

The Effectiveness of Animal Physiology Textbook Based on Higher Order Thinking Skills

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Abstract. The aim of this study was to determine the effectiveness of animal physiology textbook based on higher order thinking skills. Type of this research was quasi experiment. The design used was pretest-posttest control group design. For experimental group, learning process used animal physiology textbook based on higher order thinking skills meanwhile control group used electronic book or journal of animal physiology. Hypothesis was tested by t- test used SPSS 16.0 software program. The post-test result showed that the average score in experimental group (71,19) was higher than control group (55,67) with p-value $(0,000) < \alpha (0,05)$. H₀ was rejected and H_a was accepted. Students' higher order thinking skills in experimental group was significant higher than control group. N-gain result in experimental group was 0,59 in the category of "Good". It can be concluded that the effectiveness of animal physiology textbook based on higher order thinking skills was good.

Keywords: Animal Physiology, Higher Order Thinking, Textbook

1 Introduction

The higher education curriculum that refers to the Indonesian National Qualifications Framework (KKNI) in its preparation must meet the National Education Standard (SNP). Permendikbud No.3 of 2020 states that the National Standard of Education (SNP) is a minimum criterion for learning at the higher education level that must be met by all universities in Indonesia. One that is included in the national standard of higher education, namely the standard of learning facilities and infrastructure. This standard contains minimal criteria related to content needs and processes to achieve learning goals. In this case, the teaching book becomes one of the standards that must be met.

According to [7], teaching books are media containing learning materials that are systematically arranged for the purposes of the teaching and learning process. The teaching book is compiled by lecturers who study courses in accordance with the field of science they master. The use of teaching books is expected to accommodate students' learning difficulties so that writing is arranged with flexible learning patterns according to student needs. In addition, the writing style

is also communicative and well organized, uses standard language in accordance with scientific writing rules, has an adequate and complete depth of learning materials, and can build student motivation to learn independently. Teaching books as teaching materials are one of the important components in the learning process so that in its application it becomes the most frequently used media [2][6].

Teaching books become a necessity in various universities to assist students in completing lecture assignments, as well as achieving learning goals and competencies of graduate achievements in accordance with the curriculum and national standards of education. Students who will graduate as undergraduates are required to have general skills, namely being able to apply or develop science and technology through logical, critical, systematic, and innovative thinking in accordance with their field of expertise. Competence in national standards of education is closely related to the competencies needed in the 21st century or namely critical thinking ability, creativity, communication, and collaboration.

According to [10], one of the skills that are important to develop and is part of the goals of the education system today is the ability to think critically. Students who have critical thinking skills will be able to solve various contextual problems, especially those related to the development of animal physiology using critical and rational thinking logic. To achieve these goals, a learning process needs an evaluation based on higher order thinking skills (HOTS). Therefore, the development of teaching books based on higher order thinking skills is believed to be effective in improving the high-level thinking skills of students [5].

The development of animal physiology textbooks based on higher order thinking skills is presented in the preparation of tasks and exercise questions in teaching books. The components of HOTS in the teaching book are in accordance with bloom taxonomy revisions by [1] which are related to the ability to analyze, evaluate, and create.

The use of teaching books based on higher order thinking skills can result in productive learning activities. Students can be able to associate, manipulate, and transform their knowledge and experience with critical thinking patterns [8]. This is in line with what [3] stated the learning process can run optimally with a good teaching book accompanied by an evaluation system that can improve students' high-level thinking skills. Teaching books that can lead students to high-level thinking skills contain questions that invite students to analyze, evaluate, and create. The components of HOTS in teaching books can create effective learning to improve students' high-level thinking skills [9]. This study aims to find out the effectiveness of animal physiology textbooks based on higher order thinking skills in improving students' higher order thinking skills.

2 Research Method

This research has been conducted in Biology Education Program at Medan State University. The population was all the fifth semester undergraduate students who were taking Animal Physiology course in the year of 2021. Sample consisted of 2 groups selected randomly, class A of Biology Education Study Program as experimental group (n = 21 students) and class C of Biology Education Study Program as control group (n = 18 students).

