Implementation of DPDPE learning strategies using photosynthetic kits to enhance students’ quantitative literacy

R S Khoerunnisa¹, B Supriatno², and E Nuraeni²

¹Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 229, Bandung 40154, Indonesia
²Departemen Pendidikan Biologi, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 229, Bandung 40154, Indonesia

Abstract. This research aims to analyze the effect of Demonstration - Practical work1 – Discuss Practical Work2 - Explain (DPDPE) strategy on the quantitative literacy of biology students using photosynthetic kit. This research was carried out with the one group pretest-posttest research design involved 22 biology students at one of the State University in Bandung in the fourth semester of the 2018-2019 academic year. The research instrument used is 10 quantitative literacy test given to students, the indicators consist of interpretation, representation, analysis/application, calculation, assumption, and communication. Data analysis was carried out by recapitulating scores of the pretest and posttest. Analysis of the results in this research data was analyzed with scoring and normalize gain of the score. The results of this research showed increased students quantitative literacy. Based on these results highest enhance implementation of using the DPDPE strategy is calculation ability. In general, the results of the study are indicated by the acquisition 0.86 of N-gain averages which is a high category. The implementation of DPDPE learning strategy using photosynthetic kits can enhance quantitative literacy of biology students

1. Introduction

The world in the 21st century is a world that is always related to numbers, according to [1], this ability is also called quantitative ability, where some people sometimes ignore it. Quantitative literacy is the skills, knowledge, beliefs, habits of thought, disposition, communication skills, and problem-solving skills needed to be effectively involved in quantitative issues in the field of work and life. Quantitative literacy is also a habit of thinking to create the meaning of numerical information [2]. Most of the information in the 21st century is quantitative information, along with the increasing data and news presented through the media and the internet so that people, especially students, will be faced with many quantitative data and arguments that need to be processed and understood [3]. An individual who has a strong quantitative literacy ability has the ability to think and solve quantitative problems from a variety of authentic contexts and situations in everyday life, which involves six indicators of quantitative literacy skills namely interpretation, representation, calculation, analysis, assumptions, and communication [4].

Biology learning requires students to learn through direct experience and contextual learning, so that students can express the phenomena around them. To uncover this phenomenon, students need a strategy that takes them to think about how the phenomenon can be revealed, so it can be developed into a new
form of knowledge [5]. The results of research in 2014 stated that quantitative literacy owned by high school students, biology students, biology education students and biology teachers in Indonesia was still relatively low [6]. The low level of quantitative literacy based on the fact that teachers have not been able to develop quantitative literacy in learning biology [5]. In order to develop quantitative literacy, students need to get interesting experience and clear experimental activities so that students can feel the benefits of quantitative literacy in the real world, in addition students also need to get more opportunities to make decisions involving information gathering and assessment, quantitative analysis, and communication about quantitative topics [7]. According to the results of the analysis of learning that has been done, the strategy that is considered appropriate that can be applied in learning is a strategy that consists of several methods including demonstration methods, practicum, discussion, and explanation. This strategy is called Demonstration – Practical work1 – Discuss – Practical work2 – Explain (DPDPE) strategy which is expected to be able to develop students' quantitative literacy skills, especially in photosynthetic material.

The DPDPE learning strategy has several objectives including: demonstration activities through video screening of Leaf disks as the initial problem aimed at inviting students to think critically and include them looking for solutions (finding answers); practical work1 activity and discussion aims to train students to form concepts or knowledge based on experimental results that they find directly through observing, collecting data, processing data, interpreting data and drawing conclusions; practical work2 activity using photosynthesis kits aims to train students' quantitative literacy such as interpretation, representation, calculation, analysis/application and assumptions; and explanatory activities aim to explain the relationship between the facts that students find through a series of activities that they have also done to equalize and consolidate the concept of photosynthesis. The photosynthetic kit used in learning using the DPDPE strategy was specifically developed. The lack of quantitative literacy in biological experiments, especially photosynthetic material, lies behind the development of these photosynthetic kits. Photosynthetic experiments carried out using photosynthetic kits are Ingenhouz experiments (using Hydrilla verticillata) that can show the facts to students about the results of photosynthesis in the form of air assumed as oxygen so that its volume can be calculated. The photosynthetic kit consists of several components including specimen tubes, water storage glasses, measuring pipes, suction syringes, three-lane faucets and small hoses. The specimen glass connected to the measuring pipe aims to collect the volume of oxygen produced during photosynthesis. While the measuring pipe connected with a small hose, three-lane faucet, and suction syringe serves to attract the volume of oxygen collected in the measuring pipe so that it can be calculated. The implementation of DPDPE learning strategies in photosynthetic material using photosynthetic kits is expected to develop quantitative literacy in students.

