Mathematics, Informatics, Science and Education International Conference (MISEIC)

PREFACE

The Mathematics, Informatics, Science and Education International Conference (MISEIC) 2017 is organized by Universitas Negeri Surabaya is motivated to bridge the scientists, education experts and practicioners, and students in the scientific forum through sharing ideas and issues about theoretical and practical knowledge in mathematics, informatics, science and education. This seminar will be held on September 9, 2017 and will take place in Surabaya, Indonesia. The theme for this conference is "Building Togetherness for The Upcoming Challenges in Mathematics, Informatics, Science, and Education". Thus, this conference has aims: (1) to bring together the scientists, engineers, researchers and practitioners, students, and civil society organization representatives in the scientific forum. (2) To share and to discuss theoretical and practical knowledge about innovation in applied science and engineering.

This conference hosted by the Universitas Negeri Surabaya is considered to accommodate discussion among researchers in the field of mathematics, informatics, science and education as a scientific forum. Therefore, the invited speakers in this conference are expert in the field of mathematics, informatics, science and education.

The MISEIC 2017 took place in Surabaya, Indonesia, on 9 September 2017 involving more than 300 papers are participated from various topics including pure and applied mathematics, science and technology innovation, computer science, and innovation in mathematics, science, and computer science education. There are 75 selected papers that go through a strict peer reviewed process, and these papers will be published in the present conference proceedings.

We would like to thank the organizing committee and the members of reviewers for their kind assistance in reviewing the papers. We would also extend our best gratitude to keynote speakers for their invaluable contribution and worthwhile ideas shared in the conference.

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as Presenter of a paper entitled

Improving The Science Process Skills and Concept Mastery for Primary School Students through Learning Based on 5E Instructional Model

in Mathematics, Informatics, Science, and Education
International Conference
"Building Togetherness for The Upcoming Challenges in Mathematics, Informatics, Science, and Education"

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Improving Science Process Skills for Primary School Students Through 5E Instructional Model-Based Learning

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Improving Science Process Skills for Primary School Students Through 5E Instructional Model-Based Learning

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Abstract. The main objective of this study is to describe the effectiveness of 5E instructional model-based learning to improve primary school students' science process skills. The science process skills is important for students as it is the foundation for enhancing the mastery of concepts and thinking skills needed in the 21st century. The design of this study was experimental involving one group pre-test and post-test design. The result of this study shows that (1) the implementation of learning in both of classes, IVA and IVB, show that the percentage of learning implementation increased which indicates a better quality of learning and (2) the percentage of students' science process skills test results on the aspects of observing, formulating hypotheses, determining variable, interpreting data and communicating increased as well.

1. Introduction

In this 21st century, the graduates are expected to have double skills of current competence. The four important skills trained by the teacher to the students are 4C (Critical thinking and problem-solving, Communication, Collaboration, Creativity and Innovation) [1]. In science subject, the four skills are integrated to the science process skills. The science process skills can equip students' thinking skills [2]. The basic science process skills consist of observing (calculating, measuring, classifying, finding relationship of space/time), hypothesizing, planning the experiment, controlling variables, interpreting data, drawing conclusions (inference), predicting, applying, and communicating [3].

When viewed from the skills that are included into science process skills, it is clear that the science process skills are important in science learning as the basis for improving the other thinking skills which are much more complex such as 4C that has been explained before. It is also supported by Aydinli (2011) which states that teachers should pay great attention to students' science process skills by providing hands-on activities' task oriented to improve their understanding of a science concept [4]. The science subjects in primary school is less meaningful if it is taught through lecturing method in which teacher actuvely gives information to the students. The curriculum has ordered that the learning process must be actively build concepts that learning is done by the students themselves and the process can be reinforced by a scientific approach. Natural science is a kind of knowledge that has special characteristics to learn the factual of natural phenomena, both events and causal relationships. Natural science is a subject in primary school that encourages students to have knowledge, ideas and concepts that are organized. Thise knowledge, ideas, and concepts are related to the natural surroundings, obtained from experience through a series of scientific processes such as investigation, preparation and

presentation of ideas. The scope of natural science materials in the primary school generally covers two aspects, namely scientific work and concept mastery.

The learning process done by students who are actively seeking and finding their own natural science's concepts can certainly not be separated from the science process skills that they have. Students need the science process skills in their activities to find the right science concepts. Science process skills become the driving wheel of discovery and development of facts and concepts as well as the growth and the development of attitudes and values [3]. Students who are active in learning science through the use of process skills, discussions, and experiments, gain more meaningful learning and dispel perceptions of rote learning [5].