Type of this research was quasi experiment. The design used was pretest-posttest control group design. The design was represented as: O1 X O2 with O1 representing the pretest, X representing the treatment implemented, and O2 representing the posttest. The experimental class and the control class were given a pretest with the same questions first. Then, given treatment in the form of learning animal physiology for 7 weeks or 14 meetings. In the experimental class, the learning process used animal physiology textbooks based on higher order thinking skills. The materials taught was 5 chapters sourced from the textbook, namely Chapter VII Nervous System, Chapter VIII Endocrine System, Chapter IX Excretory System, Chapter X Osmoregulation and Thermoregulation, and Chapter XI Bioluminescence. Meanwhile, in the control class, the learning process was carried out with the same material as in the experimental class, but by using a journal or e-book of animal physiology. After the treatment was completed, a posttest was conducted with the same questions as the pretest.

The data used in this study was quantitative data derived from the results of pretest and posttest. Multiple choices and essays test were the instruments for data collection. Hypothesis was tested by t- test used SPSS 16.0 software program In order to undertake hypothesis testing, the researcher expressed the research hypothesis as a null and alternative hypothesis. The null hypothesis and alternative hypothesis are statements regarding the differences or effects that occur in the population. The level of statistical significance or the probability (i.e., the p-value) of observing the sample results given is determined to express that the null hypothesis is true. However, the statistically significance chosen was 0.05. There was a 5% or less chance (5 times in 100 or less) that the difference in the mean exam performance between the two teaching approaches is as different as observed given the null hypothesis is true. If the p-value is less than (or equal to) 0.05, the null hypothesis is rejected and alternative hypothesis is accepted. If the p-value is greater than 0.05, the null hypothesis is accepted and alternative hypothesis is rejected. The hypothesis is as follows:

H0 : Students' higher order thinking skills in the class of using animal physiology textbook based on higher order thinking skills was significant lower than students' higher order thinking skills in the class of using journal or e-book of animal physiology.

Ha : Students' higher order thinking skills in the class of using animal physiology textbook based on higher order thinking skills was significant higher than students' higher order thinking skills in the class of using journal or e-book of animal physiology.

Data was also analyzed by N-gain test. It is used to determine the achievement of students' higher order thinking skills from before and after the learning process. The formula of N-gain test is as follows:

$$N\text{-gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum Score} - \text{Pretest Score}} \quad (1)$$

The results of N-gain are classified into 3 categories as shown in Table 1. A good level of effectiveness if the N-gain value is greater than 0.40.

Gain Score	Criteria
$g > 0,70$	High
$0,30 \leq g \leq 0,70$	Medium
$g < 0,30$	Low

3 Result and Discussion

The average score of pretest in the experimental class was 29.43 ± 8.76 and is not different from the control class, which was 28.72 ± 6.94 . However, after the learning process by using Animal Physiology textbook based on higher order thinking skills, the average score of posttest in the experimental class was 71.19 ± 9.14 . It was higher than the average score of posttest in the control class used journals or e-books, namely 55.67 ± 6.83 . Pretest and posttest score both in experimental class and control class can be seen in Figure 1.

