How to improve the science process skills of biology education students on photosynthesis topic?

A Yuniarti*, B Supriatno, and E Nureni
Departemen Pendidikan Biologi, Universitas Pendidikan Indonesia, Jl. Dr. Setia Budhi No. 229, Bandung 40154, Indonesia
*anisyah.yuniarti@student.upi.edu

Abstract. The DP4 learning strategy in this research is the acronym of Demonstration method, Practical work-discussion₁ method, Presentation-discussion₁ method, Practical work-discussion₂ method, and Presentation-discussion₂ method. This study aims to describe the effect of applying DP4 learning strategy to Science Process Skills (SPS) of biology education students on photosynthesis topic. The research method is a weak experiment, with the research design “The One-Group Pretest-Posttest Design”. The implementation of the study involved 36 biology education students at one of the universities in Pontianak. The research instrument used is in the form of test equipment, assessment rubric, and questionnaire. Data were analyzed using Microsoft Excel and SPSS 24 Program. The statistical results show that DP4 learning strategy has an effect on improving biology education students science process skills on photosynthesis topic. This due to the topic of photosynthesis that is learned through demonstration, practical work-discussion, and presentation-discussion activities to direct the students to observe the facts that appear in experiment, to formulate hypotheses, to determine the independent variables, bound variables and control variables in the experiment, to experiment, create data tables and write experiment data, interpreting and analyzing experimental data, connecting experimental variables, and make a conclusions from experimental results. This DP4 learning strategy can be utilized by educators in learning photosynthesis topic.

1. Introduction
Biology discusses by way of finding and understanding about nature systematically, Biology is not only the collection of knowledge that contains facts, concepts, and principles but also the process of inquiry [1]. Biology learning requires students to be active in finding the concept of biological material through observation, experiment, create pictures, charts, tables, and communicate the results to others. Such biological characteristics require biology education students as biology teacher candidates to be able to teach students through a scientific approach [2]. In order to carry out a scientific approach, students need to be trained to develop scientific skills called science process skills (SPS).

Science Process Skills is defined as the individual’s ability to apply scientific methods in understanding, developing and discovering science [3]. Science process skills referred to as “lifelong learning skills” are skills to acquire and process information [4]. Science A Process Approach (SAPA) classifies the science process skills into two types: basic science process skills and integrated science process skills. Basic science process skills consists of six skills: observation, inferring, measuring, communicating, classifying, and predicting. Integrated science process skills consists of six skills: controlling variables, making operational definitions, formulating hypotheses, interpreting data, conducting experimenting, and formulating models [5].
Science process skills are a necessary tool to produce and use scientific information, to perform scientific research, and solve problems [6]. The activities which consist of basic and integrated process skills are the key factor of scientific/science literacy and the key dimension of scientific [7]. In addition, SPS need to be trained so that students have the necessary competencies to face the challenges of the 21st century [8]. National Education Association states that there are four competencies that must be possessed that are critical thinking and problem solving, communication, collaboration, creative and innovative [9]. These four competencies have been integrated into science process skills.

One way to trained SPS for biology education students is to use the DP4 learning strategy. DP4 learning strategy is the acronym of the learning method comprising demonstration method, practical work-discussion method, presentation-discussion method, practical work-discussion method, and presentation-discussion method shortened to DP4. The DP4 learning strategy consists of four goals. First, demonstration activities through Leaf Disks experiments aim for early problems that invite students to think critically and engage in solutions (find answers). Second, practical work-discussion aims to train various science process skills such as observing, conducting experiments, creating data tables, collecting and processing data, interpreting data, and drawing conclusions. Third, practical work-discussion using a photosynthesis kit aims to trace the science process skills such as identifying variables, hypothesizing, graphing, describing relationship among variables, measuring and predicting. Fourth, in the presentation of the various cognitive presentations of the found facts that aim to equalize and consolidate the concept of photosynthesis as well as to train communication skills in the science process skills.

