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Improving Learning Outcomes Through the Use of Media STEM Based on Volcano Eruption Simulation in the Theme of Natural Events

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Abstract
The objective of the study is to reveal the improvement in student learning outcomes in the use of instructional media teaching aids on STEM-Based Volcano Eruption Simulation (Science, Technology, Engineering, Mathematics) on the theme of Thematic Class I learning natural events. This research was conducted on first-grade students of Public Elementary School of Laweyan Surakarta City in the Second Semester of the 2018/2019 Academic Year. The number of students was 25 students, consisting of 8 male students and 17 female students. The study was a Classroom Action Research (CAR) with patterns: planning, implementing, observing, reflecting, revising. The data were collected through the method of discussion, observation, tests, field notes, and documentation. Based on the results of the study, it was found that student learning outcomes had increased learning outcomes. They were the first cycle (79.60%) and the second cycle (84.00%). The study was concluded as through the use of instructional media for teaching aids of STEM-Based Volcano Eruption Simulation (Science, Technology, Engineering, Mathematics) on the theme of natural events Class I can improve the learning outcomes of Class I students of Public Elementary School of Laweyan Surakarta City Semester II in the Academic Year of 2018/2019.

Keywords:
Learning Outcomes, Volcano Eruption Simulation Media, STEM (Sains, Technology, Engineering, Mathematics

INTRODUCTION

The paradigm of present education positions the teacher as an agent of change. It means that the teacher is an agent for students in changing aspects of students, in the aspects of knowledge, attitudes, or skills. Teachers, as agents of change, must be able to provide a change to students in learning. Teachers, as an agent of change, must be able to follow changes in the educational paradigm of the present era that is identical to the era of 21st-century learning. 21st Century learning refers to 4C where 4C is communication skills, collaboration skills, critical thinking skills, and Creative thinking skills must always be built because they provide an important role to face the challenges of the industrial revolution 4.0. The industrial revolution 4.0 is marked by a transformation in all aspects of science by empowering the sophistication of digital-based technology. The industrial revolution 4.0 provides a challenge for teachers to be literate in digital literacy, particularly based

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on ICT (Information and Communication Technologies). This is reinforced by Zain's research that 4C skills in 21st-century learning suggest being applied in learning and innovation skills, life skills and careers that will be embedded and how information, media, and technology skills should be given to current "technology savvy" students (Zain, 2017, p. 2260).

STEM learning (Science, Technology, Engineering, Mathematics) is an innovative learning strategy that is compatible with 21st-century learning because, in STEM, several aspects become the demands of 21st-century learning, including communication skills, collaboration skills, thinking skills critical and creative thinking skills, problem-solving skills, and the skills to conduct experiments (research). By using STEM learning, both teacher and student are not necessarily able to answer a problem, but a teacher or student can analyze a problem and ultimately be able to solve the problem properly. STEM learning creates the character of students to have critical thinking and creativity in dealing with problems related to real life.

According to Asih Mardati (2015), learning media is one of the learning tools that a teacher must develop to make it easier to deliver the material. Learning media influences the learning climate in the classroom. Creative and innovative learning media will motivate students to be motivated in learning activities. STEM-based learning media (Science, Technology, Engineering, Mathematics) is a learning media that connects learning experiences in the concepts of science, technology, and mathematics in one problem. STEM-based learning media provides experiential learning not only one skill but also communication skills, collaborative skills, critical thinking skills and creative thinking skills, problem-solving skills, and skills in conducting experiments (research).

Based on the problems, therefore, the researchers conducted a classroom action research-oriented to improving student learning outcomes by entitling "Improving Learning Outcomes Through the Use of STEM-Based Volcano Eruption Simulation Media for Natural Events Theme."

THEORETICAL PERSPECTIVES

Research Method

The research is a Classroom Action Research (CAR) because the research is conducted by the teacher in their class (Suharsimi Arikunto, 2008). The population and sample of this study were participants of class I, one of Public Elementary School of Laweyan Surakarta City in the Academic Year of 2018/2019, within 25 students, consisting of 17 female students and eight male students.