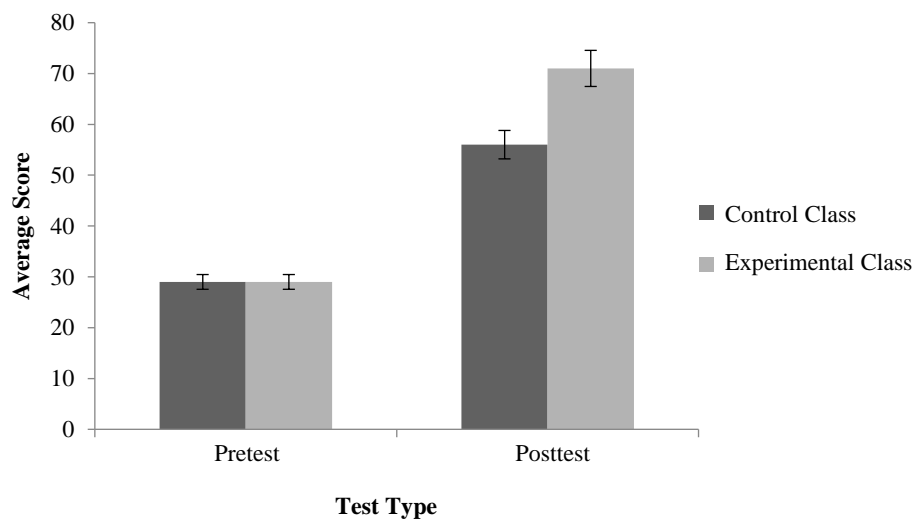


Fig. 1. The Average Score of Pretest and Posttest in Experimental Class and Control Class

T-test was conducted by using pretest and posttest data. The result of t-test can be seen in Table 2. The pretest score in the control class and the experimental class were not significantly different ($p > 0.05$). This shows that there is no significant difference between students' higher order thinking skills in the control class and experimental class before the lesson is implemented. After the learning process is carried out in both classes, then a posttest is carried out in the form of a higher order thinking ability test. The test results were then tested by t-test (Table 2). H_0 is rejected and H_a is accepted. The result of the t-test shows that students' higher order thinking skills in the experimental class is significantly higher than the control class. In other words,

learning using animal physiology textbooks based on higher order thinking skills is more effective than learning using journals or e-books.

Table 2. T-test

Data	Class	α	Sig. t (p-value)	Conclusion
Pretest	Control	0,05	0,784	There is no significant difference
	Experiment	0,05		
Posttest	Control	0,05	0,000	There is a significant difference
	Experiment	0,05		

Data was also analyzed by N-gain test. The result of N-gain test can be seen in Figure 2. Based on data analysis, the average N-gain score in the experimental class was 0.59 ± 0.13 and higher than the N-gain score in the control class, which was 0.38 ± 0.09 . The result of the acquisition of N-gain in the experimental class and control class are in the medium category.

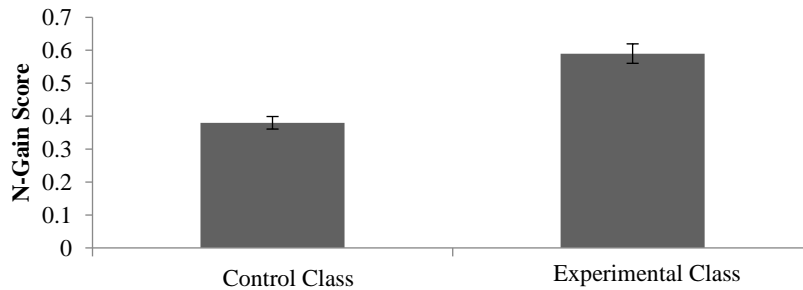


Fig. 2. N-Gain Score in Experimental Class and Control Class

The result of N-gain score was analyzed by the category of higher order thinking skills (analyzing, evaluating, creating) that is shown in Figure 3. The results of the N-gain test based on the category of higher order thinking skills shows that the ability to analyze, evaluate, and create in the experimental class are higher than the ability to analyze, evaluate, and create in the control class. This shows that the Animal Physiology textbook based on higher order thinking skills is effective in improving students' higher order thinking skills. According to [4], the level of effectiveness is good if the N-gain score is greater than 0.40 ($N\text{-gain} > 0.40$). The average N-gain score in all categories in the experimental class (0.59) is greater than 0.40 and is included in the category of good meanwhile the average N-gain score in all categories in the control class is lower than 0.40 and is included in category of not good.

