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International Conference on Biology and Applied Science (ICOBAS)

Malang, Indonesia • 13–14 March 2019

Editors • Romaidi, Didik Wahyudi, Retno Novvitasari Hery Daryono, Eriyanto Yusnawan and Akira Kikuchi

AIP Conference Proceedings

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Preface: International Conference on Biology and Applied Science (ICOBAS)

International Conference on Biology and Applied Science (ICOBAS) 2019 is a well-established scientific meeting that provides a scientific forum to contribute to biodiversity conservation and environmental protection especially in this 4 industrial revolution era. The conference has taken places at Sahid Montana 2 Hotel, 13-14 March 2019, and organized by the collaboration between Department of Biology, Faculty of Science and Technology, State Islamic University of Malang, Indonesia; Mukaishima Marine Laboratory, Graduate School of Science, Hiroshima University Japan; Faculty of Life and Environmental Science, Prefectural University of Hiroshima (PUH) Japan; Department of Biology, Chulalongkorn University, Thailand and Society for Biology Lecturer of Islamic Universities of Indonesia.

The objectives of the conference are to provide a scientific forum to contribute to biodiversity conservation and environmental protection, especially in this 4 industrial revolution era. In this forum, the scientist shared their knowledge and explored the opportunities for international collaboration from a range of disciplines in order to sustain our biosphere. The scopes of the conference include, but not limited to, the following topic areas: botany, zoology, ecology, biotechnology, biodiversity conservation, environmental protection and policy and biology education.

This conference not only included keynote and invited speakers, but also oral and poster presentation. As well, some satellite activities such as the use of microscope training, herpetofauna workshop were also performed in accordance with this conference. Even this conference is the first conference on Biology and Applied Science, but the number of attendants reached 260 researchers including several attendants from foreign countries, such as Thailand, Japan, and France.

These proceedings contain articles that were accepted for publication through the double review process. A total of 163 papers have been accepted for publication in this proceeding. Finally, we would like to express our deep gratitude to all committee members, keynote and invited speakers, anonymous reviewers, authors, sponsor and all who have contributed for the success of ICOBAS 2019.

Romaidi, Eriyanto Yusnawan, Akira Kikuchi, Didik Wahyudi, Retno Novvitasari Hery Daryono
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MATERIAL SCIENCE

BIOLOGY EDUCATION

Integrating Local Resources into Inquiry-based Teaching Materials to Training Students' Science Process Skills

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Abstract. Students in learning, especially in biology subject, can use local resources. This research focuses on training student process skills (SPS) using inquiry-based teaching material that integrates local resources. Furthermore, this study employed an experimental study using post-test only control design. As many as 185 students were involved as the sample. They were divided into two groups, namely the experimental group (88 students) and control group (97 students). The data were collected using the SPS test. These data were further analyzed using a t-test. The results show that $P < 0.05$, meaning that the integration of local resources in an inquiry-based teaching material can help students' SPS training. Considering this result, teachers are able to incorporate local resources (from the environment) in teaching material to help students practice SPS

INTRODUCTION

Science process skills (henceforth SPS) refer to skills that promote and facilitate students in understanding science. Furthermore, these skills also function to improve the students' engagement in learning and cultivate their curiosity. It is revealed that the effect size of SPS on students in Indonesia is low compared to those in the USA and Thailand [1]. This blames the fact that the learning process is yet to focus on SPS. The learning of natural science subjects in Indonesia tends to focus on memorizing concepts of the lesson [2]. In the biology subject, specifically in the senior high level, teachers dominate all the processes [3]. The teachers explain all the material while the students take notes on every important material from the teachers [4]. Some studies have revealed that conventional learning has some drawbacks, such as hindering students' learning by which it contributes to the failure of the students in a subject [5]. This suggests a necessity to shift the learning paradigm from the conventional to creative and innovative learning. The issues of implementing conventional learning can be addressed if the teaching and learning process focuses on processes, particularly the students' skills in natural sciences learning.

