Scientific Approach to Enhance Students' Science Process Skills

Ramlawati[1], Muh Tawil[1], Rismayani[1], Ratnawaty Mamin[1], and Rifda Nur Hikmahwati Arif[1]

[1]Universitas Negeri Makassar

Abstract. The purpose of this research is to improve the students' science process skills (SPS) by application of scientific approach in natural science teaching. The research method is quasi experiment by using non-equivalent control group design. The population consists of 9 classes with the number of students 321 people grade VII at SMP Negeri 1 Bajeng Gowa District in 2015/2016 academic year. The sample of research was conducted by purposive random sampling. The instrument is a SPS test. The four SPS indicators that were assessed are observing, grouping or classifying, inference, and communicating Based on descriptive data analysis results show that the N-gain score of experiment class is 0.52 is higher than control class is N-gain 0.41. Both N-gain in medium category. The result of inferential analysis show that there is an influence of scientific approach to students' SPS in grade VII at SMP Negeri 1 Bajeng Gowa District.

Keywords: Scientific Approaches, Science Process Skills

1. Introduction

The science learning process in junior high school is dominantly oriented to the learning outcomes so that it is less importance of science process skill. One of the causes of low science process skill is in the learning process still centered on the teacher centered, which in the learning process using the conventional approach.

In accordance with [1] statement that explains that science is a way of thinking, a way of conducting an investigation, a collection of knowledge, and interaction with technology and social. In [2] mentions science is a learning that done by the students not something done to the students. Furthermore, the science learning process should be done in accordance to the nature of science that the learning should be done by the students, not something that done to the students [3]. Based on the statement above it can be concluded that learning science is a learning that requires the students to be active in the learning process, starting from the way of thinking, how to investigate, how to collect the information, how to conclude the invention, how to communicate the findings, and how to connect the discovery with technological advances in Community.

The nature of science as a whole as a process, as product, and as an application. To be able to fully understand, the learners must have the skills of the science process skills. In addition, the learners are also expected to gain a challenging and meaningful learning experience so as to master the facts and

/the concepts [4] therefore the students are required to focus on the science process skills. Scientific process skills are defined as skills that can be transferred to many applied sciences and they reflect the behavior of the scientist [5]. The science process skill includes skills that everyone can use in every step of his daily life scientifically and improve the quality of living standards by applying the nature of science, hence these skills affect the life of the individual, social, and global. Scientific process skills are a necessary tool for creating, and using scientific information, to display scientific research, and to solve the problems [6]. So it can be said that the science process skill is the skill commonly done by scientists to gain the knowledge, do the research, solve the problems, and produce the product and can be applied in everyday life.

Scientific process skills are essential to teaching the knowledge of science content and scientific inquiry [7]. Teaching science process skills also encourage positive attitudes toward science among to the students [8]. The indicators on the skills of the process of science are observing, grouping, concluding, and communicating [9].

 Scientific process skills are essential in education. This is because these skills are useful in solving problems encountered in everyday life. In addition, these skills can provide students with the ability to formulate their own concepts and how to learn a finding, develop the ability of learners, help concrete thinking, and develop the creativity of learners. Based on the understanding views above can be seen that the science process skills of learners will be able to find and understand the concept of the material that be taught [10].

Empirical facts at SMP Negeri 1 Bajeng, the science process skills of learners especially on science subjects in the academic year 2014-2015 are not assessed, for the reason that educators are still difficult in elaborating a suitable approach to assessing the science process skills. Science learning should be done scientifically so that learners are expected to gain a challenging experience learning and meaningful learning to master the facts and concepts. In addition, natural science learning is also scientifically able to train the learners to learn activities in observing, grouping, concluding, and communicating.

Based on the results of research conducted by [11] known that the scientific approach is an approach that can improve learning outcomes and process skills. Therefore, to help the learners fulfill the process skills in the field of science, it is necessary to try out a learning approach that enables them to understand the subject matter well. A workable approach is the scientific approach. By using this approach, the theory that is obtained can be applied maximally in the field.

Learning by scientific approach is a learning process designed in such a way that learners actively construct the concepts, the laws or principles through the stages of observing, questioning, collecting information managing information, communicating [12]

The material to be used in this research is the classification towards living things. The material classification towards living things is one of the materials that be taught to students of VII grade. The author selected this material as a study in this research because this material requires an immediate experience to be able to understand. The learning that be used in this research is a scientific approach, which there will require many activities of learners and train the science process skills.

