Characteristics of biotechnology learning materials generally used by biology education students in Padang City

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Abstract. Students’ understanding is very necessary in studying biotechnology. This understanding is obtained through a learning process that is supported by learning materials that can help students understand the material. This study aims to determine the characteristics of biotechnology learning materials used by biology education students in Padang City. The type of this research is descriptive research. The participants of this study are 4 lecturers of biotechnology, 113 university students, and biotechnology learning materials used in the learning process. Data collection instruments used are guidelines for interviewing the lecturers and questionnaires for the students. The sampling method used is purposive sampling. Research data are analyzed by using descriptive statistical analysis. Students state that biotechnology is difficult to understand because the material is in the form of a process and cannot be observed directly for the entire material. The learning materials used are in Mic. power point form and printed learning materials that are not able to visualize the material. Students argue that the ideal biotechnology learning materials to support the understanding are learning materials that can visualize material in the form of processes that cannot be directly observed. This finding suggests that it is necessary to have materials that can visualize biotechnology materials in order to increase students understanding of the material.

1. Introduction

Biotechnology is a science that always develops along with the development of technology. Based on the study, biotechnology has the ability to answer challenges that will be faced in the future regarding various products from various fields of science [1]. In addition, biotechnology is one of the fastest growing parts of the scientific discipline and has great potential to improve human life [2]. In addition, biotechnology is one of the fastest growing parts of the scientific discipline and has great potential to improve human life [3], and the New Zealand Curriculum Framework that recognizes the importance of biotechnology in the country [4]. In Australia, the federal and state governments also have identified the relevance of biotechnology in the curriculum.

Biotechnology is one of the fastest growing fields in biology for both scientific purposes and among the society [5]. Therefore, the society needs more education about this process [6]. Understanding biotechnology can have a good impact on the use of biotechnology in life. It is becoming increasingly clear that a broader understanding of the social, ethical and economic implications of biotechnology is needed. In addition, remembering the potential impact of biotechnology on human health, agriculture and
the environment also supports the background of the need for understanding in the field of biotechnology [7]. European countries have established the European Initiative for Educational Biotechnology and the European Union funds a study of different cultural contexts in which biotechnology teaching and learning is instilled [8]. This shows that understanding in the field of biotechnology is very necessary.

Biotechnology has developed approximately 15 years earlier than other fields of scientific biology. This development reveals a fact that biotechnology has benefits in life. This benefit has the potential to help many people from various professions and for positive interests [9]. Biotechnology also has the potential to improve the quality of life such as in the field of food quality, treatment and bioremediation for the environment [10]. According to the 'International Service for Agri-biotech Acquisition Applications' (2014), biotechnology has shown a great progress over the past few decades in the sector of agriculture and in certain sub-sectors [11].

2. Background of study

2.1 Characteristics of biotechnology materials
Biotechnology is a broad field that covers a variety of natural and social science disciplines [12], so it is an ideal subject for the curriculum. Biotechnology consists of concepts and procedures that are considered as abstract topics for most students. For example, DNA, RNA and protein cannot be handled physically or observed directly. Biotechnology topics such as cloning are also seen as very abstract concepts. The replication process cannot be observed directly. However, if students do practice for the learning material, then the abstract material can be better understood. Practicing makes science feel more meaningful than just reading concepts [13].

2.2 Students' understanding on biotechnology
The study of biotechnology is based on whether students understand concepts such as DNA to DNA manipulation. Many students have heard some terms but most of them may not be able to explain these things. Students also have difficulty in visualizing the structure of DNA, replication, central dogma and DNA cloning techniques. Without application based-learning will produce unsatisfactory results [7].

2.3 Students' attitudes towards biotechnology
Biotechnology contains interesting topics to discuss. [14] cites a 1998 study by Todt and Götz that captures students' interests and attitudes towards biotechnology and especially gene technology. Todt and Götz's study find that they are only interested in the social, ethical, economic and technical aspects of the gene technology. Students' interest is not knowledge-based, but rather based on curiosity. The media turns out to have an impact on the development of students’ interest, especially if there is a medical application or ethical question [15].

2.4 Availability of learning materials
Instructional materials is one of the factors that support student learning comprehension. Learning material also can improve the critical thinking of student, concepts understanding, and attitude toward learning [16]. Learning materials must also be adjusted to the characteristics of the material. The obstacles in teaching the biotechnology topics cause biotechnology to get less attention in teaching and learning activities activities [17]. Constraints faced by lecturers in teaching biotechnology in Indonesia include lack of expertise in biotechnology, lack of experience and suitability activities in teaching biotechnology, and lack of resources and time [18]. Therefore, the availability of learning resources of subject in biotechnology is very important.

Learning materials used in learning should be adjusted to the characteristics of abstract biotechnology
material, meaning that the instructional material can visualize the material well so that the abstract thing in the material can become more tangible, such as adding media that can visualize the material.

3. The aim of the present study
The purpose of this study is to determine the characteristics of biotechnology learning materials generally used by biology students in Padang city. The results of this study can be used as guidelines for developing ideal biotechnology learning materials that are in accordance with the characteristics of biotechnology materials.

4. Method

4.1. Participant
The participants of this study are 4 biotechnology lecturers from 4 universities in Padang City and 113 university students studying biotechnology. The students also come from 4 different universities in Padang City that consist of 81 biology education study programs students and 32 biology study programs students. In addition, the learning materials used in the biotechnology course do not become the subject in this study.

