Submerged plant’s ability to present photosynthesis based on oxygen production

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Abstract. This study aims to provide information about alternative experimental photosynthesis for experimental teaching practices in school in the coastal region. The research method was conducted experimentally by taking examples of Submerged plant in littoral area of Leuweng Sancang beach, Garut. Plant samples were given the same light intensity treatment, then the oxygen productivity was studied as an indicator of photosynthesis rate. The results showed that there were different photosynthetic rates in different types of submerged plants. Algae as submerged plants generally photosynthesize at high light intensity. However, there are also plants with photosynthesis in low light. The comparison between sea grass (Thallasia sp) with sea weed (Ulva sp) shows the difference in oxygen productivity. Submerged plants based on their ability to produce measurable oxygen can be utilized for experiments on photosynthesis learning.

1. Introduction
Photosynthesis is defined as the process of converting light energy into chemical energy [1]. Supriatno (2013) states that photosynthesis as an abstract process of energy transformation, meaning capturing and using light energy, then through various processes can form the starch stored in the form of chemical energy and produced oxygen [2]. In a classroom learning process, the abstract energy transformation process is difficult for students to understand. The results of some research shows that there are still many misconception and misunderstanding both students and teachers understand this concept [3-10]. There are some facts to build the knowledge of photosynthesis in students, and the ability of teachers to transform factual information into students' conceptual understanding [2, 11-17]. Various experiments to show symptoms of photosynthesis as factual data have been developed, among others, with the Ingenhousz experiment. However, for some teachers, especially in coastal areas, it is difficult to find Hydrilla sp or Elodea sp commonly used for classroom experiments.

As a result of the difficulty of obtaining these plants, resulting in laboratory practice activities did not take place. Thus students do not learn factually. Consequently the process of knowledge construction is not maximal, and often leads to misconception. One solution to overcome these problems is to seek alternative plants for practicum activities, as part of the teaching materials development process. This alternative plant is obtained by utilizing the rich water plants of coastal communities. However, a research is needed to obtain representative, easy to obtain and easy to use for experiments in the learning process. It is hoped that through this research, obstacles in the learning of photosynthesis topic can be overcome.
2. Methods
This research uses experiment method. Conducted in August of 2017. The object of research is a plant of submerged plant in the coastal litoral area Leuweng Sancang, Garut. The plant sample is taken and weighed, then inserted in a transparent chamber connected to the volume. Subsequently all experimental samples were jointly placed in conditions exposed to full sunlight for 60 min. The dissolved oxygen conditions were measured before treatment and after treatment. The intensity of light during treatment was measured with lux meters, and salinity was measured using a refractometer. The dissolved oxygen condition before and after the experiment was measured by DO meter and oxygen in bubble form was measured using a volume. The condition of dissolved oxygen and oxygen volume is measured after the experiment illustrates the oxygen increase or photosynthetic productivity.

3. Results and Discussion

3.1. The ability of algae in photosynthesis
Based on the results of the measurement of light intensity at the time of the experiment was conducted about 25,000 lux and 86,000 lux, with the average temperature of the beginning of experiment 27.3°C and the average final temperature 35.6°C. Conditions of water salinity, before and after the experiment no change, is 29 ppt. The results of measurement of oxygen levels are stated in Table 1. The oxygen increase as a result of photosynthesis differs in each type of submerged plant. The measured oxygen volume column (11) illustrates the amount of oxygen bubbles that come out and can be measured with a volume at a light intensity of 86,000 lux. At low light intensity visually visible but not measurable because of the small amount, difficult to measure so ignored.

Based on the data in Table 1.1 shows that the rate of oxygen productivity as a result of photosynthesis differs in each type of submerged plant. The measured oxygen volume column (11) illustrates the amount of oxygen bubbles that come out and can be measured with a volume at a light intensity of 86,000 lux. At low light intensity visually visible but not measurable because of the small amount, difficult to measure so ignored.

Based on the data in the table, there are differences in the oxygen yield of photosynthesis at high light intensity and low light intensity. In general all plants photosynthesize at high light intensity, which is shown by increasing dissolved oxygen levels compared to the initial conditions. The average oxygen solubility at the end increased (6.86 ± 2.13 mg / lt) all increased compared to baseline (3.1 mg / lt). At the highest light intensity the highest rate of photosynthesis occurs in the plant species Ulva sp (9.10 mg / lt) and Padina sp (11.50 mg / lt). This is in line with measurable oxygen productivity (column 12) in the Ulva of 0.20 ml / grams and on a 0.14 mg / gram Padina sp biomass. At low light intensity the
opposite condition occurs, the dissolved oxygen content decreases significantly compared to the initial conditions. The average oxygen solubility at the end of the experiment was 5.18 ± 2.93 mg / lt. It described the rate of plant respiration at low light intensity higher than the rate of photosynthesis, thereby reducing dissolved oxygen content. Plants whose photosynthesis rate is reduced drastically at low light intensity include Rhodymenia sp, Ulva sp, Turbinaria sp, Sargassum sp, Caulerpa sp, Halimeda sp and Gelidium sp. While Gracillaria sp and Padina sp are still able to maintain the rate of photosynthesis. Thus the Padina sp is able to photosynthesise at high light intensity as well as at low light intensity. The difference in photosynthesis rate can be caused by the influence of light and the condition of photosynthetic pigment found in the plant itself. Algae as submerged plant has a variety of pigments. Different plants have different types and pigment concentrations, thus affecting the rate of photosynthesis.