The purpose of this study is to identify; (1) To identify the amount of the improvement of the science process skills of learners after being taught by using a scientific approach. (2) To identify the extent of improvement of the science process skills of learners after being taught by using a conventional approach. (3) To identify the effect of science process skill between groups of learners that are taught by using a scientific approach and group of learners that are taught by using conventional learning model.

Student activities in learning using a scientific approach in the 2013 curriculum are as follows; (1) To observe: observing activities is to prioritize meaningful learning process. The advantage of this activity is to present the real object media, in order learners are happy and challenged, and easy to implement. In learning in the classroom, observing can be done through various media that can be observed learners, for example: video, picture, etc .. Observing activities in learning is done by taking steps such as the following; (a) To determine what object to observe (b) To create an observation guide according to the scope of the object to be observed (c) To determine clearly what data needs to be observed, both primary and secondary (d) To determine where to place the object to be observed (e) To determine clearly how the observations will be done to collect data to run easily and accordingly (f) To determine the way and recording the observation results, such as using notebooks, cameras, tape recorders, video recorders, and other stationeries. (2) Questioning is a process of constructing knowledge of concepts, principles and procedures through group discussions or class discussions. In the questioning activities, learners develop oral and written skills in formulating questions, from simple and short questions to complex and critical questions. To encourage effective and efficient outcomes the process of questioning in the discussion should be prepared by the teacher, there are: the objectives and outcomes of the activities are clearly defined; Procedure and time allocation of discussion is determined; If a discussion sheet is available; Given sufficient appreciation to learners who actively participate. (3) Gathering information: this activity is a process to strengthen factual, conceptual, and procedural understanding through the direct activity of collecting data. (4) Processing information or associating: associating or reasoning is a high-level thinking activity on data gained through trying activities to be. Included in the category of association is to systematically presents data, sorting, grouping, linking, formulating, concluding and interpreting. Associating activities can be designed using experimental worksheets in order that to be more guided and directed in accordance with the goals and objectives of learning. In the project and product task generally do not require a worksheet because learners are more free in creating and innovating. (5) Communicating the final result of a learning activity in which learners are able to express their attitudes, knowledge, and skills in the form of spoken, written, or relevant works. This activity is a means to learners used to speak, write, or make certain work to convey ideas / ideas, experiences, and impressions etc including by involving emotions and idealism. To reduce time constraints, especially when the form of presentation activities is used, teachers should schedule effectively by dividing the role and time allocation of activities in one semester / year, so that each learner gets a proportional opportunity [12].

Learning model used in learning with scientific approach is model of discovery learning. In the learning process, the teacher acts as a mentor by providing opportunities for learners to learn actively and independently, as the opinion of teachers should be able to guide and direct the learning activities of learners in accordance with the purpose. This condition can change the orientation center of the educator into the center of orientation in the learners [13]

According to [14], the impact of discovery-oriented learning activities are; (1) Can develop the intellectual potential of learners because one can only learn and develop his mind if using his intellectual potential to think. (2) Students can learn the heuristics (manage messages or information) of the discovery, meaning that the way to learn invention techniques is to provide students with the opportunity to conduct their own research. (3) May cause long-lasting memory to be internalized in the learner.

[15] stated that the process of learning procedures that must be implemented from the model of discovery learning is generally as follows; (1) providing Stimulation. At this stage, the teacher can present a problem that contains a description of a problem. Without being given a generalization, learners are able to have a desire to find their own solutions to the problem. The simulation at this stage serves to provide a learning interaction condition that can develop and help learners to explore materials. (2) Identification of problems. Teachers provide opportunities to learners to identify relevant and flexible issues to solve. The problems that have been chosen must then be formulated in

the form of a hypothesis which is a question (statement) as a temporary answer to the question posted by the teacher. (3) Data collection. At this stage, the teacher provides the learner with the opportunity to gather relevant information, read the literature, do the self-test, and so on in order to prove whether true or not the hypothesis that has been proposed. At this stage also, the learners can learn actively and independently studying to find solutions to the problems encountered. (4) Data processing. Data processing is an activity to process data and information that have been obtained by students through interviews, observations, etc. Furthermore, the data is interpreted, processed, randomized, classified, tabulated, and can also be calculated in a certain way and interpreted at a certain level of confidence. Data processing also serves as the formation of concepts and generalizations. From these generalizations, the learners will gain new knowledge about alternative answers or solutions that must be verified logically. (5) Proof. At this stage, learners do a careful examination to prove whether true or not the hypothesis that has been established with the findings of alternatives associated with the results of data processing.