Data Collection and Analysis

Data collection techniques in classroom action research were observation, interviews, tests, and documentation. These data were analyzed by Milles & Huberman's interactive analysis (Sugiyono, 2012:337-345). Milles & Huberman revealed that to measure learning outcomes, data analysis can be done with four steps, namely data collection, data reduction, data presentation, and concluding (Sugiyono, 2012:337-345).

This class action research sets the following indicators of success: If students have shown a 75% increase in learning outcomes completely according to the minimal completeness criteria standard after using the Si-Eguapi Media (Volcano Eruption Simulation) Based on STEM.

Research Procedures

This research was conducted in two cycles. Each cycle consists of 2 lesson hours (2 x 35 minutes) and four implementation steps according to the opinion of Arikunto, Suhardjono, and Supardi (2015 Arikunto, Suhardjono, and Supardi (2015: 41-43) revealed that classroom action research generally consists of four steps namely planning, implementing / acting, observing and reflecting. Planning in the first cycle is the use of Si Eguapi (Volcano Eruption Simulation) media based on STEM. The agreed learning method uses the discussion method and completes the test individually. While planning in the second cycle is students conducting experiments based on teacher guidance. While the implementation, both cycle I and cycle II were carried out in semester 2 of the 2018/2019 school year. Observations are carried out by observational guidelines and by field notes and are made to avoid burdening administration. Observations were carried out by researchers by recording the effects of actions related to reactions, student initiatives during the learning process, and paying attention to the place of implementation as well as the constraints encountered during the action carried out and field records. The reflection both in cycle I and cycle II was conducted to study the success of learning through the use of STEM-based Si Eguapi (Volcano Eruption Simulation) media.

LITERATURE REVIEW

Learning Media

According to Agung, M. (2017), The use of media in learning could improve student interest and attention to motivate students in the teaching and learning process, which in turn can improve understanding and learning achievement. Rosita Primasari (2014) learning media

functions to present objects that cannot be seen by students directly or objects that are too micro to be seen directly, for example, enlarging small objects, presenting events that are located far away, complex, complicated, which are rapidly or directly slow to be systematic and simple. Falahudin, I. (2014) argues that learning media include learning aids in teaching as well as a means of carrying messages from learning sources to recipients of learning messages (learners). Based on the opinions, it can be assumed that learning media is a teaching medium that is a tool in learning activities that aim to make it easy for students to understand an object of learning so that it can ultimately improve students' learning skills and learning outcomes.

STEM (Sains, Technology, Engineering, Mathematics)

Aldila, C., (2017) argues that STEM learning does not only mean strengthening the practical education of STEM fields separately but also developing educational approaches that integrate science, technology, engineering, and mathematics, with a focus on education. According to Permanasari, A. (2016), STEM literacy or scientific and technological literacy is the ability to use scientific knowledge and its implementation, identify problems and make conclusions based on evidence to understand and make decisions about nature and changes in nature as human activities in daily life. Based on the opinions, it can be assumed that STEM Literacy is the ability to use science and technology to solve problems in real life and be able to make conclusions based on evidence to create a constructive, caring, and reflective personality towards nature and changes in nature as human activities in daily life.

On the other hand, Mangiante and Gabriele-Black suggested that STEM teaching practices build teacher understanding about students' thinking. STEM practices can correct elementary school students' misconceptions so students can imagine work designs, make evidence-based decisions, and evaluate solutions based on criteria (Mangiante & Gabriele-black, 2020).

Learning Outcomes

Firmansyah, D. (2015) learning outcomes are the final results gained or obtained by a student after getting experiences a learning process that is marked by a scale of values in the form of letters or symbols or numbers, and this is commonly used as a benchmark of success or failure of the student in learning. Mayulu, D. (2013) learning outcomes are the result of an interaction of teaching and learning actions and are usually indicated by the test

scores given by the teacher. Delu Pingge, H. (2016) learning outcomes related to changes in self-learners, both concerning cognitive, affective, and psychomotor aspects. Based on the opinions, it can be drawn that learning outcomes are the final results of students after getting experience the learning process through the interaction of teaching and learning activities both cognitive, affective, and psychomotor and being marked with a scale of values in the form of letters or symbols or numbers.

