Implementation of Learning Based on Scientific Approach to Improve Science Process Skills of Biology Education Students in General Biology Course

By Rahmi Susanti

Implementation of Learning Based on Scientific Approach to Improve Science Process Skills of Biology Education Students in General Biology Course

R Susanti[1,2], Y Anwar[1], Ermayanti[1]
[1] Biology Education, Universitas Sriwijaya, Indonesia
[2] mamahabnur@yahoo.co.id

Abstract. The purpose of this research is to know the science process skills of biology education students through learning based on scientific approach. The study involved 42 students from Biology Education of Sriwijaya University that enrolled in general biology course. The research used pre-experimental method with one group pretest-postest design. Collecting data using a written test of 60 questions that consisting of 7 aspects of science process skill (observing, communicating, classifying, predicting, identifying variables, formulating hypothesis, and interpreting data). The data were analyzed with Kolmogorov-Smirnov test followed by Mann-Whitney test. The results showed that there was a significant improvement in the science process skills, with significance value of = 0,000 at α = 0,025. Improved science process skills in biology education students are included in the medium category, with an average of normalized gain (n-gain) = 0.41. The highest increase in science process skills on the communicating aspects (n-gain = 0.65) and the lowest on predicting aspects (n-gain = 0.17). Based on the results of this study indicates that learning based on scientific approaches can improve the science process skills of Sriwijaya University Biology Education students in general biology course.

1. Introduction

One of the national standards of higher education regulated in the regulations of the minister of research, technology and higher education Number 44 of 2015 is learning process standard. The learning process standard is a minimum criterion regarding the implementation of learning in the study program, which has characteristics, namely: interactive, holistic, integrative, scientific, contextual, and student-centered. Scientific learning is the achievement of graduate learning achieved through a learning process that prioritizes a scientific approach.

Learning using a scientific approach is not only done in universities, but also from elementary and secondary education. Learning in the 2013 curriculum is competency learning by strengthening the learning process to achieve competency in attitudes, knowledge and skills. Strengthening the learning process is done through a scientific approach. The scientific approach is a learning approach that encourages students to be better able to observe, ask, try/collect data, associate/reason, and communicate[1]. Learning based on a scientific approach is a way to develop attitudes, skills and knowledge that follow scientific methods with systematic stages.

Natural Sciences including biology is a branch of science that explores nature systematically. Thus, learning science is not just mastering knowledge in the form of facts, concepts, or principles, but also science is the process of systematic inquiry into nature, habits of thought, skills, and practices [2,3].

Science is the body of knowledge, method/inquiry, and how to know. With other requirements, science is how knowledge is developed (scientific inquiry). Scientific knowledge, at least in part, is based on natural observations (empirical), which involve explanation, imagination and creativity [4,5,6]

Active learning in biology learning shows that involve students actively in learning. Students describe an event, or a physical object, actively ask questions, explore knowledge, explain natural phenomena that occur around them, prove them through experimental activities, and communicate their conclusions. Active learning in biology involves physical and mental activities. Hands-on activities are not enough, students must also have thought experience [7]. The key to learning science is to carry out activities that involve the process of observing, predicting, and also explaining, and more important is connecting to the science process[8].

Science as a process is the steps taken to conduct an investigation to find an explanation of natural symptoms. The step is to formulate the problem, formulate hypotheses, design experiments, collect data, analyze and finally draw conclusions[7,9]. Scientific inquiry is a systematic approach that is used in an effort to answer the questions posed and draw conclusions [6].

Law, theory, concepts, and principles in science are only products of a series of scientific investigative processes. The beginning of scientific inquiry is curiosity about natural phenomena, then becomes a problem and question to find a solution through observation and experiment, until a conclusion is obtained. The process of scientific inquiry is packaged more systematically in the form of skills. Science learning is learning that requires students to be active, in a sense, physically and mentally active. This shows that learning involves two things, namely processes and skills [7].

One of the main skills that must be achieved in the curriculum for students is science process skills. This skill must be mastered in all fields of science, especially biology [10]. Science process skills are the main skills that must be achieved in science education if they are to become scientific educated people[10,11].

SPS are process-oriented learning approaches. Process skills involve cognitive or intellectual, manual and social skills[10]. Cognitive or intellectual skills are involved because by doing process skills students use their thoughts. SPS is grouped into two categories, namely basic and integrated science process skills [10]. Basic science process skills include: observing, communicating, measuring, classifying, concluding and predicting. Integrated science process skills include: identifying variables, formulating hypotheses, interpreting data, and conducting experiments. Basic science process skills are needed to carry out further skills and require higher thinking processes. Science process skills can be developed and emphasized since elementary school, and continued to high school and so on to college. Integrated science process skills are skills needed by students to design and conduct scientific investigations [12, 13].

In accordance with the description above, a study of the implementation of learning based on a scientific approach was carried out to improve the science process skills of prospective teacher students through general biology courses. Reseach purposes is to find out how the influence of learning with the scientific approach to the complexity of the science process.

Reseach Method

The research method used is an experimental method with one group pretest postest design. In this design, before the treatment group was given a pretest, then after being given the posttest treatment [14]. The design used in this research is described as follows.