Based on the science education literation view as a process, in the current science learning process skills are used. The approach of science process skills can be defined as an insight or development of intellectual, social, and physical skills derived from abilities that are principally based in the learners. The indicators of science process skills is listed in Table 1 [16].

Table. 1 Indicator of Science Process Skills [17]

Scientific Process Skills Indicators	Description
Observing qualities	Using the five senses. Using words to describe what is seen, felt, heard, smelled, and (if appropriate) tasted. Notice details. Break things into parts. Name and describe the parts. Draw what you see and label parts of the drawing.
Measuring quantities	Using numbers to describe an object, for example by counting parts, measuring different parts with a ruler, weighing with a scale or balance, and comparing objects using quantities (Eg. 2 apples weigh the same as 1 mango).
Sorting and classifying	Make up categories and group things by breaking them down. (Eg. These are all buttons. Now I will put in a group buttons that are red. Now in that group I will separate buttons that are red with 2 holes and buttons that are red with 3 holes, etc.)
Inference	What are your assumptions? I assume this is an insect because it has six legs, and when I've seen insects before they have six legs. What have you seen before that reminds you of this? Why do you think that's going to happen?
Predicting	What's going to happen? If I do this, this will happen… How will we find out what will happen? What are we going to do to find out what happens?
Experimenting	I wonder what will happen if we do this? I predict that this will happen. What do I have to do to find out if I'm right or wrong? What materials will I need? What steps will I take (procedure)? What needs to happen for my prediction to be right? How will I know if I'm wrong? How will I measure it? Was my prediction right? If so, why? If not, why not?
Communicating	Sharing ideas through talking and listening, drawing and labeling pictures, drawing and labeling graphs and acting things out.

Science learning in schools can apply scientific methods by familiarizing students with scientific work. Introducing learners on a problem to seek solutions, can motivate learners to do scientific work by applying scientific method. The formulation of scientific method are to observe on the surrounding environment, formulate problems from the observation, formulate a hypothesis which is a temporary answer of the problems encountered, then to design an experiment to hypothesis test and implement experiments to obtain data, then experimental data is analyzed finally draws conclusion design from proving the hypothesis [18].

2. Research Methods
This type of research is a quasi-experimental with non-equivalent control design. The population in this

study is the students of grade VII at SMP Negeri 1 Bajeng in 2015/2016 academic year. The population consists of 9 classes with the number of students 321 people. The sample of research was conducted by purposive sampling which the technique of determining the sample was taken based on the average value of the learning result of the two classes. The average value of the second class learning result is 81. The experimental class in this study is VII.C class while the control class is VII.H Class with the number of learners each 30 people.

The data analysis in this research include: Descriptive Analysis and Inferential Analysis. This descriptive analysis is used to examine at the mean, standard deviation, the highest value and the lowest value. While inferential analysis is used to analyze the improvement of pretest and posttest science process skills that are taught using a scientific approach and conventional approach using the N-gain formula. Before calculating the N-gain, the hypothesis (t-test) should be tested first. However in the hypothesis test there is a prerequisite test. Prerequisite test consists of normality test (Chi-squared) and homogeneity test (Barlet-Test).

3. Result And Discussion

2.1 The result of descriptive analysis

The result of descriptive analysis show the description about scores of science process skills in learners of each research group. The results obtained on pretest and posttest by the experimental class learners and control class from this study are presented in Table 2.

Table 2. Score of students' Science Process Skills

Data	Experiment Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Number of samples	30	30	30	30
The lowest score	5	45	5	47
Highest score	90	100	92	95
Average score	44	82	43	68
Standard deviation	21	16	22	20
Variance	441	256	484	400

The improvement percentage increase in the experimental and control class science process skill indicators is listed in Table 3.

Table 3. Increasing of each science process skills indicator

Indicators of science process skills	Score increase (%)	
	Experimental Class	Control Class
Observe	35.9	41.8
Grouping	33.5	26.1
Conclude	20.5	12.4
Communicate	76.9	40.0

The experimental and control class N-gain results is shown seen in Table 4.