This suggests a necessity to shift the learning paradigm from the conventional to creative and innovative learning. The issues of implementing conventional learning can be addressed if the teaching and learning process focuses on processes, particularly the students' skills in natural sciences learning [6]. The studies suggest adapting inquiry learning in biology subject where the subject contains some abstract concepts. Some research reveals that inquiry learning influences the SPS of the students. This type of learning has a positive impact on the students' SPS [7-11]. Jauhar points out that the purpose of the inquiry learning is to train the students' science competencies, e.g., formulating a question, proposing hypotheses, collecting and analyzing data, as well as summing up a conclusion [12].

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Moreover, the issues of the students' lack of understanding abstract and complex concepts can be tackled by the inquiry learning [13]. The above discussion suggests the advantage of inquiry learning in teaching a group and in improving students' SPS.

Collecting data through investigating a natural phenomenon to explain the proof is embedded in the inquiry learning [14]. It is suggested to implement this learning model in the future [15], to develop the SPS [1]. This is because the inquiry learning cultivates the students' motivation in learning biology-enabling the students to observe biological object directly and discussing in a group [16]. Science education, such as biology, demands certain skills, such as formulating hypotheses, manipulation, and reasoning skills [17]. The implementation of SPS in learning is aimed at attaining particular goals and conceptualizing a learning process that drives the students' potential [18]. SPS has been among the variables or focuses on biology. In addition, some research on developing students' SPS has also been conducted. The research suggests adopting inquiry learning. The above discussion shows the importance of inquiry learning in cultivating students' motivation in learning as well as practising their reasoning skills.

Some studies reveal the success of implementing inquiry learning to improve students' SPS. Some of the examples are the study by Susilawati and Sridana with the average result of 64.3 [19], Audityo, Hairida and Rasmawan with the result of 68.22 [20], and Sitompul and Sirait with the average result of 66 [21]. Another study by Dewi and Atun focuses on two (2) indicators of SPS, i.e., observation and communication [22]. With that being said, innovation in inquiry learning is needed to elevate the level of students' SPS. Expanding the measurement of SPS indicator is also essential. The use of local resources in an inquiry-based teaching material is considered innovation.

Integrating local resources in inquiry learning is able to enhance the students' performance and critical thinking skills [23]. Such integration allows the students to use, empower, and develop their potential [24]. The local potential encompasses facilities and infrastructure for the composter, various decorative plants in a greenhouse, and a fairly large yard with several tall plants [25]. All of the tools and materials used by the teachers are able to improve students' SPS [26]. The school environment can serve as a potential learning resource to discuss the topic of the ecosystem in grade X, senior high level [25]. Exploring the advantages of a local potential is able to be incorporated in the biology subject as it analyzes living things and how they interact with each other and the environment; this integration is considered unique to a curriculum [27]. The integration of local resources is able to motivate students in learning [28]. Considering the significance of inquiry learning in previous studies, this present study focuses on addressing the issues of students' SPS skills through the implementation of inquiry learning. Integrating local resources into an inquiry-based teaching material is the objective of polishing students' SPS.

EXPERIMENTAL DETAILS

This present study employed an experimental study using post-test only control design [29]. As many as 185 students were involved as the sample. They were divided into two groups, namely the experimental group (88 students) and control group (97 students). These students were from a senior high school in Manokwari; they are all in grade X majoring in mathematics and natural sciences.

TABLE 1. Research design

Group	Treatment	Post-test
Experimental group	X	O_1
Control group		O_2

Note: O_1: the post-test result of SPS of students who were taught using inquiry-based teaching materials with the integration of local resources; O_2: the post-test result of SPS of students who were taught by conventional teaching

Lesson plan, student worksheet, process skill test, and student book are the instruments of this research. These instruments are inquiry-based learning. Furthermore, three experts were involved as the validator of the instruments. The validation test reveals that the percentage of the above instruments are generally very valid with the percentage 97.69% (lesson plan), 93.52% (student worksheet), 86.90% (process skill test), and 87.01% (student book).