2. Methods
The type of research chosen in this study is the Weak Experiment which aims to identify the effect of DPDPE learning on students' quantitative literacy. This study uses the design of one group pretest-posttest involving subjects as many as 22 fourth semester biology students at one of the state universities in Bandung, Indonesia who are studying the subject of plant physiology using the DPDPE learning strategy. The DPDPE learning strategy consists of Demonstration - Practical Work1 - Discussion - Practical Work2 – Explain. That strategy is divide into two stages. The first stage begins by conducting a demonstration, namely students watching videos about leaf discs, followed by formulating questions in the experimental activities. Demonstration activities aim to develop students' critical thinking skills. After the demonstration, the activity continued with doing Practical-work1 completed by student worksheets (DKL), in this activity students carry out the first practical activities by conducting several experiments including Ingenhouz, Sachs, and Priestley (CO2). The activity aims to develop student concepts that are formed based on the experimental data they found when conducting experiments. The next method is a discussion method that aims to discuss the facts of the findings of the first practical activity that has been done before, in this activity students can exchange ideas and opinions so that
students have a conception formed from the facts of their findings. Discussion activities can also train students’ quantitative literacy, in this case, is communication skills. The second stage starts with Practical-work2 activity completed with student worksheets (DKL), in this activity students do lab work using photosynthetic kits. The activity aims to train students’ quantitative literacy, including interpretation, representation, calculation, analysis/application, assumptions. After doing Practical-Work2 activity, the students carry out explanatory activities, in this activity students write relationships between several facts they find through learning activities (Demonstration - Practical Work1 - Discussion - Practical Work2) written on paper so they can relate their findings to each other. The instruments used to collect research data include quantitative literacy tests that contain several questions with quantitative literacy indicators according to [4] including interpretation, representation, calculation, analysis/application, assumptions, and communication given as pretest and posttest. Data analysis was carried out by scoring and evaluating the pretest and posttest, then performing the N-gain calculation proposed by [8] to determine the significance of the effect of applying the DPDPE learning strategy to students’ quantitative literacy.

3. Results and Discussion
The first paragraph after a heading is not indented (Bodytext style). The result of this research shows student’s quantitative literacy achievement. Statistical data that shows the value of the pretest-posttest, and the interpretation of the value of N-gain students' quantitative literacy after implementation of the DPDPE strategy can be seen in table 1.

| Statistical Data          | Pretest | Posttest |
|---------------------------|---------|----------|
| Number of students        | 22      | 22       |
| Maximum Score             | 25      | 68       |
| Minimum score             | 1       | 48       |
| Mean                      | 9.45    | 61.05    |
| Standard Deviation        | 6.139   | 5.719    |
| Variance                  | 37.688  | 32.712   |

Table 1 shows the average increase in biological student quantitative literacy skills of 51.6 after the application of DPDPE learning strategies. After analysis, the average N-gain shows a value of 0.86 which is a high category. Students can develop their quantitative literacy skills during the learning process using the DPDPE strategy. The increase was caused by the application of a strategy consisting of several learning methods and the use of photosynthetic kits that could facilitate students to develop various quantitative literacy abilities. In addition according to [5] states that students are conditioned to know "something" new with natural phenomena directly. Quantitative literacy can be trained both in writing, oral, and practicum [9]. The quantitative literacy indicators include interpretation, representation, calculation, analysis/application, assumptions, and communication. The percentage increase in each quantitative literacy indicator can be seen in Figure 1.
Figure 1. Increased student quantitative literacy skills

Figure 1 shows a significant difference in increasing the quantitative literacy of biology education students before and after learning using the DPDPE strategy on photosynthetic material. The experience obtained directly by students in finding facts through practical activities requires students to interpret data, then make representations, calculations, analysis/applications, assumptions, and communication. The calculation indicator is an indicator experiencing the highest increase among other indicators. This is due to the existence of activities that can develop maximum calculation capabilities, for example, the activity of calculating the volume of oxygen collected from photosynthesis, and calculating the rate of photosynthesis under different conditions of temperature and light intensity. Calculations are competencies in making mathematical estimation [4]. Based on statistical analysis, the effect of applying DPDPE learning strategies can be seen in table 2.

Table 2. The influence of DPDPE learning strategies on student’s quantitative literacy

|       | One Sample Test |       |       |       |
|-------|-----------------|-------|-------|-------|
|       | t               | df    | Sig.  | Mean  | 95% Confidence Interval of the Difference |
|       | df              |       | (2-tailed) | Difference | Lower  | Upper  |
| Pretest| 50.062          | 21    | .000  | 6.104,545 | 585.096 | 635.813 |
| Posttest| 7.224           | 21    | .000  | 945.455  | 67.326  | 121.765 |

Table 2 shows the significant influence of the application of DPDPE learning strategies to the increase in students' quantitative literacy abilities seen in p-value <0.05. The effect of applying DPDPE learning strategies can be seen from the increase in student quantitative literacy.

4. Conclusion

Based on data from the research results it can be concluded that the increase in students' quantitative literacy skills is caused by the application of appropriate learning strategies. Through the application of DPDPE learning strategies, students can gain experience and practice their abilities directly through practical activities. The DPDPE strategy can also help students to understand photosynthetic concepts more easily, demanding that students be more active in learning, train students in discussions and express opinions so that quantitative literacy skills can be mastered well. Even so, the application of the DPDPE learning strategy requires good time management in its implementation.
5. References

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