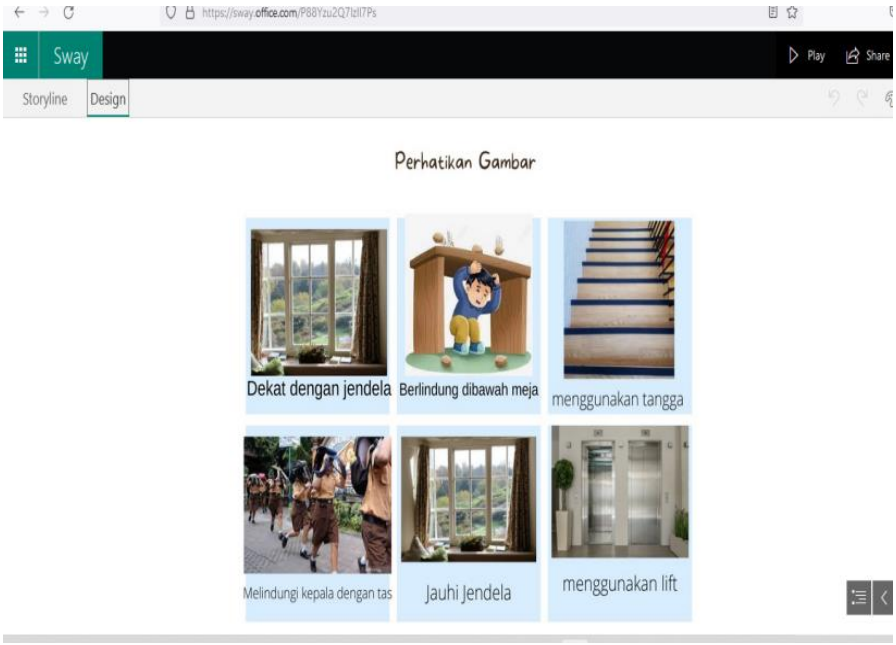

Figure 1 Display of e-LKPD

The results of the initial PBL-STEM-based e-worksheet design that had been completed were then validated by 2 experts namely material/content experts, linguists and design/construction experts and 2 science teachers. The results of the Validation of Experts and Practitioners on the e-worksheet are for the aspect of the content of the material with an average of 81% and declared valid. The construction aspect is 80% valid, while the language aspect is on average 80% and is declared valid.

The test instrument (pretest/posttest) was tested on 28 students of SMPN 4 Xaverius Bandar Lampung who had studied disaster threat materials in the region. Testing the validity of the test instrument was carried out using product moment correlation and the reliability of the test instrument was carried out using Cronbach's Alpha. The results of the validity and reliability test are questions with high validity numbers 2,5,6,8. Questions with moderate validity are numbered 1,3,4,10 while

questions with low validity are 9 and 7. The reliability of questions is 0.736 with high qualifications.

Table 1 Disaster literacy indicators as the output of disaster education according to Chung & Yen (2016).

Dimensions	Category	Description
Knowledge	Disaster knowledge	a. Analyzing the causes of floods b. Explain the impacts and dangers of floods for humans and the environment
	Preparedness knowledge	a. Develop flood disaster mitigation procedures b. Create an action plan for flood disaster mitigation and preparedness
	Response knowledge	a. Deciding on response procedures in the event of a flood disaster b. Designing post-flood rescue measures and medical treatment
Attitude	Awareness Prevention	a. Evaluate the environment comprehensively and identify potential flood hazards b. Analyze information related to flood disasters proactively
	Prevention value	a. Promote the importance of flood prevention, disaster relief, and evacuation plans b. Explain the relationship between flood prevention and social costs
	Sense of responsibility toward prevention	a. Organizing the promotion and prevention of flood disasters in the community b. Planning the implementation of evacuation and shelter placement
Skills	Preparedness Action	a. Planning escape routes and locations in the event of a flood disaster b. Plan and participate in exercises and training for flood prevention and relief
	Response behavior	a. Ensuring personal safety and helping others to escape in the event of a flood disaster. b. Cooperate during evacuation and shelter placement.

