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# Improving Basic Science Process Skills Through Inquiry-Based Approach in Learning Science for Early Elementary Students

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## ABSTRACT

The aim of the study was to examine the improvement of basic science process skills among second graders in science learning through an inquiry-based approach. The participants were 23 students from a second graders class. Participants were with the age around seven years old. The 5E model of inquiry-based approach was used to teach science. Mixed method approach used in the study. The qualitative data were collected through classroom observation, teacher interviews, and students' works. The quantitative data were collected from performance tests measured by using a rating scale instrument. The improvement of basic science process skills were examined through descriptive statistic and t-tests. The study showed that the basic science process skills improved after the intervention of learning. The study also revealed the factors contributed to the inquiry-based approach of science learning to develop the basic science process skills, such as the use of worksheets, singing a song, and the interactions with both peers and teacher.

**Keywords:** Science process skills, inquiry-based approach, 5E model, science teaching, early elementary

## INTRODUCTION

Teaching science to young children is important. Science provides children opportunities to grow their innate curiosity and discover about the natural world. By learning science, children can strengthen their problem-solving skills (Carin, Bass, & Contant, 2005). It also contributes to developing a positive attitude toward science. Since the attitudes begin to grow at an early age, it could affect later success in learning science (Eshach, 2006). Children's ability to explore their direct surroundings can strengthen their attitude and skills which contribute to the children becoming lifelong learners (Brunton & Thornton, 2010).

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Science education, especially practical activities, are suggested to be included in the early childhood education program (Mirzaie, Hamidi, & Anaraki, 2009).

Science learning has three major aspects; a body of knowledge, a method or process and a way of knowing. Science as a body of knowledge refers to science products such as information, concepts, and facts. Science also involves a set of methods or processes. The method is the process in which a body of knowledge is produced. In the method or process, students learn how to do science through exploration by observing, classifying objects, measuring and so on. Furthermore, science also is as a way of knowing (Bell, 2008; Rezba, Sprague, McDonnough, & Matkins, 2007). Learning how to do science is more beneficial for children than learning the facts, concepts, and theories (Martin, 2009).

Science process skills are physical and mental skills to collect information and organize them in several ways. These skills can be used in predicting and explaining phenomena, and solving problem (Carin et al., 2005). The science process skills are used to process new information in concrete learning. They also can build new concepts and new understandings of science (Charlesworth & Lind, 2010). Science process skills are the skills that scientists use in their study (Bentley, Ebert II, & Ebert, 2007; Martin, 2009). There are two categories of science process skills; basic process, and integrated process. The basic science process skills include observing, classifying, measuring, inferring, predicting, and communicating (Bentley et al., 2007; Martin, 2009). The integrated science process skills involve identifying and controlling variable, formulating and testing hypothesis, interpreting data, defining operationally, experimenting, and constructing models (Martin, 2009).

Observation is a process to collect information about the world using senses (Carin et al., 2005; Charlesworth & Lind, 2010; Morrison, 2012). Observation is the first step in collecting information and the only way to gain knowledge about the world (Charlesworth & Lind, 2010). Children observe using their senses to perceive objects, events, properties and behavior (Bentley et al., 2007). During observing the objects, they practice using various senses such as sound, sight, smell, touch, and taste (Charlesworth & Lind, 2010; Martin, 2009; Rezba et al., 2007). Children can also use instruments to support their senses during observation, such as using magnifying glasses, telescope, and microphones (Carin et al, 2005).

Observation skill is the core of science learning (Jackman, 2012; Martin, 2009) and often considered being the most significant skill of science process (Charlesworth & Lind, 2010; Johnston, 2005). Therefore, it is the most crucial scientific skill to be developed in elementary schools. Children need to practice this skill appropriately to make learning experiences stored in their long-term memory. Thus it will be better for children to create a connection with the new things they explore (Martin, 2009).

From observations, students can proceed to the process of comparing and classifying objects (Jackman, 2012). Classification skill is the process of grouping objects or events into categories based on characters or properties of objects or events (Bentley et al., 2007). Classification skill is very useful in organizing information in science (Carin et al., 2005). Children learn classification by grouping and sorting real objects. They can sort the objects based on their observation. Students can initially group objects by one feature. For example, they can sort objects based on color, size, or shape (Charlesworth & Lind, 2010). Students can strengthen the ability to classify objects with practice and appropriate coaching (Bentley et al., 2007).