The data were analyzed using the percentage of the achievement of measured SPS indicator. Further, the normality test used Kolmogorov z test and the homogeneity test used a Levene test. An independent t-test was used to analyze the difference of the SPS post-test result of control and experimental group.

$$SPS = \frac{\text{Number score obtained}}{\text{Maximum score}} \text{ X } 100 \quad (1)$$

The students' SPS is considered very good if the score ranges from 80 - 100. Other categories are good (score 70 - 79), moderate (score 60 - 69), poor (score 40 - 59), and very poor (score 0 - 39) [3].

RESULT AND DISCUSSION

The result of this present study is a description of the achievement of each SPS indicator (see Fig. 1), the normality and homogeneity of the indicator (Table 2), mean of the SPS (Fig. 2) and the difference of the SPS test of control and experimental group (Table 3).

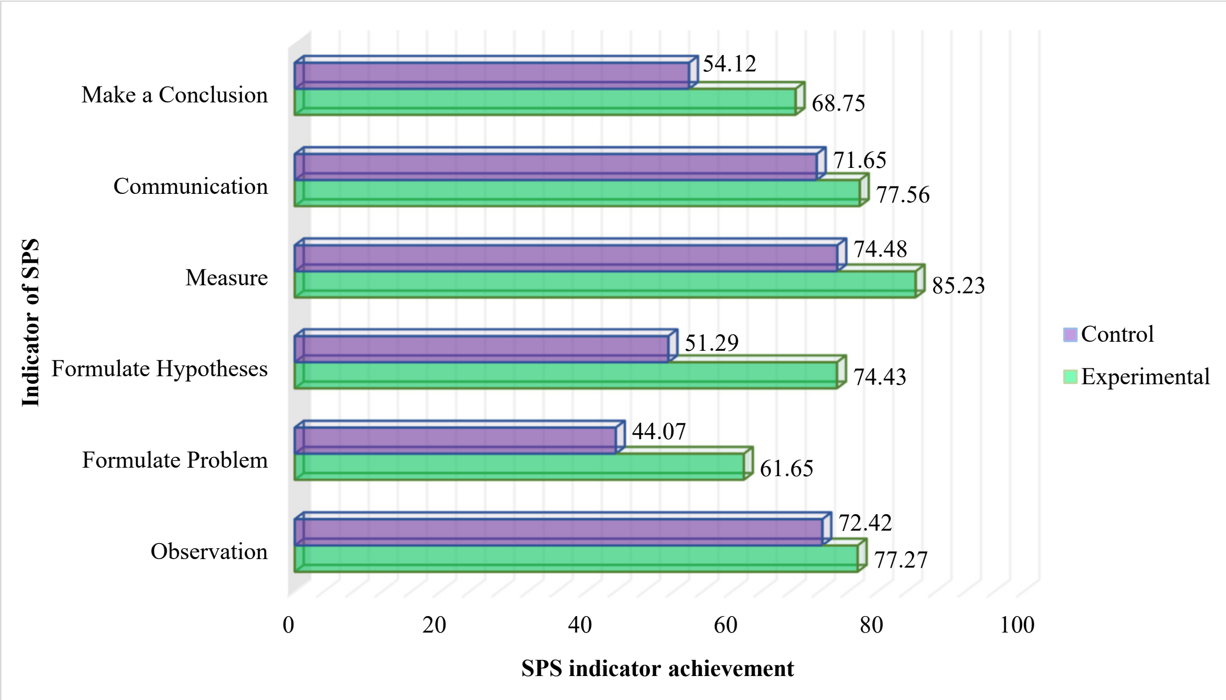

FIGURE 1. The comparison of SPS indicator achieved by students in the experimental and control group