4.2. Instruments
The research instruments used are guidelines for interviewing the lecturers and questionnaires for students. This interview guide contains several questions about the learning methods used, learning materials used, and the level of students' understanding of biotechnology. Questionnaires given to students contain the availability of learning materials along with the form of learning materials used, students' opinions about the biotechnology materials, students' attitudes towards biotechnology, and ideal biotechnology learning materials according to students' view. This questionnaire belongs to semi-closed types that have two scales, namely "yes" or "no" and are accompanied by reasons. In this questionnaire, only positive items are used to avoid invalid instruments. This is in line with the statement of [19] which states that negative items can reduce instrument validity and reduce the response of students to each item.

4.3. Data Analysis
Data from this study are analyzed using descriptive statistical analysis.

5. Result and Discussion

5.1 Result

| Table 1. Results of interviews with biotechnology lecturers. |
|-------------------------------------------------------------|
| Aspect Question | Interview Results                                      |
| Learning methods          | Methods lectures and group discussions                  |
| Subjects who used         | Powerpoint and learning materials printed               |
| Understanding Student     | Student enough to understand the material and have the motivation to learn good |

Table 1 shows that the method of biotechnology learning used by the lecturers is the lecture method and group discussion. Learning materials used by lecturers are Mic. power point with a percentage of 75% and printed learning materials with a percentage of 25%. As for students' understanding, the lecturers state
that students could understand biotechnology enough, but have difficulties in understanding the molecular parts and processes in the material. Besides, students also have good motivation.

Table 2. Student questionnaire results

| Questions Aspects                                           | Percentage | The average |
|-------------------------------------------------------------|------------|-------------|
| Lecturer provide learning materials                         | 84         | 75          | 79.5       |
| Learning materials help learning                            | 67         | 75          | 71         |
| Students are constrained in the understanding of biotechnology | 83         | 81          | 82         |
| Students interested in biotechnology                        | 95         | 97          | 96         |
| Biotechnology ideal learning materials                      | 96         | 97          | 96.5       |

Table 2 shows the results of questionnaires filled by students. 79.5% students state that the learning materials used are Mic. power point given by the lecturer and printed learning material in the form of a textbook. Although 71% students agree that these learning materials help the learning process, they still do not have enough information about biotechnology materials and cannot visualize biotechnology material that also contains procedures in it.

Regarding the students' understanding, 82% students say that they are constrained in understanding biotechnology material because it cannot be observed directly. However, apart from students' understanding, biotechnology material is quite favored by students. This is indicated by 96% students who answer that they are interested in biotechnology because the materials in biotechnology contain interesting topics to study. Students also express their opinions about ideal learning materials for biotechnology. 96.5% students state that the ideal learning material for biotechnology materials is learning materials that can help students to better understand the material by visualizing the material that cannot be observed directly.

The characteristics of biotechnology materials which consist of concepts and procedures that cannot be observed directly overall cause students to have difficulties in understanding biotechnology. The use of learning materials that only consist of concepts is also one of the reasons why students are constrained in understanding the material. This problem arises because biotechnology materials do not only consist of concepts. To better understand the procedures contained in the material, ideally students need to practice it directly. However, due to several constraints such as costs, the practice cannot be done for all materials. Therefore, students expect the existence of learning materials that are in accordance with the characteristics of the material, meaning that the learning materials used should be able to visualize the material presented, such as adding pictures and videos that help students understand the material.

5.2. Discussion

Biotechnology is a science that has many roles in various fields of life. The benefits of biotechnology should be used by students and the society to improve the quality in various fields. To be able to apply this knowledge well, it requires a good understanding. For students, understanding of biotechnology is obtained from the learning process. The understanding of these students is also supported by several factors; one of them is the use of learning materials in learning.

The characteristics of abstract biotechnology material are obstacles for students to be able to understand biotechnology as a whole. Students state that they find it difficult to understand things they
could not observe directly, considering that biotechnology material discussion is until the molecular level. In addition, students also argue that they find it difficult to only imagine the processes that occur in biotechnology. This is also acknowledged by biotechnology lecturers who state that students are indeed constrained in learning the molecular part of biotechnology.

The characteristics of abstract material can be clarified by the existence of supporting learning materials. However, the result obtained is that the learning materials used are only printed learning materials that are not able to visualize the abstract material. In addition, learning materials in the form of Mic. power point slides are also used which only consist of the main points of the material. According to [20], the printed learning materials can help student to understanding the material concept and the materials will be remember by the student well.

One alternative that can be used for this problem is to use media that can support learning materials to suit the material characteristics, such as the use of pictures and videos that are relevant to the material. [21] stated that learning material of biotechnology have to show the pictures that related with materials as the stimulus for student to increase the motivation in learning. Similarly, students approve the alternative because with pictures and videos, students can better understand things that cannot be seen directly and can understand the procedures contained in biotechnology materials. The use of pictures and videos media is one way to integrate the concept understanding in learning. Pictures and videos have a role to make biotechnology material more real. In addition, the learning process will be faster and easier by using audio visual compared to just an oral explanation [22]. This is also in line with the opinion of [23] which states that there are several benefits of visual aids in learning, including: a) trigger students' thinking and improving the learning environment in the classroom; b) eliminate monotonous conditions in learning; and c) increase students' understanding of the material because the tools relate to the content being taught. The media that increase student ability to understand the concept also can make student increasing their critical thinking [24].

6. Conclusion
Based on the research that has been done, it can be concluded that biotechnology learning materials commonly used by Biology Department students in Padang City are in the form of Mic. power points and printed learning materials in the form of textbooks. Students acknowledge that these learning materials do not contain enough information about biotechnology material. In addition, the learning materials that have been used also cannot visualize biotechnology materials that contain procedures. Based on the results obtained, it is necessary to use learning materials that are able to visualize the material so that it becomes more real and can improve students' understanding. The learning materials can be accompanied by audio visual media to further provide understanding for students.

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