Table 4. N-gain results

Number	Class	N	Average
1	Experimental	30	0.52
2	Control	30	0.41

2.2 The result of inferential analysis

Inferential analysis was performed to test the hypothesis using t-test. Prior to hypothesis testing, a prerequisite test (normality test and homogeneity test) variance of the data of both groups should be conducted. Hypothesis testing

Table 7 Test Results-t skills of experimental and control class science processes

Experiment and control class data	t_{table}	t_{count}
	2,00	16,6

Based on the result of the analysis of the average population estimation of the students' science process skills in the experimental class that is the implementation of teaching by using scientific applied to the population class, the average score of the population is around 77 to 87.

2.3Discussion

Based on the results of the descriptive analysis, it is shown the students' science process skills taught by using scientific approach are slightly better than those taught without using scientific approaches. This is because learners in experimental classes that taught by scientific approach can construct their own knowledge, while in control class learners tend to wait for information delivery from teachers. The result of improvement in science process skills indicators at observation activities were 35.9%, grouping 33.5%, concluding 20.5%, and communicating 76.9%. Mean while the improvement in the science process skills indicators in the control classes were 41.8%, 26.1%, 12.4%, and 40.0% respectively. This is because the learners in experimental classes taught by scientific approach can construct their own knowledge, while in control class learners tend to wait for information delivery from teachers. The results of the science process skills test show that the percentage of learners in the experimental class is much higher than the control class.

To reinforce the descriptive analysis, an inferential analysis has been conducted to demonstrate an improvement in science process skill in experimental class and control class. The data were obtained from hypothesis test using t-test, prerequisite test was done before hypothesis test. They are normality test and homogeneity test. The test of normality (Chi-Square Test) to indicate that the two groups had normal distribution and homogeneity test proved that the process skill score between the two classes (experiments and controls) obtained from the normal distribution population while homogeneity test (Bartlet Test) to prove that experimental classes Control class has the same or homogeneous variance.

The results of inferential analysis showed that science process skill improvement experimental class and control class. N-gain results in experimental classes and control classes are in the medium category. Although both classes are in the middle category but the average experimental class is higher than the mean of the control class. Before calculating N-gain, at the first step make ui hypothesis.

Prerequisite test is conducted first before hypothesis testing. The normality test states that the experimental class and the control class have normal distribution while the homogeneity test results indicate that the experimental class and control class have the same or homogeneous variance. The result of the hypothesis test is rejected H0 and H1 is acceptable concluded that there is a difference between experimental classes taught by using scientific approach and control class taught using conventional approach. The average estimation results obtained an average of $77 \leq \mu \leq 87$. This indicates that if treatment in the experimental class is the implementation of learning using a scientific approach applied to the population, the average score of the population obtained is around 77 to 87 .

It is also supported by [19] which claimed that the use of scientific approaches has a positive influence in improving science process skills. In addition, [11] stated that there are differences in learning outcomes and science process skills among learners who follow the learning of scientific approaches againts learners that follows the direct learning.

Theoretically, the study of scientific approaches highly emphasizes learners as a center of learning (student centered). [12] stated that learning with a scientific approach is a learning process designed in such a way that learners actively construct concepts, laws or principles through observing stages, asking, collecting information, managing information / associating / concluding, and communicating.

In accordance to teaching and learning centered, the learners is expected to think that learning science is a

collection of knowledge gained from scientific inquiry. Scientific learning activities can also improve science process skills. Meanwhile the science process skills indicator consists of observing, grouping, summarizing, and communicating the learning experience. [19] indicates that skills are influenced by how much learning experience is received by the learners. The results of the Hernawati's research [20] also found that is a learning process using scientific approach gave relatively good results. However, the observing, reasoning, and communicating activities in scientific approach need detailed emphasis during the learning process. The learning habit using the scientific approach could improve the students' ability both cooperatively and collaboratively.

Based on the description above, it can be suggested that the use of scientific approach can improve the students science process skills.

4. Conclusion

Based on the results of research and discussion it can be concluded as follows; (1) Science process skills of grade VII students at SMP Negeri 1 Bajeng in science teaching by using scientific approach on subject of classification towards living creatures are in the medium category. (2) Science process skills of grade VII students at SMP Negeri 1 Bajeng in science teaching by using the conventional approach on the subject of the classification towards living things are in the medium category. (3) There is an influence of scientific approach to students' science process skill in science teaching of grade VII at SMP Negeri 1 Bajeng study on the subject matter towards classification of living creatures.

5. References

[1]   Koballa, & Chiapetta. 2010. Science Instruction in the Middle and Secondary Schools.Pearson: USA.