The expectations, which are conveyed by various experts, are not in line with the facts occurred in the field. Students do not understand correctly the essence of formulating hypotheses and correlations between variables [6]. Students are still wondering when they should formulate hypotheses and they do not know the reason of doing that. Moreover, they are unable to understand the correlation between the dependent and independent variables [6]. Science process skills are not only about formulating hypotheses and determining variables but also involving other skills such as observing, interpreting data, and communicating that are trained in this study. Science process skills can not be considered as an insignificant thing in science learning. Students need to be familiarized with the science process skills since primary school in order to obtain the correct concepts and to make other high-level thinking skills continues to increase. The higher the students' science process skills, the better the students' conception status (Knowing the Concept) [7].

The low science process skills score of elementary students is an urgent problem to be solved. If it continues, then students cannot improve the other skills that are needed in their life later on. Students need to be facilitated in the learning process that allows them to explore what they want to know freely and actively. The 5E (Engagement, Exploration, Explanation, Elaboration, Evaluation) learning model provides a suitable learning phase for improving the science process skills [8]. The reason of choosing the model is because the 5E instructional model contains structured activities starting from the preparation or agreement in which the initial concept of the students is known. The starting point is then followed by an exploratory phase in which the students perform activities to look for evidence through experiment and at the same time their science process skills are trained in this phase. In the explanatory phase, students explain, in their own language, the results they gain through presentations and discussions. In the elaboration phase, students apply the concept to new issues. In the evaluation phase, students' final abilities are revealed through tests [8]. The constructivist learning of 5E instructional models have a better impact than traditional teaching models [9]. The 5E instructional model-based learning with various methods such as conceptual change, POE (Predict-Observed-Explain), cartoon concept, and animation can improve the concept mastery of students [10]. The integration of science activities with 5E instructional model may cause cognitive conflict that leads the students to try to solve the science problem by using their thinking skills [11].

2. Method

This type of research is a pre-experimental study. The subjects of this research were two classes of 4th graders, class IVA and IVB at SD Negeri 1 Menganti, Gresik. The research design used was One Group Pre-test and Post-test Design:

$$O_1^a \qquad X^b \qquad O_2^c$$

(a) O_1 = Pre-test, (b) X= 5E instructional model-based learning, (c) O_2 = Post-test

The percentage of the learning implementation was obtained by dividing the number of aspects that were implemented in the learning with the total of aspects multiplied by 100%. The percentage of students' science process skills was obtained by dividing the total score with maximum score multiplied by 100%. The pre-test and post-test scores of science process skills were employed to find the difference

by using paired sample t-test. The test was done to be able to determine whether there are significant differences in the science process skills' test results, before and after learning process.

3. Results

3.1 The Implementation of Learning

The implementation of learning is observed by two observers. The lessons were conducted in three meetings. In addition, the lessons obtained a very good percentage. The learning outcomes can be seen in Table 1 and Table 2.

Table 1. Percentage of the Implementation of Using 5E Instructional Model-based Learning in Class IVA

Meeting	Result	
	Implemented (%)	Not Implemented (%)
1	87.50	12.50
2	91.67	8.33
3	95.83	4.17

Based on Table 1 it can be seen that the percentage of learning implementation increases which indicates a better quality of learning.

Table 2. Percentage of the Implementation of Using 5E Instructional Model-based Learning in Class IVB

Meeting	Result	
	Implemented (%)	Not Implemented (%)
1	86,96	13,04
2	95,65	7,35
3	100	0

Based on Table 2 it can be seen that the percentage of learning implementation increases which indicates the quality of learning is getting better as well as what occurs in the class IVA.

3.2 Students' Science Process Skills

The tests of science process skills are conducted twice, before treatment (pre-test) and after treatment (post-test). The difference of those test results can be seen in Figure 1 and Figure 2.

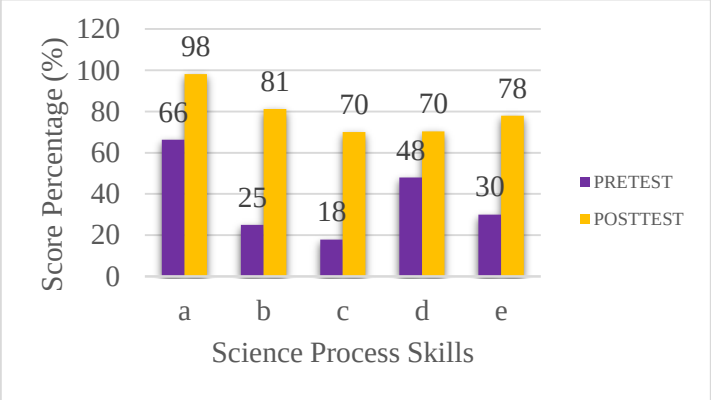

Figure 1. Test Result of Science Process Skills in Class IVA. (a) Observing. (b) Formulating hypotheses. (c) Determining variables. (d) Interpreting data. (e) Communicating.