2. Method

The research method used is the weak experiment method with the research design “The One-Group Pretest-Posttest Design”. Subjects in the study were 36 biology education students taking a course in Plant Physiology at one University in Pontianak. The DP4 learning strategy is divided into two stages. The first stage, three methods of learning are applied, namely demonstration method, practical work-discussion method, and presentation-discussion method. Method of demonstration aims to develop student’s critical thinking skills by Leaf Disks demonstration experiment. After completion of demonstration activity, continued the practical work-discussion method. The application practical work-discussion method completed with student worksheet (DKL). It aims to develop student’s science process skills by practicing Ingenhousz, Sachs, and Pristley. The next method is presentation-discussion, this method conducted aims to discuss the findings facts of practical work activities that have been done previous students, resulting in similarity and stability, and training the communication skills in science process skills. In the second stages, there are two methods applied that is practical work-discussion method and presentation-discussion method. The practical work-discussion method completed with student worksheet (DKL) and student used photosynthesis kits as a practical work activities. The practical work aims to develop student’s science process skills like observing, conducting experiments, creating data tables, collecting and processing data, interpreting data, drawing conclusions identifying variables, hypothesizing, graphing, describing relationship among variables, measuring and predicting. After that, applied presentation-discussion method to discuss the results of students observation during the practical work activities. This method is selected by researcher to give student provide practice for developing various science process skills. The research instrument used is in the form of science process skills test, assessment rubric, and questionnaire. Data were analyzed using Microsoft Excel and 24 SPSS Program.

3. Result and Discussion

Statistical data show pretest, posttest, and mean value of n-gain student’s science process skills after applying DP4 learning strategy can be seen in Table 1.
Table 1. Data statistics science process skills.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>average</td>
<td>33.91</td>
</tr>
<tr>
<td>variance</td>
<td>22.3</td>
</tr>
<tr>
<td>at least</td>
<td>28.7</td>
</tr>
<tr>
<td>maximum</td>
<td>47.6</td>
</tr>
</tbody>
</table>

Table 1 shows an average increase in the science process skills of biology education students by 48.29 after the implementation of DP4 learning strategy. After the analysis, the average N-gain shows a value of 0.72 in the range 0.61≤N-Gain≤0.80 with high category interpretation. Students can improve science process skills because during the learning process, the lecturer strives to create a learning environment that gives students the opportunity to practice various science process skills directly through practicum activities. Learning activities undertaken trained in various skills such as observing, determining variables, hypothesizing, experimenting, measuring, creating tables, analyzing data, predicting, and drawing conclusions. Science process skills can be developed through the provision of experience involving cognitive, manual, and social [10]. Improved science process skills can also be seen in Figure 1.

Figure 1. Increased science process skills of student

Based on Figure 1, it shows a significant difference in the improvement of science process skills of biology education students before and after applied DP4 learning strategy on photosynthesis concept. Direct experience in the discovery of facts through practical work that requires students to observe objects, conducting experiments, measuring, creating data tables, collecting and processing data, identifying variables, hypothesizing, interpreting data, and drawing conclusion. Based on statistical analysis, the effect of applying DP4 learning strategy can be seen in table 2.
Table 2. The influence of DP4 learning strategies on student’s science process skills

<table>
<thead>
<tr>
<th></th>
<th>One-Sample Test</th>
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<tbody>
<tr>
<td></td>
<td>Test Value = 0</td>
<td>95% Confidence Interval of the Difference</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>t</td>
<td>df</td>
<td>Sig. (2-tailed)</td>
<td>Mean</td>
</tr>
<tr>
<td>Pretest</td>
<td>49,342</td>
<td>36</td>
<td>,000</td>
<td>31,028</td>
</tr>
<tr>
<td>Posttest</td>
<td>53,271</td>
<td>36</td>
<td>,000</td>
<td>65,391</td>
</tr>
</tbody>
</table>

Table 2 above shows a significant effect of DP4 learning strategy on increasing the scope of student science process skills seen from p-value <0.05 significance. The influence of the implementation of DP4 learning strategy can be seen from the increasing of students science process skills.

4. Conclusion
Based on the result of the research, it can be concluded that the improvement of science process skills is caused by the implementation of appropriate learning strategy. Through the application of DP4 learning strategy, students gain experience and training directly through practical work activities. This strategy also can help students more easily in understanding photosynthesis concepts, digging students more actively in learning, train students in conveying opinions. Implementation of this learning strategy requires good time management.

5. Acknowledgments
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6. References