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Development of PBL-Based Science Worksheets on Natural Disaster Mitigation Materials to Increase Middle School Students' Natural Disaster Preparedness Attitudes

Danang Habib Pratama✉, Azrul Hamidi, Sabar Nurohman

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Universitas Negeri Yogyakarta, Indonesia

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Abstract

This study aims to determine the practicality and readability of PBL-based science worksheets on natural disaster mitigation material to improve the attitude of preparedness for natural disasters in junior high school students. This development research adheres to the 4D development model which includes define, design, develop, and disseminate. This research only reached the develop stage due to research limitations. Based on the results of the study, it was shown that the science teacher's response to the product obtained an average score of 3.36 with very good criteria, while the results of students' responses to the developed LKPD product obtained an average score of 3.50 with strongly agree criteria. Furthermore, based on the results of product trials and filling out the attitude questionnaire for natural disaster preparedness, students before and after the activity and analyzed using n-gain obtained an average score of 1.23 in the high category. Based on the results of teacher and student responses, that valid product is used to improve junior high school students' natural disaster preparedness attitudes.

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✉ Correspondence Author:
E-mail: dananghabib.2022@student.uny.ac.id

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INTRODUCTION

Science is an important field that is related to all aspects of the life of living creatures (Novak & Wisdom, 2018). Science has a very broad coverage from the medical, engineering and even educational fields. In the field of education, science learning is a learning activity related to natural phenomena systematically through a series of scientific processes (Rustam et al., 2019;Febrian et al., 2023). This is in line with the essence of science that science consists of three important aspects, namely attitudes, processes and products (Wolfensberger & Canella, 2015).

As time goes by, science learning experiences changes and transformations. At this time, science learning has a broader view, not only as a science that studies various phenomena but also has a broader and more comprehensive meaning (Febrian et al., 2023; Wei, 2009). This development of science learning is known as integrated science.

Integrated science learning is learning that integrates several subjects in science, namely physics, chemistry, biology and earth science in one subject, namely science (Rapilus et al., 2019). Not only that, integrated science emphasizes students' scientific knowledge, thereby encouraging them to understand and interpret scientific phenomena in everyday life by combining perspectives, concepts and methods from various scientific disciplines (Sun et al., 2014in most provinces of China, the implementation is not as successful as expected. Challenges were reported, yet without fine-grained investigation, with respect to science teachers' instruction on integrated science. In this study, we aim to detect major problems by investigating the instruction of integrated science at the secondary level. Classroom observation focused on the teacher and student verbal behavior, teachers' competency of instructional organization, their presentation of instructional content, and the organization of learning activities. Findings revealed that students were provided with limited opportunities for participating and engaging in learning as science teachers were dominant in classroom talk. Teachers emphasized on the integration of knowledge within one subject (within-subject knowledge; Wilujeng, 2017). Based on the statement from (Listyawati, 2012) that through integrated science learning students can gain direct experience because it is related to everyday life. The scientific disciplines included in integrated science are biology, physics, chemistry, astronomy, ecology and earth sciences (Hewitt et al., 2013).

Earth science is a branch of natural sciences. Earth science studies the structure of the earth and its phenomena, including natural disasters that occur on Earth. A natural disaster is an event that occurs in nature without human intervention and cannot be avoided. Natural disasters occur due to gradual or drastic changes in nature (Ammelia et al., 2022). The occurrence of a natural disaster will result in many losses experienced by every community. Therefore, to reduce losses in both material and life, every government must pay attention to and study disaster mitigation.

Mitigation of natural disasters is one of the materials studied in science lessons. according to (Coburn et al., 1994) disaster mitigation are actions taken to reduce the impact and risks of natural disasters such as earthquakes, volcanic eruptions, tsunamis and floods. Current disaster mitigation has more to do with preparedness than just handling it (Mantasia & Jaya, 2016). Mitigation of natural disasters in learning aims to provide awareness and knowledge to students regarding things that must be done during, before and after natural disasters occur (Maryani, 2015). Disaster mitigation materials are effective when collaborated with the PBL learning model.