Changes in dissolved oxygen levels before and after the experiments and the phenomenon of slow release of the bubbles are facts that can be observed. In this photosynthesis learning activity is the beginning to construct conceptual knowledge. In a learning object and present a very important phenomenon. According to Millar [18] objects and phenomena are real domains that can be observed, and are the basis for constructing knowledge. Practical activities play a role to help students connect between two domains of knowledge, is objects or observed phenomena and the sphere of ideas or ideas. In a learning need for interaction between the real domain and cognitive domain. This experiment also shows that all algae as submerged plants in the littoral region can used as experimental materials in learning activities to provide factual knowledge on photosynthesis material. This means that if teachers who have school in the lowlands or around the beach, and have difficulty to get materials for experiments in learning, can take advantage of these plants. However, the process of turning the students' factual knowledge into conceptual knowledge is highly dependent on the teacher’s ability and experience. The plant lives in the littoral zone, distributed among the lowest tide and and the highest ebb the extent of which depends on the shoreline. These plants are generally exposed to sunlight at low tide and submerged at high tide. To get this plant is done when the sea level before receding.

3.2. comparison of photosynthesis between seagrass and seaweed
In subsequent activities, in the same way experiments compare the rate of photosynthesis between seaweed represented by Ulva sp with sea grass represented by Thallasia sp. The experimental results are shown in Table 2.

| Parameter               | Thallasia sp | Ulva sp  |
|-------------------------|--------------|----------|
| DO early                | 3.9          | 3.9      |
| DO end                  | 7.5          | 8.1      |
| Biomass                 | 14.39        | 3.12     |
| Vol Measurable oxygen   | MI           | 12 ml    |
| Oxygen Production Rate  | 10.56 ml/gr/jam | 3.8 ml/gr/jam |

Table 3.2 shows the ratio of oxygen productivity rate of photosynthesis of algae plants (Ulva sp) using volumeter developed by the researchers themselves. The shape is like a large reaction tube, size 50 ml, which is connected in reverse with the measuring tube and reconnected with three way stopcock and syring (figure 1). By using this tool the plant is inserted into the test tube as a chamber in a beaker, so that when a bubble produced by photosynthesis all bubbles of oxygen released can be accommodated and measured. Both plants are relatively easy to obtain with sea grass (Thallasia sp), where both live in the seagrass in the littoral zone. The results of the experiments show that both are capable of producing a fairly rapid oxygen bubble and can be measured with volumeter. The result of oxygen productivity measurement for Thallasia sp is much higher than that of Ulva sp. In lighting with full sunlight intensity (about 86,000 lux), Thallasia is able to produce 10.56 / gr / h oxygen bubbles. While Ulva produces
bubbles of about 3.8 / g / hr. The ability of both plants to show the phenomenon of bubble discharge is an important observable fact.

![Sketch of The Photosynthetic Measurement](image)

**Figure 1.** Photosynthetic measurement

By means of a volumeter tool developed by bubble researchers emerging from plants can be measured quantitatively. In biology learning, quantitative facts are rarely raised, whereas they can be used to develop quantitative literacy. Practical work not only provides students with factual recognition, but can also provide immediate experience and develop specific competencies in students. With the existence of quantitative facts can be developed various competencies, including: (1) the ability to analyze the relationship between variables, such as the relationship of the effect of light intensity on the photosynthesis rate; (2) the ability to predict or predict the conditions that will occur as a result of the rise of a factor affecting photosynthesis (3) the ability to transform and interpret the graph, and others. This quantitative skill is very important, given the future development of life in information on the various fields relating to the numbers [19]. If the practical activity in learning takes about 20 - 30 minutes, then conceptually both plants can be utilized as materials for experiments in learning.

4. Conclusion

Based on the result of the research, it can be concluded that there is difference of photosynthesis rate at submerged plant as response to light. The rate of photosynthesis varies depending on the type and intensity of light. Submerged plants, especially algae, are adapted to high light intensity and others are adapted to low light intensity. The ability of algae, especially Ulva sp and sea grass especially Thallasia sp in producing oxygen that can be measured with volumeter can be used for practical activities in photosynthesis learning.

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