Source : Chung & Yen, 2016

Based on recommendations for improvement from experts, improvements were made to the initial e-worksheet design, both in terms of material/content, language and design.

Figure 2. Before revision

Figure 3. After revision

The normality test of the pretest and posttest scores of the two experimental classes was carried out using the Shapiro-Wilk analysis test using SPSS 17 software. The results of the normality test pretes eksperimen 0,196, posttes eksperimen 0,463 and pretes control 0,061, posttes control 0,060. Information obtained that the overall significance value of pretest and posttest disaster literacy in the control class and experimental class is >0.05, because the sig. > 0.05 then H0 is accepted which means that both groups of data are normally distributed. Experimental N-gain 0.69 and control N-gain 0.28

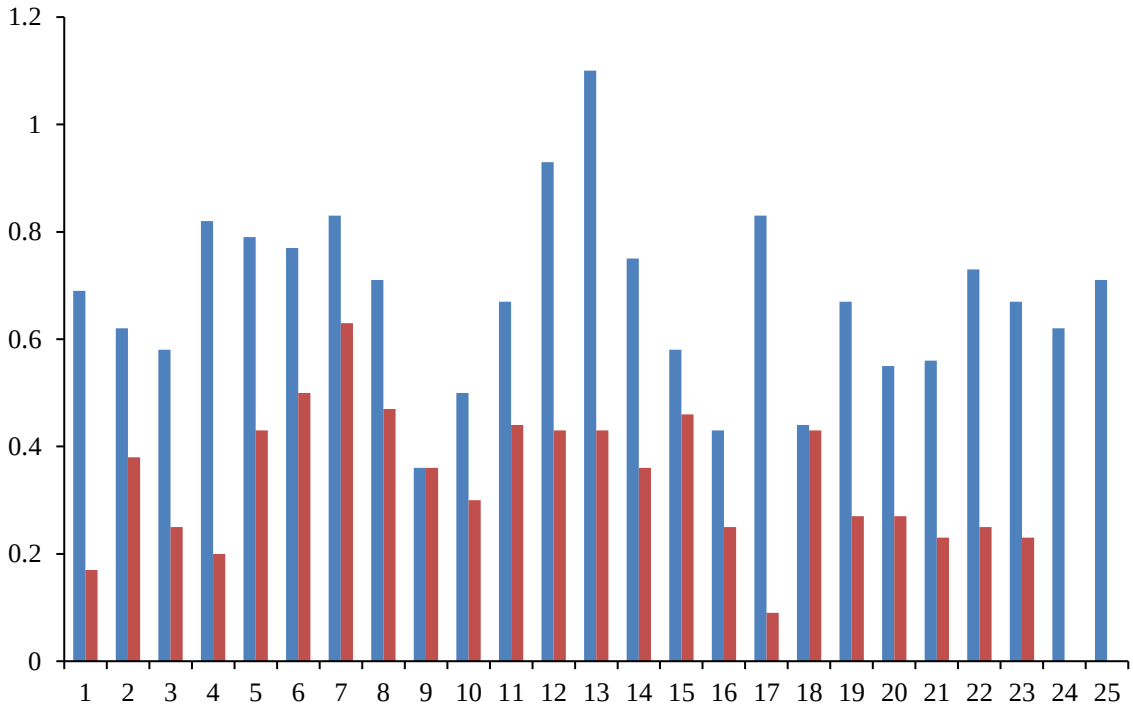

Figure 4 N-gain score for experimental (blue) and control group (red)