Measuring is an act of doing quantitative observations. Measuring can be accomplished by comparing an object, event or other phenomena with a standard or a non-standard unit (Hammerman, 2006). During an activity, the children use quantities or number to describe objects or events (Bentley et al., 2007). Children can use measurements to enhance the description, prediction, and explanation of phenomena (Carin et al, 2005). Children can learn

basic measurements such as length, volume, weight, temperature and time. They can measure using standard units and non-standard or conventional units (Martin, 2009).

Mastering the science process skills is important for future understanding in science and these skills are beneficial in daily life for solving problems as well (Charlesworth & Lind, 2010). Initial learning is a base for students to develop more understanding of science process and problem solving in later education (Aka, Güven, & Aydoğdu, 2010). The science process skills help students to understand phenomena, answer questions, develop theories and discover information (Martin, 2009). They are essential in developing ideas (Harlen & Qualter, 2004) and they increase academic achievement in science learning (Aktamis & Ergin, 2008). Özgelen's (2012) study shows that science process skills are related to cognitive development. These skills are correlated with the skills of logical thinking (Ismail & Jusoh, 2001). Another study shows that the skills performance of children is related to several factors such as gender, grade level, economic background, mother's educational background, and the number of the family (Aydinli et al., 2011; Dökme & Aydinli, 2009).

In Indonesia at lower grades of elementary school, science learning is integrated into other disciplines such as language within thematic learning and science is not implemented as a separate discipline. Nevertheless, science is still considered being important learning at early elementary schools. Schools apply thematic learning and some themes are very relevant to science. However, since science is generally integrated with language learning, science process skills do not develop adequately. Thus, science learning has been focused more on the aspect of the body of knowledge. In other words, students learn more science concepts, facts, and information by reading textbooks rather than doing science as a process. Furthermore, a preliminary observation in a private elementary school shows that a majority of students at second graders has a relatively low level of basic science process skills.

Children need to learn and develop the science process skills by practicing them in science learning. Teachers should master the science process skills and teaching strategies to help students to develop these skills (Ango, 2002). Science learning plan should include practicing science process skills to ensure the students obtaining the skills. A study implied that without planning of lesson and guidance, students might not develop the science process skills (Rauf, Rasul, Mansor, Othman, & Lyndon, 2013). Instruction to develop science process skills should also support the learning about the nature of science (Huber & Moore, 2001). Therefore, practicing the skills can be applied in science learning through an investigation of nature or material.

Inquiry is a process to find information by asking questions (Bentley et al., 2007) and a scientific process in exploration. Learning through inquiry involves asking questions, conducting investigations and collecting data. During an active exploration, students use critical, logical and creative thinking (Llewellyn, 2002). There are two main aspects of science learning through inquiry; asking questions and seeking answers through data analysis (Bell, 2008). Learning through the inquiry-based approach involves children in exploration activities which leads them to ask questions, test the ideas, and discover the answer (Ansbery & Morgan, 2007).

Children can build their potential by strengthening their scientific idea through inquiry investigation (Blake, 2009). Scientific inquiry means incorporating science process with other aspects such as scientific reasoning, scientific knowledge and critical thinking (Lederman, Lederman, & Antink, 2013). Duran and Dökme's study (2016) reveals that inquiry-based learning affects students' critical thinking significantly. Another study also reveals that students who are taught through an inquiry-based approach have higher academic achievement than those who are taught traditionally (Abdi, 2014; Aktamiş, Hiğde, & Özden, 2016). An inquiry-based project also increases the student's interest in science learning (Akinoglu, 2008). Students enjoy more learning through inquiry-based science than

traditional science learning (Suduc, Bizoi, & Gorghiu, 2015). Moreover, students who learn science through 5E model of inquiry-based approach have a positive attitude toward the subject of science (Ergýn, Kanli, & Ünsal, 2008).

Rezba, Auldridge, and Rhea (1999), (as cited in Bell, Smetana, & Binns, 2005) developed different levels of inquiry learning, such as confirmation, structured inquiry, guided inquiry, and open inquiry. In confirmation level, students confirm the principle they have learned by following given question and procedures. In structured inquiry level, the teacher provides question and procedures, and students follow these procedures to find the answer. In guided inquiry level, students use their own procedures to answer the teacher's questions. Open inquiry is the highest level which students design the procedures to answer their own question. Students can begin with the low level and gradually develop to a higher level of inquiry (Bell et al., 2005).

