The implementation of constructivist modules to correct misconceptions on the human reproductive system concept

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Abstract. It is necessary to find appropriate learning solutions to solve students’ misconceptions on the human reproductive system concepts. This study aims to determine whether learning through the implementation of a constructivist module influences the reconstruction of students’ knowledge about the human reproductive system. The method used in this study was experimental with one group pre-test and post-test design. The population consisted of 272 students from science class XI of SMAN 10 Fajar Harapan Banda Aceh and SMAN Modal Bangsa Aceh Province. A total of 107 students were chosen by random sampling. The study was carried out over four months from March to July 2019. The supporting instruments used were the learning media and the data collection instruments in the form of multiple-choice test questions with Certainty of Response Index (CRI). The data collected through a pre- and post-test were analyzed using percentages. The results show that the number of students who understand certain concepts rose by 52.36%, the number of students who had misunderstandings decreased by 43.58%, and the number of students who had misconceptions fell by 9.94%. So, it is concluded that learning through the constructivist module is effective in improving concept reconstruction and students’ learning outcomes.

1. Introduction

Certain learning obstacles have not been solved successfully by teachers, so the quality of education in Indonesia from year to year is still relatively low. The average performance of Indonesian students in science achievement is ranked 62 out of 69 countries [1]. One learning obstacle students face is the existence of misconceptions. Misconceptions arise when students believe a concept that mostly does not overlap with scientific realities [2]. A misconception usually has three primary characteristics. It is a concept that is inconsistent with concepts understood by scientists [3], it is held by a sizable proportion of the population, and it is resistant to being taught away [4]. Misconceptions must be detected quickly. This is because the concepts in a material are related to the concepts of the next material, so the correct understanding of concepts is needed.

One factor that causes misconceptions is textbooks. The content of many textbooks contains many mistakes and is not always accurate [5]. Hershey [6] suggested in 2004 reports that there are many misconceptions found in textbooks. There are 50 misconceptions that have been identified due to oversimplification, overgeneralization, or misidentification. Therefore, teachers must be aware of conceptual problems that appear in textbooks.

The way to overcome misconceptions is through the innovation of the learning process by using modules. Modules contain a series of teaching materials designed to be studied by students
independently. Modules have sustainable goals within 21st-century constructivism and education approaches that demand learner-centred learning processes [7].

Constructivism is an approach that can reconstruct students' knowledge. Through this approach, students become the centre of the learning process. In addition, students must be able to search, explore, and also elaborate a lot of information regarding the material studied. Consequently, this approach can make it easier for students to understand concepts so that misconceptions do not occur again [8]. Research by Wu and Tsai [9] in 2005 showed learning with a constructivist approach provides more opportunities for students to improve their interpretive abilities, express their ideas, negotiate with others, and build a sense of their biological knowledge. Hardy et al. [10] also pointed out that the constructivist approach to the learning process encouraged conceptual changes in elementary school children in the field of physics. Also, Fitria et al. [11] reported that learning through constructivist modules proved to be quite effective in overcoming students’ misconceptions about the concept of cells.

This study aims to determine whether learning through the implementation of constructivist modules influences the reconstruction of the human reproductive system concept which is expected to be able to reconstruct the misconceptions of students because students are demanded to be able to build concepts based on their initial knowledge.

2. Research Method

This research was conducted for four months, from 6 March 2019 to 20 July 2019 at SMA Negeri 10 Fajar Harapan Banda Aceh and SMA Negeri Modal Aceh Province. The method used was an experiment with one group pre-test - post-test. The population consisted of all students of class XI MIPA which totalled 272 students while the sample consisted of 107 students who were chosen using simple random sampling. The supporting instruments were learning media and multiple-choice test questions with CRI (Certainty of Response Index). The data was collected through the pre-test and post-test. The data were analysed descriptively.

3. Results and Discussion

In this study, the effect of the constructivist module on the conceptual understanding of the human reproductive system among high school students is presented using percentages.

The results of the questionnaire answer criteria based on the level of confidence and the reasons for answering questions in a particular way were used as data to determine students’ level of understanding about the human reproductive system.

The level of conceptual understanding can be measured through differences between students’ prior knowledge and their final knowledge which is presented in Figure1 below.
Figure 1. The percentage of students’ prior and final knowledge.