Based on Figure 1, it can be seen that the percentage of science process skills' score increases from pre-test to post-test in class IVA. In addition, the pre-test average score is 35.25 and the post-test one is 78.10. The post-test average score is better than the pretest one. Based on the result of the t-test, the t-value is -44.361 and it is revealed that the t-table value is 2.093. The value of t-arithmetic is in rejection area H_0. Hence, it can be concluded that there are significant difference of students' science process skill between before and after the treatment involved in learning.

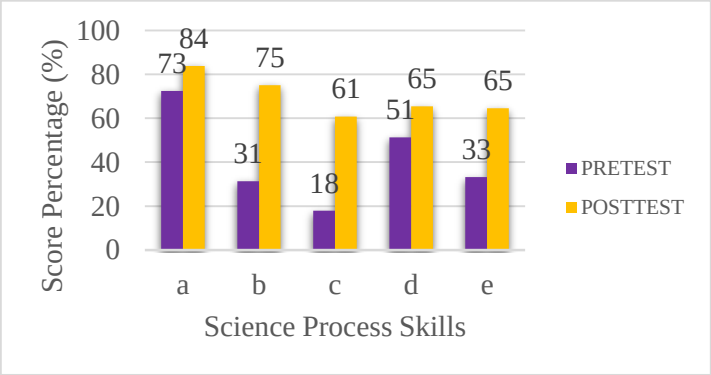

Figure 2. Test Result of Science Process Skills in Class IVB. (a) Observing. (b) Formulating hypotheses. (c) Determining variables. (d) Interpreting data. (e) Communicating.

Based on Figure 2, it can be seen that the percentage of science process skills' score increases from pre-test to post-test in class IVB. The pre-test average score is 38.75 and the post-test one is 80.15. The post-test average score is better than the pretest one. Based on the result of t-test, the t-value is -49.225. In addition, it is also revealed that the t-table value is 2.093. The value of t-arithmetic is in the rejection area H_0. Hence, it can be concluded that there are significant difference of students' science process skill between before and after the treatment.

4. Discussion

Through the results of this study, it can be seen that the percentage of learning implementation increases which indicates better quality of learning both in the class IVA and IVB. It is because the teacher has been given a briefing and training on how to implement the learning based on 5E instructional model. There is no obstacle that occurs, therefore, the teachers can carry out the learning well. The students also

look enthusiastic in following the learning process because it provides a fun and enjoyable learning. Students' interests in learning also increases which leads to improvement of students' motivation in learning science [12].

The increase of the percentage of students' science process skills' test results occurred because students were already trained to use science process skills such as observing scientifically, formulating hypotheses, determining variables, interpreting data, and communicating experimental results in the elaboration phase. Moreover, the teacher also gives an example of how to formulate the hypothesis and determine the variables first which then followed and imitated by the students. The science process skills such as observing, interpreting data, and communicating were done by the students so that it only needs to be observed and clarified if there is an error. In brief, the 5E instructional model-based learning successfully enriches the students' knowledge and improves the science process skills [13].

5. Conclusion

Based on the results of the study, it can be concluded that 5E instructional model-based learning is effective to improve students' science process skills seen from the improvement of students' test results.

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References

[1] Griffin P 2015 *Assessment and Teaching of 21st Century Skills: Methods and Aprroach* (London: Springer)
[2] Bloom Benjamin S et al 1956 *Taxonomy of Educational Objective: The Classification of Educational Golas Handbook I Cognitive Domain.* (New York: Longmans, Green and Co)
[3] Semiawan C 1992 *Pendekatan Keterampilan Proses: Bagaimana Mengaktifkan Siswa dalam Belajar* (Jakarta: PT Gramedia Widiasarana Indonesia)
[4] Aydinli E Dokme, Unlua Z K, Ozturk N, Demir and Benli E 2011 *Procedia Social & Behavioral Sciences* **15** 3469-3475
[5] Harlen W and Elstgeest 1994 *Unesco Sourcebook for Science in Primary School* (Paris: Unesco Publishing)
[6] Darus F dan Saat R M 2014 *The Malaysian Online Journal of Educational Science* **2** pp 20-26
[7] Choirunnisa, N L and Suyono 2014 *Unesa Journal of Chemical Education* **3** 153-160
[8] Bybee R W, Taylor J A, Gardner A, Scotter P V, Powell J C Westbrook A, and Landes N 2006 *The BSCS 5E Instructional Model: Origins and Effectiveness* (Colorado: Colorado Spring)
[9] Alshehri M A 2016 *IOSR Journal of Research and Method in Education* **6** 43-48
[10] Cepni S and Sahin C 2012 *Eurasian Jounal of Physics and Chemistry Education* **4** 97-127
[11] Lin J L, Cheng M F, Chang Y C, Ying-Chi, Hsiao-Wen Chang J Y, Lin D M 2014 *Eurasia Journal of Mathematics* **10** 415-426
[12] Nur M 1998 *Teori-Teori Perkembangan* (Surabaya: Unesa University Press)
[13] Karsli F and Ayas A 2014 *Procedia-Social and Behavioral Sciences* **143** 663-668