One of the models of inquiry-based approach of science learning is 5E. The 5E model follows constructivist theory (Chitman-Booker & Kopp, 2013). The 5E model consists of 5 phases; engagement, exploration, explanation, elaboration, and evaluation (Ansberry & Morgan, 2007; Carin et al., 2005; Chitman-Booker & Kopp, 2013). Learning starts with the engagement phase which supposes to generate the students' interest. At this stage, a question for investigation is raised. Students then proceed to the exploration phase, where they plan and carry out the investigation to collect evidence for answering the question. During this phase, students learn through activities as a concrete experience. Explanation phase happens when students construct their scientific explanation. At this stage, students attempt to answer the initial question. During the elaboration phase, students apply new knowledge in another situation. Finally, the evaluation phase occurs as the student's new knowledge and new understanding are evaluated (Carin et al., 2005). The 5E model can be implemented as a cycle or as a linear process (Ansberry & Morgan, 2007).

A study shows that inquiry-based learning can improve the science process skills among fifth graders (Şimşek & Kabapınar, 2010). Another study reveals that inquiry-based learning can enhance science process skills among fourth, fifth and sixth grades (10-12 age group) (Ergül et al., 2011). An inquiry-based approach enhances the science process skill among secondary school students (Athuman, 2017). Previous research studied secondary and higher grades of elementary school students. This study will examine lower graders who are still in the age range of early childhood. The aim of the study is to examine the improvement of basic science process skills among second graders through inquiry-based approach in science learning. In line with this aim, two research questions were addressed: (1) Is there an improvement of the basic science process skills among second graders in science learning through inquiry-based approach? (2) How factors affect inquiry-based science learning in improving the basic science process skills?

The importance of the study as follows: (1) The study can contribute to planning and implementing inquiry-based approach of science learning to increase the basic science process skills, especially in early elementary students. (2) The study can contribute in finding out the improvements of the basic science process skills through the inquiry-based approach in science learning (3) The study describes factors contributing to the inquiry-based approach to improve the basic science process skills.

## METHODS

The study used mixed methods. Since the objective of the study is to improve basic science process skills, the action research method was employed in this study. Action research can be carried out with both qualitative and quantitative method (Mertler, 2017). Action research is a cyclic process. In each cycle, there were stages of (i) plan, (ii) act and

observe, (iii) reflect (Kemmis & Mc Taggard, 1988). The main purpose of action research is to improve educational practice. The action research is a constructive inquiry. By doing each step of the action research such as planning, acting, and evaluating, researcher constructs his or her knowledge about the particular issue (Koshy, 2010). As the intervention, each cycle consisted of 10 lessons using inquiry-based approach of science learning. The inquiry model of 5E was implemented during learning activities. The beginning of the research we focused on how to plan and implement science learning through the inquiry-based approach to increase basic science process skills for early elementary students. By using action research method, researchers collaborated with the classroom teacher to gain practical knowledge and a better understanding of the learning process. Then for better achievement results, we modified the instruction along the intervention based on reflection of the learning process.

The first part of the research was to examine the improvement of basic science process skills in learning science through the inquiry-based approach. Quantitative research approach was employed in this part of the study. The results between pre-test and post-test were compared. The significance of the improvement of the science process skills was analyzed using t-test. A descriptive qualitative approach was used in the second part of the study. The factors supporting the inquiry-based approach to improve basic science process skills were determined.

### a) Participants

The study was carried out in an elementary school. The school was located in a suburban region of Jakarta metropolitan city. Participants were 23 second grade students aged around seven years old. 15 students were male and seven students were female.

### b) Data Collection Techniques and Data Analysis

For the qualitative part of this study, data were collected by taking field notes through observation, students worksheets and classroom teacher interviews. These qualitative data were analyzed which followed to three main steps; data reduction, data display and conclusion drawing (Miles & Huberman, 1994).