Figure 1 shows the increase in students’ understanding based on the average CRI score from the pre-test and post-test. This shows that students’ misconceptions were corrected as indicated by the decrease in the percentage of misconceptions. The percentage of students at three different understanding levels based on sub-concepts in the pre-test and post-test can be seen in Figure 2 and Figure 3 below.

Figure 2. The percentage of students’ prior knowledge based on sub-concepts.

Based on Figure 2 it is clear that before students learn through constructivist modules, most students do not conceptually understand the entire human reproductive system. This is indicated by the
average percentage of students who do not understand each sub-concept. The sub-concept with the greatest prior misunderstanding was menstruation and ovulation. The sub-concept with the greatest prior misconception was the structure and function of organs.

| Sub-concept                      | Average Percentage |
|----------------------------------|--------------------|
| Disorders and diseases           | 6.54               |
| Fertilization, pregnancy and childbirth | 6.3               |
| Menstruation and ovulation       | 8.09               |
| Sex hormones                     | 8.4                |
| Gametogenesis                    | 8.14               |
| Structure and function           | 4.88               |

| Reproductive organ               |                    |
|----------------------------------|--------------------|
| Disorders and diseases           | 75.7               |
| Fertilization, pregnancy and childbirth | 73.59             |
| Menstruation and ovulation       | 69.77              |
| Sex hormones                     | 63.17              |
| Gametogenesis                    | 67.41              |
| Structure and function           | 80.72              |

**Figure 3.** The percentage of students’ final knowledge based on sub-concepts.

Figure 3 shows that after students have followed the learning process using a constructivist module, students’ understanding of concepts has increased significantly compared to students’ initial knowledge. This is indicated by an increase in the average percentage of students who understand each sub-concept of the human reproductive system. The application of constructivist module result the highest score in the concept of structure and function of the human reproductive organs Misunderstanding experienced the highest decrease in the menstrual and ovulation sub-concepts of 53.82%, while misconceptions experienced the highest decrease of 14.83% in the sub-concept of fertilization, pregnancy, and childbirth.

In biology and science education, constructivism must be one of the main pedagogical principles. It has a very significant positive role in the pedagogy of science teaching which can develop problem solving abilities, critical and reflective thinking, and creativity and scientific attitude among students [12]. Constructivism can be used by students to reconstruct concepts by connecting the knowledge they have with the new knowledge they get in school [13]. Ineffective learning processes make students unable to master concepts well or can even create misconceptions [14]. If students have misconceptions, it will greatly affect the acceptance and understanding of new knowledge that they will receive later [15].

Constructivist modules can improve the achievement of KKM in students. Additionally, students who learn with constructivist modules will become accustomed to finding concepts during independent learning [16] and have a sense of responsibility towards mastering the material [17]. If students already have a self-concept, students’ interest in learning will be built indirectly. The results obtained are in accordance with the theory that there is a positive relationship between self-concept and learning interest [18].

In fact, students who have misconceptions tend to lack an understanding of the content of the questions provided so they will relate the questions to the choices available based on the students’ knowledge [19]. When giving a reason, students also give a false argument or statement that is not in accordance with the opinions of experts. Students who understood the content can understand the
questions and parts of the problem and can choose answers and give reasons that follow the opinions of experts.

Based on the data obtained from this study, the reproduction system module based on constructivism can be used as one of the media in the learning process to reconstruct students’ conceptual understanding of the human reproductive system. This is evidenced by the decrease in the percentage of misconceptions that are quite far away so that the process of reconstruction of the misconception is running properly. In reality, the constructivist module on the human reproductive system has not yet completely improved students’ understanding, and there are still some students who experience misconceptions despite other contributing factors. The use of modules automatically requires students to be diligent in reading and understanding the content along with the instructions contained in the module. However, for students who are too lazy to read instructions and content, it will be very difficult to understand the material with the use of modules alone. This is one of the shortcomings of learning media in the form of modules to improve student understanding. The new thing in this research is the use of a constructivist module that is designed based on students’ prior knowledge so that students can efficiently correct their misconceptions.

4. Conclusions
The conclusion obtained in this study is learning through constructivism-based modules influence the reconstruction of students’ reproductive system concepts.

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