Regarding learning outcomes, Birmingham et al. Suggested that participation in multidisciplinary inquiry is meaningful to teachers because it allows them to simultaneously engage in experiences as learners and science teachers (Birmingham, Coleman, & Smetana, 2019, p. 1512). On the other hand, Erikson and Erikson found three problems of learning outcomes they are. First, the problem of interpretation, which depends on the implicit learning design framework. Second, the problem of educational goals that cannot be expressed through learning outcomes, and the third is the risk that learning outcomes can build a ceiling for student ambitions (Erikson & Erikson, 2018) so that it can be understood that student learning outcomes are also largely determined by the learning plan created by the teacher.

CONTEXT: FINDINGS AND DISCUSSION

Cycle I Description

Treatments in the first cycle were implementing learning through the use of STEM-based Si Eguapi learning media. Based on the identification of the problem, the first cycle was learning activities through the use of STEM-based Volcano Eruption Simulation media to improve students' communication skills and learning outcomes by conducting a discovery experiment through the STEM-based Volcano Eruption Simulation media. Learning emphasized the activeness and creativity of students in group work when using media based on the STEM Volcano Eruption Simulation on the theme of natural events. The material delivered by the teacher in the first cycle on the theme of natural events particularly emphasized the events that occurred before the volcano erupted as an example of one natural disaster. Learning was delivered with a time allocation of 2 lesson hours.

Table 1 Learning Outcomes of Cycle I Activity

No.	Score	Frequency	Percentage (%)	Category	Description
1	85-100	10	40	Very Good	Complete
2	75-84	9	36	Good	Complete
3	65-74	6	24	Sufficient	Incomplete
4	55-64	0	0	Less	Incomplete
5	45-54	0	0	Very Less	Incomplete
Total		25			

Total of Completeness	19	79,60%
Total of Incompleteness	6	20,60%

Based on table 1, it can be assumed that the number of students who are complete there are 19 out of 25 students with a percentage of completeness 79.60%. In Cycle I learning activities have shown that student learning outcomes have improved by applying the use of media based on the STEM Volcano Eruption Simulation (Science, Technology, Engineering, Mathematics), although it has not yet reached the mastery level standard of 85% of the total number of students. Nevertheless, student learning outcomes improved after applying the STEM-based Si Eguapi media, as found by Nurjaman et al., that STEM-based learning media can be developed by teachers and prospective teachers in primary schools in implementing learning in the 2013 curriculum. With this kind of media, both teachers and students can gain 21st-century skills (Nurjaman, Hamdu, & Elan, 2018).

Evaluation of actions in the first cycle of the results of observations, observations when implementing actions, and peer discussion, including the following conclusions:

1. Students are not yet skilled in using the Si Eguapi media as a whole (Science, Technology, Engineering, Mathematics). As research by Fatmawati et al. who found that the lack of use of media will make learning outcomes low, which triggers increasingly complex educational problems, especially preparing students to be able to face the development of the 21st century (Fatmawati, Erviana, & Maryani, 2019). Thus, the lack of skilled students in this study related to the use of Si Eguapi's media is a good effort for teachers, researchers, or schools in managing the learning process in the classroom.
2. Each student has not been able to practice optimally because of the limited time that has been provided and the available media. This is also in line with Nava & Prasetyo's research, which found that although the media used were ICT-based, the media almost dominated all material even in the laboratory, so students looked passive and could not hone their skills. (Nava & Prasetyo, 2018). Therefore, we as researchers maximize student involvement in learning primarily in the use of media in cycle II.
3. Learning outcomes and assessment of communicating skills processes do not meet work indicators and completeness standards. This is inseparable from the time allocation determined by researchers. Therefore, researchers apply

classroom action research with two cycles to maximize learning through the use of innovative media in learning. As found by Budiyono that the argumentation exercise that is enough time has a very good impact on the ability of students' argumentation (Budiyono, 2015).