P_1 X P_2

P_1 = Pretest
X = Treatment
P_2 = Post test

Students involved in the study were 42 students of biology education 2017/2018 academic year from a university in South Sumatra Province as research subjects. The data were collected using multiple choice written test questions consisting of 60 questions. The problem of science process skills developed consists of seven aspects, namely: (a) observation, (b) communication, (c) classification, (d)

prediction, (e) identifying variables, (f) formulating hypotheses, and (g) interpreting data. Pretest and posttest score data were analyzed by statistics. Normality test uses Kolmogorov-Smirnov test followed by Mann-Whitney test. Improved science process skills are determined using the n-gain formula [15].

$$\text{n-gain} = \frac{(\text{posttest score} - \text{pretest score})}{(\text{maximal score} - \text{pretest score})}$$

Improved science process skills are grouped into three categories: high category ($\geq$ 0.7), medium category ($0.3 <$ n-gain < 0.7), and low category (< 0.3).

3. Result and Discussion

The average pretest and posttest scores, on all aspects of science process skills (SPS) were not normally distributed, and after being analyzed using the Mann-Whitney test on all aspects of SPS showed significant results. The values of pretest, posttest, gain, n-gain and significance (Table 1)

Table 1 Pretest, posttest, gain, and n-gain value on some aspects of SPS

No	Aspects of SPS	Pretest	Posttest	P(sig)	Gain	N-gain	Category
1	Observing	56,99	73,81	0.000 (significance)	16,82	0,43	medium
2	Communicating	75,05	89,58	0.000 (significance)	14,54	0,65	medium
3	Classifying	70,13	80,95	0.000 (significance)	10,82	0,41	medium
4	Predicting	60,71	67,86	0.000 (significance)	7,14	0,17	low
5	Identifying Variable	59,52	76,19	0.000 (significance)	16,67	0,45	medium
6	Formulating hypotheses	69,39	80,95	0.000 (significance)	11,56	0,37	medium
7	Interpretating data	70,56	80,30	0.000 (significance)	9,74	0,38	medium
	average	**66,05**	**78,52**		**12,47**	**0,41**	medium

In accordance with the results presented in Table 1, it can be explained that the science process skills of students before learning (pretest) and after learning using the scientific approach (posttest) are significantly different. It can be concluded that science process skills can be improved through the implementation of scientific approach based learning. The SPS results of students have increased in all aspects with the medium category, except in the predicting aspects with low categories. The highest increase in SPS is in the SPS aspect of communication that is 0.65, and the lowest increase is the predicting aspect, which is 0.17.

The scientific approach cannot be separated from SPS. The stages in the scientific approach and SPS aspects are in some ways the same and interrelated. There are five main learning experiences in the scientific approach, namely: observing, asking, gathering information, associating, and communicating [1]. On the other hand, aspects of SPS include observation, communicate, measuring, make classification, concluding, predicting, identifying variables, hypotheses, data interpretion, and conducting experiments [12,13].

The activity of observing the scientific approach is to identify an object through the senses of sight (reading, listening), smell, listeners and touchers with or without tools [1]. The observation process can be done through environmental observation, watching videos, observing images, reading tables and graphs of data, analyzing maps, reading books, listening to the radio, listening to stories and searching for information in mass media or internet networks [16]. The activity of observing in science process

skills is the skill of observing all the properties of objects or substances carefully using the five senses[13].

The questioning activity was carried out to get information about things that were not understood when observing [1, 17, 18]. The learning experience of the question is very dependent on observing skills. Observing is very useful for the fulfillment of students' curiosity, so that the learning process has a high meaningfulness.In information gathering activities, students explore and collect information from various sources through various ways [19, 16]. Students must have an SPS to develop knowledge about the surrounding environment, and be able to use scientific methods and be scientific to solve the problems they face everyday[1]. Information gathering activities are closely related to aspects of communication process skills.

Associating or processing information is an activity to process information that has been collected. In associating activities students compare data obtained with known theories so that conclusions can be drawn and or important principles and concepts are discovered. Associating activities can be in the form of creating categories, determining relationships between data/categories, and concluding from the results of data analysis[18]. The aspect of SPS that is closely related to associating is concluded and interpreted. Communicating is the activity of conveying information obtained from observations or conclusions, Communicate either verbally, in writing or other media. In the scientific approach, students are given the opportunity to communicate what they have learned or found in the activity of seeking information, associating and finding patterns [20]. Almost all aspects of process skills can be developed from the experience of communicating. So that students can communicate, of course they have passed the previous learning experience starting from observing to consulting.

The SPS aspect predicts it to be included in the basic SPS, but to be able to predict it must have another SPS. Things that are done when predicting include using the senses to observe and collect data /information, pay attention to any pattern through classification, then make connections to your knowledge, and predict what you think will happen in the future based on these things[21]. Predicting is to state the results of future events based on the pattern of evidence [12]. Predicting is a reasoning statement based not only on what we observe but also on the mental model that we have built to explain what we observe. Observing, instructing and predicting skills are three interrelated thinking skills [13].

4. Conclusion

Implementation of general biology learning based on a scientific approach can improve science process skills in biology education students Those science process skills are: observing, communicating, classifying, predicting, identifying variables, formulating hypotheses, and interpreting data, with medium category, except predicting with a low category.

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