Effectiveness of integrated science textbook on volcanic eruption theme with creative problem solving to improve students’ preparedness

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Abstract. Students’ preparedness towards volcanic eruptions should be encouraged early through education. Learning science that contains volcanic eruption theme has been done as the preparedness effort. Preparedness parameters are measured by knowledge and attitude. This study aims to analyze the effectiveness of integrated science textbook theme of volcanic eruption to improve the students’ preparedness. The research method used is quasi experiment with one-group pretest-posttest design conducted on 32 students of seventh grade student in junior high school 1 Solok. The students’ preparedness parameter is measured by the knowledge test sheet and the attitude questionnaire. Data were analyzed using statistic descriptive, n-gain, and effect size. The results shows the students’ preparedness on knowledge and attitude parameters are in the medium category and effect size are in strong effect. Thus, science textbook on volcanic eruption theme with the CPS model is effective to improve students’ preparedness.

1. Introduction
Indonesia is known as the Ring of Fire [1]. This is because the Indonesian territory is located at IndoAustralian Plate meeting with Eurasian Plate and Pacific Plate. Subduction between the two plates causes the formation of volcanoes. Volcanoes in Indonesia reached 129 or 13% of the total number of volcanoes in the world [2]. Given the many volcanoes in Indonesia, Indonesia is potentially a volcanic eruption. The impacts of volcanic eruptions on the community are the disruption of people’s lives, such as the destruction of houses, the destruction of property, even the loss of casualties.

National Agency for National Disaster Management recorded from 2010 to 2014 Indonesia experienced 36 times the incidence of the eruption with the death toll 432 people and injured 2217 people. This data illustrates the community's lack of capacity to cope with disasters. If we can not prevent and reduce the risk of disaster, the damage caused by volcano eruption will be catastrophic for life. Disasters strike unexpectedly [3], it is important to have disaster preparedness.

Preparedness is a series of activities undertaken to anticipate disasters through organizing and through appropriate and effective measures. Preparedness is one of the disaster management activities conducted prior to the occurrence of a disaster. The main factor to preparedness is knowledge. Their knowledge can influence the attitude to be ready to anticipate disaster [4].

Knowledge of volcanic eruptions can be given from an early age through education in schools. Attention should be accorded and support targeted to create more disasters strike [5]. Therefore, an
investigation about students’ preparedness has been done. The result show, on the knowledge parameter 56.25% of students is in less prepared level. While, on the attitude parameter 78.13% of students is in prepared level. Based on the result of preliminary, it is necessary to improve students’ preparedness through education.

Education applicable in Indonesia is currently organized based on Curriculum 2013. The consequences of the implementation of Curriculum 2013 is the integration of local content into learning. The regulation of Ministry of Education and Culture of Republic Indonesia Number 79 of 2014 explains that local content contains the content and learning process about the potential and uniqueness of the region. As mentioned before, one of the potentials or possibilities that could happen in Indonesia is the volcanic eruption.

Volcanic eruption is a natural phenomenon that can be taught through science learning. This is also in accordance with the principles of the Curriculum 2013 that is learning must be tailored to the interests of students and their environment. The process of science learning in junior high school is done through integrated thematic learning. Because the learning process is a process of interaction of students with learning resources, then efforts to integrate the topic of volcanic eruption can be done on science textbooks. Therefore, a science textbook on volcanic eruption theme with the step of creative problem solving model [6][7] to improve students’ preparedness has been developed. Learning by CPS model can improve learning outcomes of students [8]

Science textbook quality has been tested its effectiveness. Effectiveness is the level of influence or impact that is the result of the policy or step taken, which is certainly taken from the desire to achieve the target by looking at the reality that is in the field [9]. The textbook was developed to improve students' preparedness towards volcanic eruption. Thus, this study concerns to analyze the effectiveness of integrated science textbook theme of volcanic eruption to improve the students' preparedness.

2. Methodology Research
This research was conducted in 3 weeks starting from April to May 2018 by employing a quasi experiment with one-group pretest-posttest design conducted on 32 students of seventh grade student in junior high school 1 Solok. The students’ preparedness parameter is measured by the knowledge test sheet and the attitude questionnaire.

The indicators of the parameters of knowledge on volcanic eruptions are (1) knowledge of the concept of disaster, (2) knowledge of the causes of disasters, (3) knowledge of signs of occurrence of disaster, and (4) knowledge of what action needs to be done if potentially disastrous [10].

The indicators of attitude parameters are (1) receiving, meaning willing and paying attention to stimulus given, (2) responding, meaning an indication of attitude, (3) appreciating, meaning to invite others to work, and (4) bearing all the things he has chosen with all risks [11]. Data were analyzed using statistic descriptive, n-gain, and effect size. Analysis of data preparedness within the parameters of knowledge and attitude processed through the following steps.