Reflection of Cycle I

Arikunto (2008) Reflection is an activity to restate what has been done. Based on the results of the Cycle I action, classroom teachers and partner teachers determine the steps so that the learning process in Cycle II can be carried out according to plan. Partner teachers and classroom teachers prepare a) teaching materials, b) practice tools, c) observation sheets, d) assessment tools. Students who have understood the material give examples to friends who do not understand the material, and students who do not understand the material will be guided by the teacher, excluding class hours. On the other hand, Miller-Ray revealed that professional development programs often limit scientific knowledge and pedagogical experience and often produce teachers who have limited confidence in STEM expertise (Miller-Ray, 2019, p. 79). Therefore, researchers will enhance the use of instructional media for teaching aids on STEM-Based Volcano Eruption Simulation, both in terms of students and teachers.

Description of Cycle II

The action research in Cycle II was not much different from the implementation of Cycle I action, but the difference was in the emphasis on indicators and learning objectives being conveyed. Learning emphasized the activeness and skills of communicating students in group work when using the STEM-based Volcano Eruption Simulation media on the theme of natural events. The material presented by the teacher in cycle II on the theme of natural events particularly **emphasized the events that occurred after the volcano erupted as an example of one natural disaster**. The implementation of the Cycle II action was carried out based on the results of the reflection of the Cycle I actions that had been carried out was improving the learning process. As found in Peters-Burton's research, et al. that students at Bracken are involved in active and multidisciplinary learning opportunities when STEM is used as a way of thinking and as a way to incorporate content coherently into active learning opportunities that are of interest to students (Peters-Burton, House, Peters, & Remold, 2019).

Evaluation of the actions in the second cycle of the results of observations,

observations when implementing actions, and peer discussion, including the following conclusions:

1. Students have been skilled in using the Si Eguapi media as a whole (Science, Technology, Engineering, Mathematics). This is relevant to the research of Ching et al. That most students have positive learning experiences in the integration of STEM in the curriculum, including developing their perseverance and teamwork skills in problem-solving (Ching et al., 2019).
2. Each student is able to practice optimally independently. This is inseparable from the role of the teacher in the classroom, as found in the research of Sriyati et al. The research also revealed that teachers felt the importance of introducing and implementing STEM-based learning to students (Sriyati, Rochintaniawati, Widodo, Purwianingsih, & Riandi, 2018).
3. Learning outcomes and the assessment process of communicating skills meet work indicators and completeness standards. This is inseparable from the nature of STEM-based learning that connects learning material with students' real-life (Pasaribu & Suyanto, 2020).

Based on table 2, it can be assumed that the number of students who are complete there are 21 out of 25 students with a percentage of completeness 84.00%. In Cycle II, learning activities have shown that student learning outcomes have increased and have met the standard of compliance according to performance indicators that are 75%. As expressed by Peters-Burton, et al. that the pervasive STEM focus can help capture students' interest in STEM before such interest tends to decrease and provide valuable opportunities to connect science learning with important literacy skills (Peters-Burton, House, Peters, & Remold, 2019, p. 447).

Reflection of Cycle II

Based on (Sugianto 2007: 26) an effort to study what has been done or completed and what has not been done or what has not completed, what has been produced and what has not been produced, what needs to be repeated, what has been completed and what has been not complete when taking action is called reflection. This is consistent with the opinions of (Sukardi 2010: 6). Reflection provides an overview of the aspects of success and weakness in conducting research.

The results of reflection on Cycle II research activities are observations of partner teachers, and class teachers concluded that cycle II activities had reached the level of completeness and performance indicators that have exceeded 75% so that

after Cycle II activities, research action was stopped.

Based on the results of Cycle I research, it is identified that the number of students who are complete there are 19 of 25 students with a percentage of completeness 79.60%. In Cycle I learning activities have shown that student learning outcomes have improved by applying the use of media based on the STEM Volcano Eruption Simulation (Science, Technology, Engineering, Mathematics), although it has not yet reached the mastery level standard of 85% of the total number of students. Therefore, researchers maximize the implementation of actions in the second cycle by improving the quality of teaching and knowledge content of teachers through peer discussion. This is inseparable from the research results of Catalano et al. It can be used as a reference for researchers to reflect. Catalano et al. found that teachers who believed they were able to teach science effectively tended to have lower knowledge of science content (Catalano, Asselta, & Durkin, 2019, p. 65). Not only that, Parker et al. revealed that professional development is a necessity to improve teacher knowledge of pedagogical content, classroom practice, and overall teacher quality (Parker, Denisova, & Abel, 2015, p. 295).