A learning strategy called problem-based learning (PBL) can give kids the abilities they'll need in the twenty-first century (Hotimah, 2020). Problem Based Learning is a learner-centered learning model that contains active learning strategies, where students learn through various problems that arise in everyday life (Hidayati et al., 2022). According to (Thorndahl & Stentoft, 2020) that through PBL can improve students' abilities to analyze and collaborate, to have critical and independent views, besides that they can also focus on what is interesting academically. The PBL model can be applied effectively in science learning by ensuring the inclusion of several scientific process components and scientific concepts (Yoon, 2012). The PBL syntax consists of five steps, namely 1) directing students to problems, 2) preparing students for learning, 3) assisting independent and group research, 4) developing and presenting artifacts and long objects, 5) analyzing and evaluating the problem-solving process (Arends, 2012).

The science material used in the development of this LKPD is natural disaster mitigation material in class VII odd semester. The LKPD that will be developed is based on the PBL model by adhering to the syntax of (Arends, 2012) which consists of five stages with the aim of increasing students' natural disaster preparedness attitudes. based on the description of the problem, it is ne-

cessary to develop PBL-based IPA worksheets on natural disaster mitigation material to improve students' natural disaster preparedness attitudes. This study aims to determine the practicality and readability of PBL-based science worksheets on natural disaster mitigation material to improve the attitude of preparedness for natural disasters in junior high school students.

METHOD

This study falls under the category of R&D development research, which adopts the 4D development paradigm (Thiagarajan, 1976). The thiagarajan model includes the define, design, develop, and desiminate stages. In this study only reached the develop stage due to research limitations. At the Define stage, several analyzes were carried out. At the define stage, an analysis of development needs is carried out in the form of preliminary analysis, student analysis and concept analysis. The design phase is carried out by designing LKPD in the form of a cover design and a systematic design. At the develop stage, LKPD trials are carried out as well as testing the validity of readability, practicality of students and effectiveness in increasing the attitude of preparedness for natural disasters. Observation and questionnaires were used as data gathering methods. Data analysis techniques were carried out by converting qualitative data into quantitative using guidelines for rating scales 1 to 4 presented in Tables 1 and 2 below.

Table 1. Conversion of science teacher assessments

Explanation	Score
Very good	4
Good	3
Not enough	2
Very enough	1

Table 2. Conversion of student response assessments

Explanation	Score
Strongly agree	4
Agree	3
Don't agree	2
Strongly Disagree	1

The PBL-based IPA LKPD product legibility assessment on natural disaster mitigation material was developed based on predetermined criteria as presented in Table 3.

Table 3. Product readability assessment criteria

Average score	Criteria
$3{,}26 < \bar{X} \leq 4{,}00$	Very good
$2{,}51 < \bar{X} \leq 3{,}25$	Good
$1{,}76 < \bar{X} \leq 2{,}50$	Not enough
$1{,}00 < \bar{X} \leq 1{,}75$	Very enough

The measurement of variables after and before using the IPA LKPD as measured by distributing questionnaires on natural disaster preparedness attitudes is also in the form of qualitative data which is converted to quantitative with guidelines on a scale of 1 to 4 which can be seen in table 4. The procedure for filling out this questionnaire is that students before carrying out practicum activities use LKPD were asked to fill out a questionnaire via the Google form provided. After that, the students carried out the procedures for practicum activities in the LKPD, then the students filled out the questionnaire again through the Google form related to natural disaster preparedness. Pretest and posttest results are measured by standard gain.

$$\langle g \rangle = \frac{\bar{x}_{post} - \bar{x}_{pre}}{\bar{x}_{maks} - \bar{x}_{pre}}$$

The n-gain values obtained are interpreted according to the categories in table 5.

Table 4. Conversion of students' natural disaster preparedness attitude assessment

Explanation	Score
Strongly agree	4
Agree	3
Don't agree	2
Strongly Disagree	1

Table 5. Interpretation nGain

Mark	**Category**
$\geq 0{,}7$	High
$0{,}7 \geq \geq 0{,}3$	Currently
$< 0{,}3$	Low

Keterangan:
x_{post} = average value *posttest*
x_{pre} = average value *pretest*
x_{maks} = max value

RESULT AND DISCUSSION

Based on the results of the analysis at the define stage, namely producing the need for teaching materials that support students in solving problems. Furthermore, at the design stage, the initial product design of LKPD and data collec-

tion instruments is carried out. LKPD products developed in production using the Canva application. The initial design of the product covers; KI, KD, and learning objectives; concept maps; instructions for use; introduction to ulo cloth culture; Learning Activities; and PjBL project activities. The initial product design is shown in Figure 1.