[2]   NSTA. 2003. Standards for Science Teacher Preparation. Revised 2003.

[3]   Hastuti. 2015. Achievement of Scientific Literacy Through Inquiry Based Learning In Science. Implementation And Education of Mathematics And Sciences. Universitas Negeri Yogyakarta: Yogyakarta.

[4]   Maharani. T. N. A. 2014. Peningkatan hasil belajar IPA melalui model pembelajaran inkuiri pada konsep gaya. Universitas Islam Negeri Syarif Hidayatullah. Skripsi

[5]   Raj, R. G., & Devi, S. N., 2013. Science Process Skills and Achievement in Science Among High School Students. School Research Journal for Interdisciplinary Studies. ISSN 2278-8808. Institute of Advanced Study in Education: India.

[6]   Aktamis, H., & Ergin O. 2008. The Effect Scientific Process Skills Education on Students' Scientific Creativity, Science Attitudes And Academic Achievements. Asia-Pacific Forum on Science Learning and Teaching. Volume 9, Issue 1, Article 4, p.1 University of Dokuz Eylul: Turkey.

[7]   Cain, S. 2002. Sciencing. (4th ed). Upper Saddle River, NJ: Pearson Education

[8]   Bilgin, I (2006). The Effects of Hands-On Activities Incorporating a Cooperative Learning Approach on Eighth Grade Students' Science Process Skills And Attitudes Toward Science. J. Baltic Sci. Educ. 1:27-36.

        Syafitri Winda. 2010. Analisis keterampilan proses sains melalui pendekatan inkuiri pada konsep system koloid. Fakultas Ilmu Tarbiah dan keguruan UIN Syarif Hidayatullah. Skripsi

[10]   Hasanah. 2014. Analisis keterampilan proses sains siswa kelas XI pada pembelajaran system laju reaksi menggunakan Model Problem Solving. Universitas Islam Negeri Syarif Hidayatullah. Skripsi

[11]   Marjan, J., Arnyana P. I. B., Setiawan N. I. G. A. 2014. Pengaruh pembelajaran pendekatan saintifik terhadap hasil belajara biologi dan keterampilan proses sains siswa MA Mu'allimat NM Pancor Selong Kabupaten Lombok Timur Nusa Tenggara Barat. Jurnal program pascasarjana Universitas Pendidikan Ganesha Singaraja, Volume 4 tahun 2014.

[12]   Fauzan, M. 2014. Pendekatan Saintifik dalam Pembelajaran Pendidikan Agama Islam. Widya Iswara Balai Diklat: Bandung.

[13]   Sardiman, A.M. 2005. Interaksi dan Motivasi Belajar Mengajar. Jakarta: Rajawali Press.

        Uno, Hamzah B. dan Nurdin Mohamad. 2011. Belajar dengan Pendekatan PAIKEM. Jakarta: PT Bumi Aksara.

[15]   Kurniasih, I. dan Sani, B. 2014. Sukses Mengimplementasikan Kurikulum 2013. Yogyakarta:

Kata Pena.\

[16] Tawil dan Liliasari. 2014. Keterampilan-keterampilan sains dan implementasi dalam pembelajaran IPA. Badan penerbit universitas negeri Makassar : Makassar

[17] Vitti, D. & Torres, A. 2006. Practicing Science Process Skills at Home. Diakses pada http: http://static.nsta.org/connections/elementaryschool/200712TorresHandoutParentNSTAConn.pd f.

[18] Rahayu. P., S. Mylyani., S.S Miswadi. 2012. pengembangan pembelajaran IPA terpadu dengan menggunakan model pembelajaran problem based melalui lesson study.Jurnal pendidikan IPA Indonesia FMIPA Universitas Negeri Semarang. Volume 2, Nomor 1

[19] Purnama, T., Haris, A., Arsyad, M. 2015. Pengaruh pendekatan ilmiah dalam pembelajaran fisika terhadap keterampilan proses sains peserta didik kelas X SMAN 1 Marioriwawo Kabupaten Soppeng. Universitas Negeri Makassar. Jurnal Sains dan Pendidikan Fisika

[20]   Hernawati, D., Amin, M., Irawati, M. H., Indriwati, S.H, Omar, N. 2018. The Effectiveness Of Scientific Approach Using Encyclopedia As Learning Materials In Improving Students' Science Process Skills In Science. Jurnal Pendidikan IPA Indonesia. JPII 7 (3) (2018) 266-272.