For the quantitative part of this study, a rating scale of performance instrument was developed for the assessment of the basic science process skills for second graders based on the literature. To establish content validity, the items of the instrument were given to four faculty members. Two of the faculty members were from early childhood education and the other two were from science education. All faculty members were asked to judge the appropriateness of each item and its relevance to the skills being measured. Each item of instruments was refined based on the faculty members' feedback. This instrument of performance tasks was used to assess the skill of observation, classification, and measurements for second graders in elementary school. Each performance task involved hands-on activities and they were applied to the students individually. The individual total scores of the result were categorized into four levels for the skill as shown in Table 1, and each level was represented by a grade (A, B, C, D).

**Table 1**. *Grades and performance levels of the science process skills base on ranges of scores*

| Score Range | Grade | Performance level |
|---|---|---|
| 82 - 100 | A | Advanced |
| 64 - 81 | B | Proficient |
| 45 - 63 | C | Developing |
| $\leq$ 44 | D | Beginning |

The science process skills were assessed before and after the intervention of each cycle of this action research. The enhancement of the skills was analyzed through descriptive statistic which was presented data by charts of the students' skills grade before and after the implementation of the learning. Moreover, the significance of improvement of science process skills was analyzed using t-tests of the scores from pre-test and post-test. SPSS software was used to do the paired t-test analysis.

In this study, the minimum-passing criterion was established in accordance to the school standard. The students were acknowledged to meet the minimum criterion of the average score of overall science process skills acquired was $\geq$ 78. The implementation of learning was considered successful when the majority of students (e.g. $\geq$70%) in the class had obtained the score of the minimum criterion of mastery learning.

### c) Research Procedures

#### *The planning*

Science learning through structured inquiry-based approach was planned before the implementation. In this structured inquiry-based approach, a question and procedures for finding solutions were prepared by the teacher. The plan was based on the inquiry-based learning model of 5E which has the stages of engagement, exploration, explanation, elaboration, and evaluation. Relevant activities that involve basic science process skills were integrated into the exploration phase of learning. Since the school applied thematic learning, science activities had been planned based on relevant themes to science. The activities were integrated into four themes: (1) Playing in My Neighborhood, (2) Water, Earth, and Sun, (3) Caring for Animals and Plants, (4) I and My School. There were 10 lessons planned for each cycle and these were implemented as simple scientific investigations.

There were three kinds of investigations prepared for learning activities such as a simple experiment, descriptive or classificatory investigation. To develop observation skill, the objects or materials for the descriptive investigation were selected based on their properties. The objects should be representative to support children in using various senses. It should also support a quantitative observation such as counting seeds, flowers, and petals. In classification activities, choosing objects for hands-on activities was based on difference shape, color, and size. Those three basic characters were familiar in the daily life of young children. A collection of leaves, buttons, and pebbles were prepared for children to learn classification. To develop measuring skill, simple investigations were designed that involve measurements such as length and temperatures. Some measurements were integrated into observation skills activities. Thus, the children could learn to measure some objects they had observed.

Furthermore, worksheets were developed to help the students using the basic science process skills. The worksheets were provided as simple instructions written in easy language and relevant illustrations for young students. The worksheets were developed to guide the students in doing the investigation involving basic science process skills. Since students used to learn by reading textbooks, using worksheets while exploring through hands-on activities helped to move from expository learner to be more inquiry learner.

#### *The implementation*

Inquiry-based approach was implemented using the 5E model. The model has phases of engagement, exploration, explanation, elaboration, and evaluation. The purpose of the engagement phase was to generate the students' interest. The teacher began this phase by asking questions. These questions were not only relevant to the thematic topic but also to

students' daily activities. These questions would direct the students to a short discussion. The discussion allowed the teacher to find out what students already know. The teacher could explain the new knowledge that students needed. Furthermore, the inquiry question was raised by the teacher which leads the students to explore and find the answer.

Exploration was the phase when the students explore the objects to find the solution or answer. Explanation phase occurred when students formulated their answer. In these two phases, the students worked in small groups, explored the objects together with their peers and give the answers. They practiced exploring objects appropriately by following simple instruction on the worksheets. However, sometimes the teacher had to explain or demonstrate how to use the basic science process skills when students needed. While doing exploration, the students discussed the answers within their group. Furthermore, they filled out the worksheets given individually. In this study, generally, the elaboration phase did not occur in the same activity or lesson. Thus, new knowledge or skills might be elaborated to the next lessons. Moreover, the achievement of the skills was evaluated through the students' performance and worksheets. During the implementation of science learning, the learning process was observed and these observations resulted in data for the qualitative study.

