

Improving HOTS in Biology Learning: A Supplement Book of Plant Growth and Development

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Received September 8, 2019; Revised November 1, 2019; Accepted November 8, 2019

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Abstract Biology learning in the 21st century requires Higher Order Thinking Skills (HOTS) especially on the topics of Plant Growth, Development, and Environment. The purpose of this study was to improve students HOTS in learning Biology using the Supplement Book of Plant Growth and Development (SB-Plant). The research method used in this study was an experiment with a sample of 56 students. The instruments used were 8 items about HOTS, which have been declared valid and reliable. The results showed that the average HOTS score of students increased significantly by using SB-Plant. The highest gain score in the third indicator (create) with an increase in gain score of 0.46 (moderate). Meanwhile the smallest increase occurred in the first indicator (analyze) with a score of 0.20 (low). The conclusion was that SB-Plant is effectively used to increase HOTS in Biology learning.

Keywords SB-Plant, HOTS, Learning, Students

1. Introduction

21st Century Biology learning has made learning change from teacher -center to the student -center. Students are not only asked to record everything explained by the teacher, but also actively seek various information [1-3]. The impact of this change in learning approach resulted in students also being required to have higher abilities in terms of thinking. This ability is often referred to Higher Order Thinking Skills (HOTS) which is the ability to analyze, evaluate, and create [4-6]. This ability was skills that can be trained in learning at the classroom.

In Biology learning specifically in topic growth and development of plants, students really need HOTS. This is because on this topic a lot of material is not enough just to use the ability to memorize and remember. In detail, if we want to learn about the role of internal factors such as genes and hormones in plants, it requires the ability of HOTS.

This is because the topic has many problems that are relevant to daily life and must be solved by students [7-9]. This makes HOTS important for students to learn about plant growth and development.

The problem that arises is that the ability of students HOTS is still relatively low [10,11]. Many kinds of research have revealed the profile of students HOTS in science learning [12-14]. In addition to the HOTS profile of students, many researches have been done to improve various skills to improve the quality of science learning [15-17]. Other research such as developing digital learning media and online-based learning, one of them was the development of the Supplement Book of Plant Growth and Development (SB-Plant) for high school students [18]. Supplement Book is a book that serves to explore a particular topic.

In previous research, SB-Plant has not been implemented in the classroom. SB-Plant has the potential to improve students HOTS, especially when discussing the topic Plant Growth and Development. This SB-Plant will be used in classroom and on trial effectively to improve students HOTS. Based on this, the purpose of this study was to improve students' HOTS in Biology learning using SB-Plant.

2. Methods

The method used in this study was one group experiment without a control group. The treatment given was Supplement Book of Plant Growth and Development (SB-Plant) products that had previously been developed [18]. This research was conducted in July-August 2019 in senior high school students. The schools used in this study were 2 schools. The sample, which was selected by simply random sampling, selected 56 students in 12th grade. The instrument used was a Higher Order Thinking Skills test consisting of 8 items given during the pre-test and post-test. The indicator of HOTS instrument used

consists of 3 aspects, namely analyze, evaluate, and create [4]. More details can be seen in table 1.

Table 1. Indicator of instrument

Aspect	Indicator	Item
C4 (Analyze)	Analyze the factors that cause growth and development of plants	1,2,3,
C5 (Evaluate)	Criticize the role of internal and external factors of plant growth and development	4,5,6
C6 (Create)	Create simple research designs and concept maps about plant growth and development	7,8

The validity test used in this study was the Pearson product-moment. Meanwhile the reliability calculation used alpha Cronbach. After the instrument was declared valid and reliable, the data was collected and presented in table. Analysis of the data used the normality and homogeneity test then proceeded with the dependent t-test using SPSS. In addition, the gain score is also calculated to see the magnitude of the average increase in each item. After calculating the gain score, the next step was to categorize the gain score according to the criteria in Table 2.

Table 2. Category of community attitudes

Gain Score	Criteria
$g \geq 0,7$	High
$0,7 > g \geq 0,3$	Moderate
$g < 0,3$	Low

SB-Plant consists of 5 parts, from cover, introduction, main content, conclusion, and evaluation for students. These five parts were made because the SB-Plant was an additional book that was for advance. That was because the textbooks in schools are not as deep as those discussed at SB-Plant. The SB-Plant book was made in Indonesian

language. However, a description of the SB-Plant book can be seen in table 3.

Table 3. Part and Description of SB-Plant

No	Part	Description
1	Cover	Cover describes a plant that experiences growth and development
2	Introduction	This section explains various basic terms such as the notion of growth and development, and a general description of the concept of growth and development
3	Main content	In the main content section, the concept of: 1. Internal factors of growth and development: genetics, plant hormones 2. External factors of growth and development: temperature, humidity, acidity, nutrient content, etc.
4	Conclusion	In this section students are asked to draw conclusions and evaluate and comment on events related to plant growth and development
5	Evaluation for students	In this section students are asked to discuss and answer HOTS questions which consist of the ability to analyze, evaluate and create

Source: Supriyatin & Ichsana [18].

3. Result and Discussion

The results of the study showed that all items are valid and reliable. Then the data is described in table. Data are presented pre-test post-test and gain scores. Calculation of the gain score is the difference between the test post and pre-test. More can be seen in table 4. In Table 4 the largest increase can be seen from the gain score, which is in item 8, while the smallest increase is in item 5. Overall it has increased in each item. Then the students HOTS score can be seen from each indicator in Table 5.