2.1. Achievement Level of Preparedness Classical
Achievement level of Preparedness Classical were analyzed using statistic descriptive and catagorized based on following criteria [9]: (1) if 80 < Score ≤ 100 (Highly Prepared), (2) if 65 < Score ≤ 80 (Prepared), (3) if 55 < Score ≤ 65 (Almost Prepared), (4) if 40 < Score ≤ 55 (Less Prepared), and (5) if Score ≤ 40 (Not Prepared). Furthermore, learning outcomes are said to be effective if 75% of all students is reach established criteria [12].

2.2. Improvement of the Student’s Preparedness
Improvement of the Student’s preparedness were analyzed using N-Gain formulation and based on the value of pre-test and post-test than catagorized based on following criteria [13]: (1) if n-gain > 0.7 (high), (2) if 0.3 < n-gain < 0.7 (medium), (3) If n-gain < 0.3 (low). Thus, textbooks are effective when N-gain in medium and high category.
2.3. Effect Size of Using Textbook to Improve Student’s Preparedness.

The effect size calculation uses the formula [14] and categorized based on following criteria [15]: (1) if \(\mu < 0.15\) (Effect are ignored (very small)), (2) if \(0.15 \leq \mu < 0.40\) (small effect), (3) if \(0.40 \leq \mu < 0.75\) (medium effect), (4) if \(0.75 \leq \mu < 1.10\) (strong effect), (5) if \(\mu \geq 1.10\) (very strong effect). Thus, textbooks are effective when effect size with medium, strong and very strong effect category.

3. Results and Discussion

The results showed that after the implementation of learning using this textbook, the level of the students’ preparedness on the attitude and knowledge parameter is shown in Figure 1.

![Figure 1](image1)

**Figure 1.** Classical Preparedness on (a) Knowledge Parameter; (b) Attitude Parameter.

Based on Figure 1(a) shows that after implementation textbooks the preparedness knowledge parameters of 37.50% of the students are at a prepared level, and 62.50% of the students are at a highly prepared level. Furthermore, based on Figure 1(b) shows that the parameters of preparedness attitudes of 21.87% of students are at a prepared level and 78.13% of students are at a highly prepared level. Classically, the results of the students' preparedness showed that more than 75% of students
were prepared toward volcanic eruption. Learning outcomes are said to be effective if 75% of all students reach established criteria [12].

The students' preparedness improvement based on pre-test and post-test values was calculated using N-Gain formulation [13]. Comparison between attitude parameter and knowledge in pre-test and post-test were shown in Figure 2.

![Comparison between attitude and knowledge parameter within pre-test and post-test](image)

Based on Figure 2 shows that comparison of preparedness between knowledge and attitude parameters. The pretest results on knowledge is 48.28 in the less prepared category and and attitude parameters is 75.78 in prepared. After the implementation of the post test result on the knowledge increases to 77.53 in prepared category and and attitude parameters increases to 89.77 in highly prepared. N-gain obtained on the knowledge and the attitude parameter are 0.565 and 0577 in the medium category. Furthermore, the textbook effect size for preparedness improvement is done using the effect size formulation [14]. The results shows the students' preparedness on knowledge and attitude parameters are 0,945 and 0,956 in strong effect. Thus, science textbook on volcanic eruption theme with the CPS model effective to improve students' preparedness.

Furthermore, science textbook on volcanic eruption theme with the CPS model effective to improve students' preparedness due to several factors. First, integrated science textbook consist of natural phenomenon in the theme of volcanic eruption. This is in accordance with the principles of the 2013 curriculum that learning must be tailored to the interests of students and the environment so that learning becomes more meaningful.

Second, the existence of learning models in the form of creative problem solving related to volcanic eruption theme. Learning by CPS model can improve learning outcomes of students [8]. Third, the since textbook on the volcanic eruption theme contain information about disaster preparedness actions. The program that can be done to improve students' preparedness is to insert disaster alert on teaching material [16].

Before using textbooks, attitude parameter is already in prepared level, but the knowledge parameter is in less prepared level. This is because previously there were several students who had participated in the volcanic eruption mitigation and simulation so that the attitude of students was formed from their experiences. Attitude is a response to certain objects that are formed through the learning process, personal experience, and socialization [17]. After using textbooks, the students’
preparedness of increase in medium category. Improving students' preparedness indicates a strong effect on the use of textbooks that have been developed. Thus, science textbook on volcanic eruption theme with the CPS model effective to improve students' preparedness.

4. Conclusion

Effectiveness of integrated science textbook theme of volcanic eruption to improve the students’ preparedness. The research method used is quasi experiment with one-group pretest-posttest design conducted on 32 students of seventh grade student in junior high school 1 Solok. The students' preparedness parameter is measured by the knowledge test sheet and the attitude questionnaire. Data were analyzed using statistic descriptive, n-gain, and effect size. The results shows the students' preparedness on knowledge and attitude parameters are in the medium category and effect size are in strong effect. Thus, science textbook on volcanic eruption theme with the CPS model effective to improve students’ preparedness.

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