The above Fig. 1 reveals that in the experimental group, the students' SPS can be polished effectively. Two indicators of the experimental group, i.e., "formulate the problem" and "conclude" are in the moderate category, while the other three indicators (communication, measure, and observation) are categorized good—only one indicator, i.e., "measure" that falls under the excellent category. The measured SPS indicators in this present study complement the ones formulated by Dewi and Atun [22]. They only focus on the indicator of observation and communication. Although the indicator "make a conclusion" is categorized moderate, the result of the experimental group is better than the control group. It is assumed that this issue is due to the indicator of "formulate problem" that is classified the same as the indicator "conclude". This is the second measured indicator. The indicator mentioned above, during learning processes, was the first focus. The practice ends with the indicator "conclude". Students' ability in formulating problems and their skills to generate a conclusion is categorized moderate. The result of this research found one indicator with the excellent category. This differs from the one seen in Damopolii, Yohanita, Nurhidaya, and Murtijani as they only found that the indicators are only categorized good [3]. Another different finding is that this present study used an essay test rather than multiple choice SPS test. Moreover, the result seen in Dewi and Atun does not provide the detail of the determination of a category for SPS indicator [22], while this research explains the standard for categorization of indicators. The category of SPS of this present study, if it is compared to the results of the control group, is also better than other studies despite two indicators that fall under the moderate category.

Students in this research participated in training focusing on six SPS indicators that are analyzed during the inquiry learning integrated with local resources. Firstly, students were asked to observe an object. The activities in this session encompassed observing, reading, and listening to everything related to the object. Secondly, the students formulated a problem. They were assigned to generate questions about issues and everything they found related to the lesson, i.e., human coordination system. Following this process is generating hypotheses. The students formulated a hypothesis from the problem statement they have proposed. This step cultivates the students' curiosity (whether or not the hypothesis is accepted) by which it drives the students to actively engaged in the experimental. The fourth step is hypothesis testing in which the students answer the questions based on the result of the experimental. This is to determine whether or not the hypothesis is accepted. The fifth step is communicating the result of the experimental in a written or oral form. In addition, students should comment on their peer's work. A study reveals that students with good communication skills are able to explain the phenomenon based on the data [30]. The last or sixth process is summing up. The students conclude all the result of the experimental based on the objective. The result of the pre-requirement analysis test and the difference between students' SPS in each group is provided in Table 2 and Fig. 2 respectively.

TABLE 2. Normality and homogeneity test result

Group	Mean	Std. Deviation	Kolmogorov z	Levene Test
Experimental	74.25	13.19025	0.128	0.330
Control	61.40	13.82303	0.231	

Table 2 provides the information on the data of SPS of the experimental and control group. The data are considered normal (0.128 > 0.05; 0.231 > 0.05) and homogeny (0.330 > 0.05).