Tabel 2. Problem based learning and stem

PBL	STEM
1. Problem orientation Explaining the learning objectives, students are then asked to watch the videos contained in the e-LKPD, namely videos about buildings that are resistant to earthquakes and buildings that are not resistant to earthquakes.	1. Science Watch videos related to earthquake-resistant buildings and non-earthquake-resistant buildings. Gather information about earthquake-resistant buildings. Carry out activities in the form of designing earthquake-resistant buildings using toothpicks and marsmellows.
2. Organizing students After watching the video then students diminta untuk menjawab pertanyaan berkaitan dengan video yang telah ditampilkan.	2. Technology Read information about technology used in earthquake-resistant buildings
3. Membimbing penyelidikan Encourage students to collect information about earthquake-resistant buildings on the internet. After looking for information students make groups Then students carry out activities in the form of making earthquake-resistant building design by using toothpick and marsmellow.	3. Engineering Understand the information provided Regarding techniques in making earthquake. Resistant buildings
4. Develop and present results Presenting results in the form of experimental results in making buildings earthquake resistant and understanding and answering questions.	4. Mathematics Carry out activities to design earthquake-resistant buildings by taking into account the calculations for the design of the building
5. Analyze and evaluate the problem solving process. Helping students evaluate the investigation process by asking students what obstacles they face during experimental activities and then providing information about the technology that has been done to make earthquake-resistant buildings.	

Activity 1, namely making earthquake-resistant buildings, includes 5 stages of activities in accordance with the PBL syntax, namely problem orientation, organizing students, guiding investigations, developing and presenting results, analyzing and evaluating problem solving processes.

Figure 6. Earthquake building

The second activity is that students are asked to understand what to do before, during and after an earthquake occurs by carrying out the activities contained in the e-worksheet. The second activity, namely before, during and after the earthquake occurred, students were made in groups and then observed and answered the questions contained in the activity. Students were asked to explain what the impact was due to the earthquake, some of the students answered "It causes buildings to be destroyed, roads are damaged, facilities cannot be used" "electricity goes out as a result of hampering community activities". After that, students observe a picture, then students are asked to determine what must be prepared in the disaster preparedness bag. As a result, all students can correctly determine what to bring in a disaster preparedness bag, namely masks, fast food, PPPK boxes, mineral water, valuable documents, clothes, flashlights and whistles. After that the students made a rescue route from the school location plan.

The next activity when an earthquake occurs, students observe the picture and then determine what to do when an earthquake occurs indoors. Most of the students answered that they took cover under the table, went down using the stairs, when they went out they protected their heads with their bags, away from the windows. Then students are asked to do a simulation when an earthquake occurs in the classroom. It can be seen in Figure 7

Figure 7. Earthquake disaster simulation takes place indoors

Next, students observe what to do when an earthquake occurs outdoors. Some students answered looking for a spacious place, away from buildings and away from electricity poles. However, there were some students who answered close to a big tree. Then, after observing and determining what to do during an earthquake, students simulated when an earthquake occurred outdoors. It can be seen in Figure 8

Figure 8. Simulation of an earthquake occurring outdoors

The next activity after the earthquake occurred, students looked at the picture then answered and determined what things should be done after the earthquake occurred. The students' answers were to be alert to aftershocks, pay attention to the condition of the surrounding debris, look for gathering points, help around if someone was injured, look for evacuation routes, not enter buildings that were hit by the earthquake. Then the students simulated helping their friends who were traumatized by the earthquake. It can be seen in Figure 9

Figure 9. Simulation in helping a traumatized friend

It was obtained information that the percentage of student responses to the attractiveness of the developed e-worksheet was 88.40% and the teacher was 88%. The percentage of aspects of the ease of response by students is 87.52% and teachers are 88%. Most of the students stated that the e-worksheet made it easier for them to learn the earthquake threat material, making it easier for them to study independently. The teacher also stated that the use of the developed PBL-STEM-based e-worksheet was able to improve students' literacy literacy. In the aspect of usefulness, the percentage of student responses is 89.92% and the teacher is 92%. The teacher and most of the students stated that the use of letters, sentences and language in the e-worksheet was easy to understand. Based on the description, it shows that the PBL-STEM-based e-worksheet that is used to study the threat of earthquake disasters is interesting, useful and the language used is easy to understand and can improve disaster literacy for junior high school students.

▪ CONCLUSION

The characteristics of a valid e-worksheet to improve disaster literacy have five stages of activities according to the PBL syntax in problem orientation syntax, students are asked to watch the video. Organizing students, guiding investigations that is encouraging students to collect information, then students doing activities in the form of making earthquake-resistant building designs, developing and presenting results, analyzing and evaluating problem solving processes. The drawback in this study is that it does not use all indicators of disaster literacy.

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