Based on the results of the Cycle I and Cycle II action research, it can be concluded that the learning media based on the STEM Volcano Eruption Simulation can improve student learning outcomes in classroom learning. Teachers can explore the potential of students in solving a real problem in the classroom, assisting students being active in discussing with their classmates and training students to communicate, and students more easily find, understand difficult concepts. This is consistent with research studies, which state that the learning process is student-centered so that it can involve the activeness of student learning in class. The related thing was also expressed by English that the integrative STEM shows a continuous and dynamic teaching and student-centered learning process (English, 2017, p. 7).

In the study, the teacher provides a problem in learning can create a better learning atmosphere where a problem can spur students to get answers to problems and ways of solving various problems. It is in line with Vygotsky's learning theory, stating that the occurrence of social interaction with other friends, thus triggering the formation of new ideas and enrich the intellectual development of students. Yildirim and Topalcengiz also found that students who were equipped with STEM knowledge would be able to identify, apply and integrate their concepts to understand complex problems and produce solutions to

solve those problems (Yıldırım & Topalcengiz, 2018).

Figure 1. Graph of the results of media action research on the STEM-Based Volcano Eruption Simulation Initial Conditions, Cycle I, Cycle II

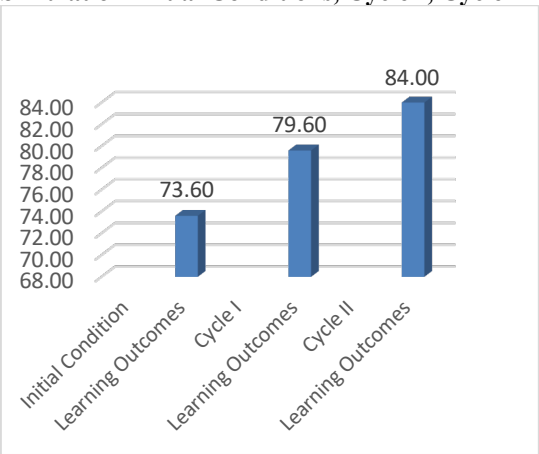

Figure 2. Graph of the results of media action research on the STEM-Based Volcano Eruption Simulation Initial Conditions, Cycle I, Cycle II

CONCLUSION

Based on the results of this study, it can be concluded: the characteristics of media based on the STEM Volcano Eruption Simulation on the theme of Class I natural events to improve student learning outcomes is to use science and technology to solve problems in real life and be able to draw conclusions based on evidence so that it is created personally that is constructive, caring and reflective of nature and changes to nature as human activities in daily life. The use of Volcano Eruption Simulation media Based on the results of the learning process activities through the Si Eguapi media based on STEM (Science, Technology, Engineering, Mathematics), it is known that learning outcomes increase, as evidenced by student learning outcomes reaching the completeness level of Cycle I 79.60%, Cycle II 84, 00%.

On the other hand, the success of student learning is not necessarily only influenced by the learning media used by teachers in schools. In this regard, Jaakkola and Veermans found that learning outcomes seemed to be influenced by developmental factors. The study found significant interactions between classroom conditions and levels concerning learning outcomes, which showed that results generally improved as a function of class level, but there were important differences between conditions regarding improved outcomes in three classes (Jaakkola & Veermans, 2018). Another case with Jaakkola & Veermans, Sheehan, et al. showed that how the family environment has a role in learning science and mathematics. The research revealed that parents could indirectly influence their children's exposure to the STEM concept by influencing how often their children are exposed to television science and mathematics, applications, and computer games (Sheehan, Hightower, Lauricella, & Wartella, 2018). However, Sheehan et al. also stated that further research was needed to understand the nature of children's exposure to the media, including what scientific and mathematical content children

face and how parents interact with their children around STEM media. Therefore, for further research, maximum peer planning and discussion are needed so that the application of STEM-based learning can be successful. Jaakkola and Verman reinforce this by suggesting that caution is needed when designing learning in elementary school students (Jaakkola & Veermans, 2018).

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