Finally, the whole learning process of the first cycle was reflected and the students' achievement of the basic science process skills was evaluated. The implementation of learning was considered successful when a majority of the class had obtained the score of the minimum criterion of mastery learning established by the school. When the implementation of learning was not successful in the first cycle, the second cycle was proceeded. Based on the reflection of the whole learning process of the first cycle, the instruction to be implemented for the second cycle could be revised for better achievement.

During the second cycle, the implementation of inquiry-based learning of the 5E model was continued within thematic learning. However, the use of detailed worksheets was minimized to allow the students to work more independently in employing the science process skills. A special song with lyrics about observation skill was prepared. Students practiced singing for a few days before the investigation. By singing the song, the students were encouraged to use observation skill appropriately.

## FINDINGS

### a) The Improvement of the Basic Science Process Skills

Pre and post-tests of the performance assessment scores were used for quantitative data analysis. Pre-tests applied before the implementation of the first cycle and posts test applied after the implementation of the second cycle. The total individual scores of the skills were categorized to the four levels of the skills; advanced, proficient, developing, and beginning and these levels were represented as grade A, B, C, or D.

#### *Pre-test results*

Pre-test results of the assessment of basic science process skills showed that majority of students achieved grade C or D. That means some students had the performance level of developing the skills, while other students were still in the beginning level. There was a small portion of students achieved grade B - proficient performance- for both observation and classification skill (see Figure 1).

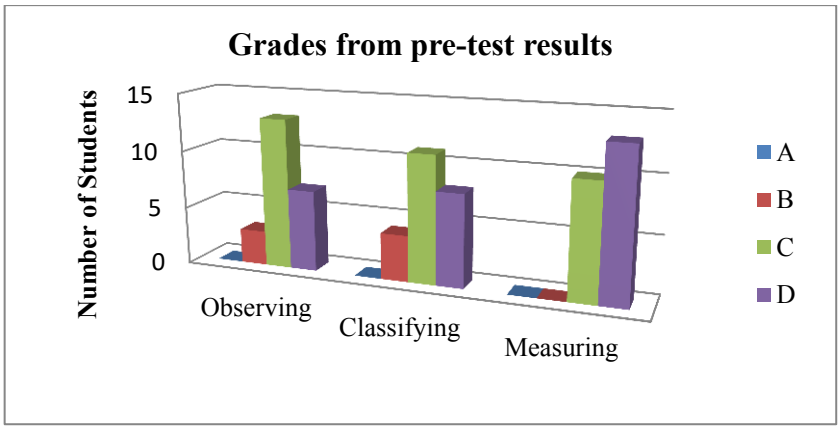


***Figure 1.*** Grades from pre-test results

***Post-test results for the first cycle***

The post-test results of the first cycle revealed that majority of students achieved grade B for all basic science process skills. Thus, the students achieved the proficient level of performance. However, for the observation skill, there were also many students obtaining grade A - an advanced level of performance (see Figure 2).

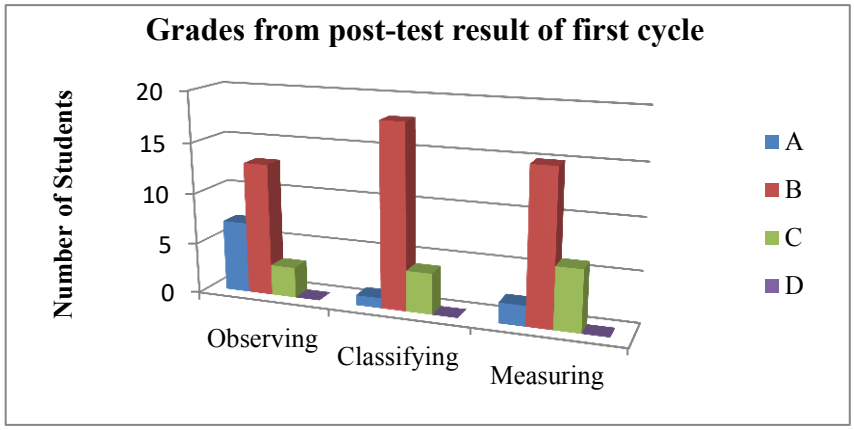


***Figure 2***. Grades from post-test results of the first cycle

The minimum criterion of the score for mastery learning of was $\geq$ 78 based on the standard established by the school. Data showed that the majority of students did not meet the minimum standard for the basic science process skills. The percentage of the students meet the minimum criterion is presented in Table 2.