Table 4. Students HOTS scores viewed from each item

No	Item	pre	post	gain score	category
1	Analyzing the effects of auxin deficiency	2.95	4.23	0.14	Low
2	Analyzing the effect of abscisic acid on roots, leaves, stems, fruits	2.39	4.70	0.24	Low
3	Analyzing the effect of ethylene on fruit	2.39	4.34	0.20	Low
4	Comments about the temperature factor for plants	4.05	4.86	0.10	Low
5	Comments about the factor of excessive fertilizer purchase	3.21	5.39	0.25	Low
6	Giving arguments about plant genes	1.80	4.70	0.28	Low
7	Creating a research design about plant growth and development	2.98	7.50	0.50	Moderate
8	Making a concept map about plant growth and development	1.11	5.68	0.42	Moderate

Table 5. Student HOTS scores viewed from each indicator

Indicator	Pre	Post	Gain	Category
Analyzing the factors that cause growth and development of plants	2.58	4.42	0.20	Low
Criticizing the role of internal and external factors of plant growth and development	3.02	4.98	0.22	Low
Creating simple research designs and concept maps about plant growth and development	2.04	6.59	0.46	Moderate

Dependent t-test was conducted to test the significance of the difference between the pre-test and post-test scores. Significant test results showed the t-value is higher than t-table. In addition, if seen from the Sig value <0.05 , it can be concluded that the post-test score is significantly higher than the pre-test score. This can be interpreted that SB-Plant can increase the HOTS of senior high school students.

Table 6. Dependent t-test results

Mean	Std. Deviation	t-value	df	Sig. (2-tailed)
20.50	13.30	11.528	55	.000

Based on the results of the study it can be said that the SB-Plant is effectively used in Biology learning. That was because SB-Plant was developed with the characteristics of senior high school students who find it difficult to understand the topic. SB-Plant has several advantages such as (1) easy to understand contains (2) simply packaged (3) based on HOTS. These three advantages cause SB-Plant products to increase HOTS of senior high school students in Biology learning. As an Supplement book, SB-Plant is in accordance with its function which is to deepen students' knowledge on the topic of plant growth and development [19,20].

The first advantage is that contains are easy to understand. Most textbooks used in schools often contain languages that are difficult to understand. Textbook often uses Latin terms and is too rigid, unlike the SB-Plant which uses simple and communicative language. In the discussion of auxin, ethylene and abscisic acid, it is explained simply using language that is easier to understand. The use of this language was important because good learning media must be communicative [21-23].

The second advantage is simply packaged. Layout of SB-Plant is simple without using much writing. Besides that the number of pages presented in SB-Plant is only 27 pages. Then the distance between the lines also uses large spaces, so students can easily read them. These pages will make it easier for students to get important points from the concepts to be described in the SB-Plant. The sentences are also not long and straight to the point. This makes it easy for students to understand because the information conveyed will be more informative [24-26].

The third advantage is SB-Plant was a HOTS based book. This can be seen in the students' activity section that contains instructions for students to discuss. In addition, students are asked to analyze and evaluate the phenomena in their environment related to plant growth and development. In addition, the topic presented in learning to use SB-Plant is material that requires HOTS capability, for example regarding the impact of fertilizer use in plants. Students will be trained to analyze the problem and then evaluate the effects of excessive fertilizer use. After that student are expected to create

innovation to solve these problems. The ability of HOTS is expected to be used by students to solve problems regarding the growth and development of plants that they encounter every day [27-29].

The increase caused by the use of SB-Plant is due to these three advantages. When seen in table 3, it is clear that the biggest increase occurred in item 7, designing experiments on plant growth and development. This showed that SB-Plant stimulates students to be able to make a research design [30,31]. Then when seen in table 4, the biggest increase was also found in the third indicator which is about the aspect of creation. This indicates a positive thing considering the score from the aspect of creation that is relatively low in pre-test. Meanwhile, if we see the smallest increase occurring in the first indicator regarding analyzing the factors inhibiting plant growth and development. This indicates that this book has not generated much data that can make students analysis power increase significant [32,33].

As for implementation of SB-Plant in schools, there are still some shortcomings that must be noted. One of them is the availability of time in the use of SB-Plant. Biology learning at the senior high school level, teachers often skip the discussion about growth, development, and plant environment in detail. This is because the teacher considers that the growth and development of plants are something that students can already understand though students may not be able to understand it well. This must be overcome because students must understand a topic from basic concept [34-36].

In using this SB-Plant, the teacher can combine it with learning models. Teacher must use learning models that prioritize problem-solving, because there are very suitable for use in learning combine with SB-Plant to improve HOTS [8,9,37-39]. Problem-based learning model, for example, the teacher can first give a case relating to the growth and development of plants such as the low number of fruits on a mango tree. After that, to solve the case, students are asked to learn the concept through SB-Plant. Then after learning about the growth, development, and environment of plants, students are asked to provide solutions to the problem of the small number of fruits in the mango tree.

4. Conclusions

Based on the results of the study it can be concluded that the HOTS score of students has increased. This proves that SB-Plant is effectively used in learning Biology and can improve HOTS. That is because SB-Plant has the advantages of which (1) contains easy to understand language (2) is simply packaged (3) is based on HOTS. Implementation of SB-Plant can combine with Problem-Based Learning (PBL) to solve the problem about plant growth and development.

Acknowledgements

Thank you for Faculty of Mathematics and Natural Science, Universitas Negeri Jakarta for funding this research in 2019. Thank you to all the respondents who have been participated in this research.

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