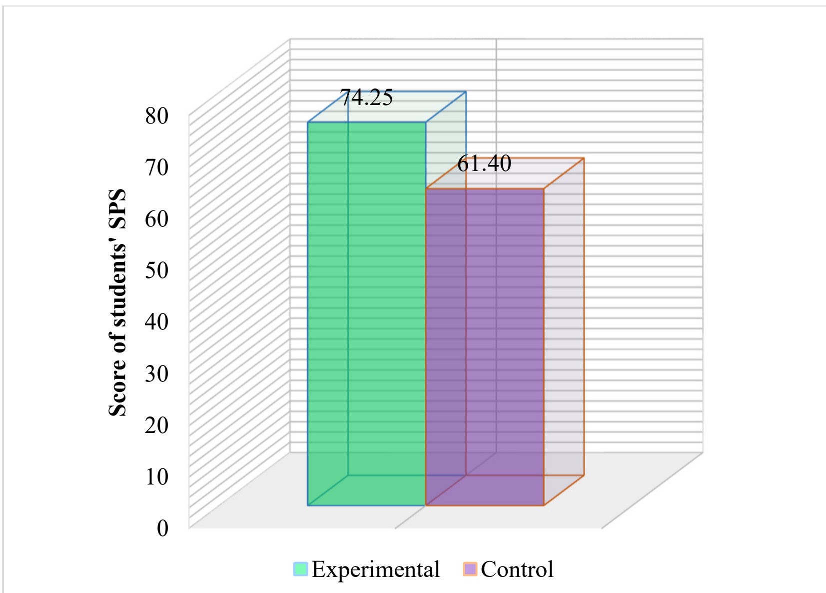

FIGURE 2. Mean of SPS of the experimental and control group

Figure 2 depicts the average of students' SPS in each group. The figure shows a difference in the average achievement of the students' SPS in the experimental and control group. The result of this present study (with the mean of 74.25) differs from several studies conducted in the last four years (2015 - 2019) where the indicators are categorized moderate [19, 20]. The mean of the indicators is 73.46 [26], 71.125 [31]. The difference of the posttest of SPS of the control and experimental group in a study by Sitompul and Sirait measures at 6 [21]. A study by Dewi and Atun shows that the difference in the SPS of control and experimental group is at 2.98 [22]. In this study, the difference measures at 12.85.

TABLE 3. Independent t-test result of SPS

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Science Process Skill	Equal variances assumed	6.452	183	0.000	12.84794	1.99124
	Equal variances not assumed	6.467	182.524	0.000	12.84794	1.98669

The result of the KPS test reveals that the overall SPS of students in the experimental group (74.25) outnumber the outcome of the control group (61.40). The difference is considered significant (0.000 < 0.05) due to different treatments on each group. The students in the experimental group were taught using inquiry learning method with the integration of local resources. These students participated in a field observation in their school to practice generating concepts. This process allows the students to use their skills optimally. Poor SPS skills of the students in the control group are due to the use of conventional learning. Such a learning method does not incorporate investigation activities. The students in the control group did not analyze the result of their experiments. As a result, this hinders the students during the SPS test. A teacher is demanded to possess certain attitudes and competencies to lead the students to succeed in an inquiry learning [32]. Conventional learning is supposed to create a situation that raises students' participation in learning. However, inquiry-based learning is way better as this method improves the students' knowledge and skills [5].

In a study by Sitompul and Sirait, the indicator is only categorized moderate [21]. They employed an inquiry method with the integration of a virtual lab. In this present study, inquiry learning incorporates local resources into the teaching material. Students do some investigation in the field during the learning process; this step follows the design of the inquiry learning. The use of local resources allows students to understand the concepts of the material. Over-relying on the examples in a student book (as the sample is not based on the students' environment) hinder the students from comprehending the subject. Local resources also help the teachers to explain scientific information in inquiry-based learning. The learning process takes place naturally because the students investigate the phenomenon in their surrounding [24]. However, the result of this study differs from the results seen in Sarah, Prasetyo, and Wilujeng [33]. They find out that the indicator of honesty, cooperation, and responsibility of the students who were taught using inquiry learning (with the integration of local potential) is the same as those who were taught using conventional learning. In this present study, the integration of local resources in inquiry-based learning is able to develop the students' SPS compared to other variables. Such integration is to address the issue that inquiry learning is designed for students with high-level skills. Still, the integration of local resources should consider the selection and designing of the learning material. The learning must be suitable for the material and variables measured. Otherwise, the outcome is not effective. Teaching effectiveness depends on the creativity and innovation of the teacher [34]. From the above results, it is expected that inquiry learning can be implemented in biology subject to enhance students' SPS.

SUMMARY

This research concludes that inquiry learning is able to polish students' scientific competences. Integrating local resources is among the best options to further enhance the effectiveness of the learning method. Still, the limitation of this research is the fact that two indicators of SPS, i.e., "formulate problem" and "make a conclusion" that are only categorized moderate. It is expected that pre-tests should be used in further research to determine the increase in the students' SPS at the end of learning. In the future, teachers can implement inquiry-based learning with the integration of local resources to improve the students' SPS.

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