**Table 2.** *Percentage of students meeting the minimum passing criterion in the first cycle.*

| Science Process Skills | % |
|---|---|
| Observation | 39% |
| Classification | 35% |
| Measuring | 26% |
| Mean | 33% |

***Post-test results for the second cycle***

The post-test results showed that majority of students achieved grade A. Results revealed that students obtained the advanced level of performance. However, many students also obtained grade B - in the proficient level of performance (see Figure 3).

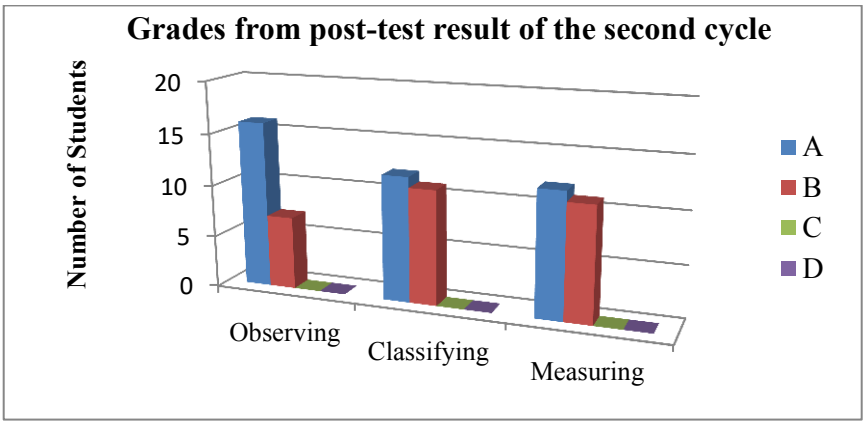


***Figure 3***. Grades from post-test results of the second cycle

The data also showed that, in the post-tests, majority of the students reached the scores of ≥ 78 which was the minimum standard for the passing criterion. The percentage of the class member reach the minimum standard for each skill is presented in Table 3.

**Table 3.** *Percentage of students meeting the minimum passing criterion in the second cycle*

| Science Process Skills | % |
|---|---|
| Observation | 82 |
| Classification | 96 |
| Measurement | 100 |
| Mean | 93 |

***The significance of improvement of the basic science process skills***

The improvement of the basic science process skills was examined through paired t-tests of the scores results of the assessments of pre and post-tests of inquiry-based science learning. Data showed that there was a significant improvement between pre and post-test for observation, classification and measurement skills (see Table 4).

**Table 4.** *The t-test of pre and post measurements of science process skills*

| Skills | Variable | N | Mean | Sd | Sig |
|---|---|---|---|---|---|
| Observation | Pre-test | 23 | 54.2 | 13.2 | 0.00 |
| | Post-test | 23 | 87.6 | 9.2 | |
| Classification | Pre-test | 23 | 53.5 | 9.9 | 0.00 |
| | Post-test | 23 | 86.4 | 6.4 | |
| Measurement | Pre-test | 23 | 52.8 | 7.5 | 0.00 |
| | Post-test | 23 | 88.6 | 4.6 | |

### b) Factors Contributing to the Inquiry-Based Approach to Improve the Basic Science Process Skills

The second research question was how factors affect science learning through inquiry-based approach to improve the basic science process skills. In addition to science investigation using hands-on activities, there were several factors contributed to the inquiry-based approach to increase the basic science process skills. These factors included the using of worksheets, singing a special song, and interacting with both peers and teacher.

Students began to use basic science process skills by following simple written instruction on the worksheets during the first cycle of research. The worksheets were provided with relevant illustrations to ensure the students to use these skills. In observing the objects, students followed the written instruction to be able to use their various senses and to make quantitative observations. Students simply provide their short answers by filling out worksheets. Students also followed the written instruction to find out the difference and similarities between the objects. This enables them to enhance their classification skills. Similarly, they measured some objects they observed as it was directed on the worksheets.