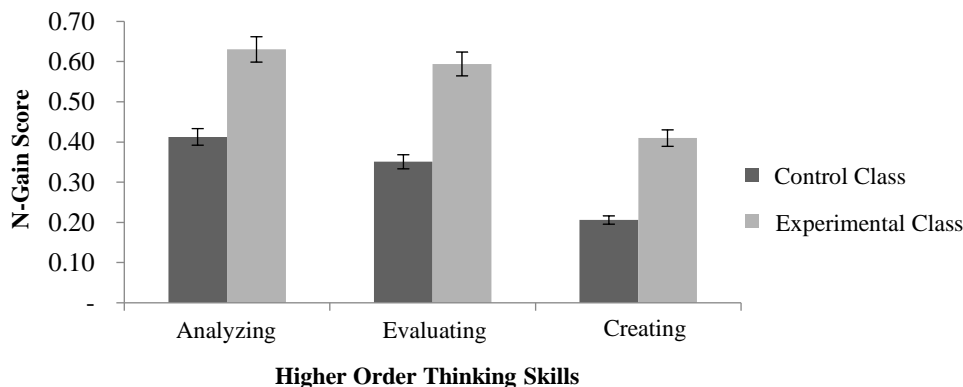


Fig. 3. N-gain Score Based on The Category of Higher Order Thinking Skills

The effectiveness of a developed textbook was tested by conducting the learning process using animal physiology textbook based on higher order thinking skills. The textbook was used as a learning source for students. Learning activities in the classroom used an active learning method that asked students to think at high levels, namely analyzing, evaluating, and creating, based on the tasks and exercises presented in the textbook. Students were actively asked to solve the problems presented in the exercise and connect it to the learning concepts. In addition, students were also asked to discuss the materials contained in the textbook critically in their group discussion. Then, they presented it in the class. Through those activities, the ability of critical thinking and problem solving which are the parts of the process to cultivate the students' higher order thinking skills can be improved. This is in line with what [5] stated that in the process of cultivating students' higher order thinking skills requires a learning process that leads to HOTS learning activities, such as using learning media or textbook based on higher order thinking skills. The improving of students' higher order thinking skills can be seen from the increasing of students' critical thinking, problem solving, reasoning ability, and decision making.

The effectiveness of animal physiology textbook based on higher order thinking skills was tested by t-test and N-gain test. Based on the analysis of the t-test, it is known that the students' higher order thinking skills in experimental class that uses developed animal physiology textbook is significantly higher than the students' higher order thinking skills in control class that uses journals or e-book. This suggests that animal physiology learning using a textbook based on higher order thinking skills is more effective than learning using journals or e-books. This result is also supported by the average of N-gain score in the experimental class, which is 0.59 greater than 0.40 ($N\text{-gain} > 0.40$). It shows that the effectiveness level of animal physiology textbook that has been developed is included in the good criteria. The result of this study is in line with [4] stated that the effectiveness of a textbook is good if the acquisition of N-gain score is greater than 0.40.

The average of N-gain score in the control class is 0,38, smaller than 0.40 ($N\text{-gain} < 0.40$). In general, this suggests that the effectiveness level of animal physiology learning using journals or e-book is in the category of not good. However, if the N-gain score is analyzed based on the category of higher order thinking skills, the ability to analyze in the control class is relatively good. This is different from the acquisition of N-gain scores in all categories of higher order thinking skills in experimental class, namely the ability to analyze, evaluate, and create included

in the category of good ($N\text{-gain} > 0.40$). The result of this study is supported by previous research. According to [9], one of the ways to cultivate the students' higher order thinking skills is to carry out the learning process by using teaching books as the learning sources that can lead the students' to think at a high level, such as analyzing, evaluating, and creating. The tasks and exercises compiled in the textbook are not limited to the ability to remember or understand (lower order thinking skills), but the tasks and exercises compiled in the textbook must be able to improve the students' higher order thinking skills. There must be some stimulus presented in the textbook that stimulate the students to think at high levels. With the components of higher order thinking skills (HOTS) in a textbook, it can create the effective learning and improve the students' higher order thinking skills.

4 Conclusion

The research result shows that students' higher order thinking skills in the class of using animal physiology textbook based on higher order thinking skills is significant higher than students' higher order thinking skills in the class of using journal or e-book of animal physiology. The average $N\text{-gain}$ score using animal physiology textbook based on higher order thinking skills is included to the category of good. It can be concluded that the effectiveness of animal physiology textbook based on higher order thinking skills is good to enhance students' higher order thinking skills.

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