Figure 1. Student Worksheet Product Design

After the science LKPD product prototype has been repaired and perfected, the research process continues to the develop stage. At the develop stage, product readability validation activities were carried out by 2 science teachers. Furthermore, a limited trial was conducted at one of the junior high schools in Yogyakarta with a total of 8 students to test the practicality of using the product and the attitude of caring for the culture of students. The readability test of PBL-based LKPD products on natural disaster mitigation material to improve students' natural disaster preparedness attitudes with the results of the validation of junior high school science teachers is presented in table 6 below:

Table 6. The results of assessment from science teacher

Aspect	Score	Code
Content eligibility	3,61	Verry good
Language	3,10	Good
Presentation	3,29	Verry good
Graphics	3,44	Verry good

Based on the results of the validation assessment by two junior high school science teachers, the average of all aspects was 3.36 with very good criteria. Thus, PBL-based IPA LKPD products on natural disaster mitigation materials to improve natural disaster preparedness attitudes can be used in the learning process in schools. Furthermore, the product was conducted limited trials with subjects totaling 8 students.

The student response test was carried out with 8 kids in one of Yogyakarya's junior high schools. before conducting student response tests, revisions were first carried out according to input from the validator. After the product is revised, a limited trial can be carried out on students by distributing student response questionnaires. The results of student responses are presented in table 7 below:

Table 7. The results of responses from students

Aspek	Skor	Kode
Content eligibility	3,54	Strongly agree
Language	3,42	Strongly agree
Presentation	3,50	Strongly agree
Graphics	3,50	Strongly agree
Use	3,53	Strongly agree

Based on the results of the analysis of students' responses to PBL-based IPA LKPD in the process of coloring ulos woven fabric to improve natural disaster preparedness attitudes of class VII junior high school students, the average of all aspects was 3.50 with the criteria of strongly agreeing. 8 students, then the measurement of students' natural disaster preparedness attitude variables was carried out with the same number of subjects through the distribution of natural disaster preparedness attitude questionnaires. Measurement of students' cultural caring attitude is assessed by indicators of cultural caring attitude, namely (1) knowledge and attitude preparedness, (2) policy preparedness, (3) natural disaster mitigation system preparedness, (4) resource mobilization preparedness. The measurement of the attitude variable for natural disaster preparedness is presented in table 8 below.

Table 8. Reseult score nGain

Variabel	Pretest	Posttest	Score nGain	Category
Natural disaster preparedness	1,58	3,29	1,23	High

Table 8 shows the scores of students' natural disaster preparedness attitudes where each of them gets an increase of 1.23 with the High criteria.

Through this LKPD teaching material, students can instill an attitude of preparedness for disasters. The LKPD developed is equipped with activities that support and stimulate students to be alert if a natural disaster occurs. Through the LKPD that will be developed, it is hoped that it can instill knowledge that must be known when a natural disaster occurs. Students are also expected to be able to become agents of change through disseminating information related to na-

tural disaster mitigation starting from their families to all communities in Indonesia in particular.

CONCLUSION

The conclusion from this development research is that PBL-based LKPD science teaching materials will be useful for students in instilling an attitude of preparedness in dealing with natural disasters. Based on the results of the LKPD product legibility test from junior high school science teachers that the overall average aspect is 3.36 with very good criteria (SB). Thus the product is declared to be used in science learning activities at school. Student responses to LKPD products obtained an average overall aspect of 3.50 with the criteria of strongly agree (SS). Based on the analysis of the pretest and posttest data on the cultural caring attitude questionnaire using N-Gain, a score of 1.23 was obtained which indicated the high category, thus through the PBL-based IPA LKPD trial on natural disaster mitigation material to improve natural disaster preparedness attitudes.

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