Another important factor which helped the students to improve observation skill was the use of a song. In the second cycle, the students were provided with a song with lyrics about observing objects properly. By singing the song before doing science investigation, students were encouraged to use various senses and make quantitative observations. Some of the students also sang the song during the investigation when they needed to recall the procedures. Thus, students were able to practice the skill more independently without written guidance.

The study revealed that students learned basic science process skills through interaction among their peers during the investigation. Since the students carried out investigation within small groups, they could learn from working cooperatively with each other. For example, a student told his friend how to observe a plant's characters. He showed his friend how to rub the leaf surface. Another student asked her friend to smell an object. Thus, she encouraged her friend to use various senses during observation. Some students also learn by observing their friend while the friend was employing the skills. For example, a student saw his friend counting the number of leaves for quantitative observation, then he did the same thing.

During the investigation, some students learned practicing basic science process skills from the teacher. In addition to the using of structured inquiry-based approach, students learn the skills through a confirmation level of inquiry. Students gained new knowledge about how to observe, classify and measure the objects through a demonstration and explanation from the teacher. For example, sometimes students asked the teacher to show how to classify certain objects. The classifying skill depends on the characters of objects being sorted. Some students can group certain objects more easily than other objects. For example, it easier for young students to classify a collection of buttons rather than a collection of leaves. Thus, to classify a more complex collection of objects, the students need more help from the teacher.

## DISCUSSION and CONCLUSION

This study revealed that science learning through the inquiry-based approach improved science process skills of second graders who were the age within the early childhood. The basic science process skills were increased gradually through the first cycle and the second cycle of the research. The total score of the skills improved as well as the scores for each individual skill such as observing, classifying and measuring. Thus, the results of this study support the previous study conducted in Turkey that an inquiry-based approach improved science process skill of fourth, fifth and sixth grades (Ergül et al., (2011). Similarly, Simsek

and Kabapinar's study (2010), showed that fifth grade elementary students' science process skills were enhanced by using the inquiry-based approach.

This action research had been undertaken within two cycles. The school established standards for mastery learning. The minimum criterion for mastery learning was 78. Data showed that only 33 % of students achieved the minimum score in post-test after the first cycle. Therefore it was assumed that the first cycle of the learning was not successful. During the first cycle, students were able to use science process skills, however, they still need the written guidance on the worksheets to follow. They did not use the skills spontaneously, especially in using observation skill. In observing the objects, some students did not use various senses or make quantitative observations. In classification, majority of students were able to find the differences and similarities between the objects. Some students could classify a collection of simple objects such as buttons. However, they were not able to do the classification of certain objects such as a collection of leaves. Therefore, they needed more practicing classification skill for various objects. These might be the reasons for the low achievement for some students' science process skills during the first cycle. For all of the science process skills, the majority of students did not meet the minimum standard for the passing criterion of the score $\geq$ 78 during the first cycle. Therefore, the action research was continued to the second cycle.

In the second cycle of the research, students continued practicing the skills through the 5E model of inquiry-based approach. After the second cycle of the study, data showed that 93% of the students reached the minimum criteria of the score $\geq$ 78. Therefore, the results showed that the intervention of inquiry-based science learning was successful after the second cycle of the implementation. During the second cycle, the use of detailed worksheets was greatly reduced so the students were able to work more independently. Students practiced observation skill by singing a special song. In the second cycle, the students also practiced doing more classifying. Additionally, they already have got the skill to find the difference and similarities of the objects. Similarly, students practiced measuring and that make them master in applying unit of measurements. There were total 20 lessons in the two cycles of this study. These lessons enabled students to practice basic science process skills regularly. As a result, this study indicated that the second graders need a quite long time to improve the basic science process skills gradually.

This study also revealed how second grade students improve the basic science process skills in science learning through the inquiry-based approach. Students used the skills in the phase of exploration of the inquiry-based model of 5E. They were involved in the exploring science's hands-on activities. Results showed that young students enjoy hands-on activities. According to Çimer, (2007) many researchers suggested that students should be actively involved in the learning activities for effective science learning. Hands-on activities are important during the investigation in inquiry-based learning to improve students' attitude toward science learning (Koç & Böyük, 2012). In this study, planning the investigation and choosing material for hands-on activities were very important factors. This study revealed that investigation types and materials need to be relevant for hands-on activities to develop each aspect of the science process skills. Moreover, the students learned using the skills as a concrete practical experience through scientific investigations. A study by Alkan (2016) showed that experiential learning was effective to enhance academic achievement and scientific process skills.

This study revealed both worksheets and singing the song had an important role in mastering the basic science process skills. In the first cycle, students carried out their investigation by following written instruction on the worksheets. The students were able to follow the instructions on the worksheets as these instructions were provided with simple language and illustrations. During this study, some students seemed to be passively involved

in working in their small group. According to Choo, Rotgans, Yew, & Schmidt (2011), passive learners could be depending more on the worksheet to guide them than involved in small group learning opportunities. Although the students learn with guidance using worksheets, students need to be involved in science learning for several lessons. Thus, students practiced applying basic science process skills through regular practices. These practices allowed students to develop their habit of using the science process skills. A study from Turkey by Aktamis and Ergin (2008) used students' worksheets of science process skills to enhance their science achievement.

In the second cycle, the students worked without using the worksheets. A song about observation was provided students to help them using observation skill. They had the opportunity to sing the song when they need. This study indicated that the song also strengthened the manner of the students to use observation skill in science learning through inquiry-based approach. Students seemed to enjoy exploring the objects while they sing to recall the procedures of how to observe appropriately. This result also supports the previous study by Governor, Hall, and Jackson, (2013) that song can be used as a mnemonic device to help students to learn science.

In accordance with the lessons plan, this study applied a structured inquiry-based approach to science learning. However, during the learning process, sometimes the teacher also needed to explain some concepts and demonstrate how to investigate and find the answer. Thus, some students learn through a confirmation level of the inquiry-based approach. According to Rezba, Auldridge, and Rhea (1999), (as cited in Bell et al., 2005), there are four levels of inquiry learning; confirmation, structured inquiry, guided inquiry, and open inquiry. This study revealed second grade elementary students can investigate at the level of structured inquiry. However, in a certain situation, students learned through the level of confirmation of the inquiry-based approach. Thus, the second grade elementary students also learned science process skills through a lower to higher level of inquiry. In addition to the inquiry, the teacher also explained some concepts to help students to understand lessons better. This study indicated that various teaching approaches support to improve the basic science process skills. Although during the study, the learning was implemented mainly through structured inquiry-based approach, the teacher also used other approaches in certain situations. A previous study revealed that the use of various teaching approaches in a single lesson could create more opportunities to develop science process skills (Rauf et al., 2013).

This study proved that science learning through the inquiry-based approach improved the basic science process skills for second graders. The students practiced using basic science process skills mainly through structured inquiry activities of the 5E learning model. The study also showed that some factors considered contributing to the inquiry-based approach in science learning. In addition to hands-on activities, the students employed the basic science process skills by following simple written instruction on the worksheets. The students also used a song as a tool to recall the procedures of observation skill. Student interaction with their teacher and peers were other aspects that affected to improve the science process skills. Various teaching approaches such as demonstration and explanation can also contribute to improving the basic science process skills.

This study can have practical implications for early elementary science teachers. The important implication of this study is a teacher can use an inquiry-based approach to improve basic science process skills for second graders in early elementary school. For students who are usually taught with an expository approach, the teacher can start with a structured inquiry. However, in a certain condition, a confirmation level of inquiry may be also needed. Bell and his colleagues (2005) suggested scaffolding the inquiry gradually from the lower to higher level. This study also had an implication that young students need time to spontaneously apply basic science process skills. The study showed that the majority of young students used

mainly the sense of sight during observation. Therefore, hands-on activities should focus on to strengthen other appropriate senses such as smell, touch, sound, and taste when it is possible. Another implication is the teacher can use simple worksheets and a song to promote the basic science process skills for early elementary school students.

**Suggestion**

Science learning through the inquiry-based approach can be applied to the regular program to improve basic science process skills for second graders. This study was limited to the second graders in elementary school. Therefore, similar future studies may also use an inquiry-based approach for first graders or younger children. Since the learning approach used in this research was mainly the structured inquiry of the 5E model, future studies may employ other levels of inquiry.

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