Biochemistry Concept Level of Difficulty Profile of Prospective Biology Teachers’ Perception

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Abstract
This descriptive study deals with the prospective teachers’ difficulties in understanding the biochemistry concepts to obtain a figure of biochemistry difficulty profile. The subjects of this research are 42 2nd semester biology students in at LPTK in Aceh Province. The data needed for this study are collected by using an open and closed questionnaire referring to the Likert scale. The data are statistically processed. The results showed that the most difficult biochemistry topics include the topics on the catabolism of carbohydrates (27.3%), catabolism of lipids (16.8%), and catabolism of protein (14.5%). The difficulties in mastering the concepts are sought to be due to their using a lot of chemical formulas and chain reactions that hindered the students to fully understand them. These concepts will be easier to understand and attractive by using computer technology. The results show that biochemistry is important for the prospective teachers. In terms of this, it is highly recommended to prepare good material, learning, and authentic assessment that provide challenges and improve students’ capabilities that can be applied in real life situations. Besides, it is important to do continuous and periodic assessment on this matter.

Key words: Level of difficulty, biochemistry concepts, prospective biology teachers.

Introduction
As an agent of learning, teachers should have five professional competences. One of them is mastering the subject’s material, structure, concepts, and scientific mind-set that support students in learning the subject. Professional competence is further elaborated for teachers in each respective subject of learning. One of 14 professional competencies that should be possessed by a biology teacher is to understand the concepts, laws, and theories of biology and its application in a flexible dimension (Permendiknas No. 16, 2007).

The Institution of Teacher Training (LPTKs) is an institution that produces teachers, one that prepares the students of prospective teachers to have four competences including pedagogic, personality, professional, and social competences. The professional competence of a biology teacher is attained from the Expertise Course (MKK). One of the courses included in MKK is Biochemistry. Biochemistry is one of the basic courses that should be taken by the students of prospective biology teachers in the institute. This course is intended to help students understand the chemical processes which are going on in the living things.

Biochemistry is the science of the structure, organization and function of the molecular processes of living beings. Biochemistry learning can be divided into three parts, namely: 1) the chemical structure of organic matter and the relationship between its structure and function, 2) metabolism, which is the overall chemical reaction that occurs in the organic material, and 3) molecular genetics, which studies the chemical structure of organic materials including the structure and function of macromolecules such as studies of the structure and function of carbohydrates, amino acids and proteins, lipids and nucleic acids. The study of metabolism covers the material such as enzymes, catabolism and anabolism of carbohydrates, proteins and lipids, while the study of molecular genetics includes DNA (chromosome structure and gene), DNA replication and transcription, and protein synthesis and regulation (Lehninger, 2008).

The results of analysis of the biochemistry syllabus on some LPTK show the lectures’ goal that only emphasizes the aspect of concept understanding. On the other hand, the author’s experience in handling the course for about ± 11 years using a strategy that focuses on the concept explanatory attributes utilizing various media and learning sources have not showed satisfactory results. The outcomes
achieved are restricted only on the mastery of the defined concepts. Meanwhile, the ability to understand abstract concepts and the relationships between concepts are difficult to achieve. When dealing with abstract concepts, such as metabolic reactions, students tend to develop alternative definitions to understand them.

Furthermore, if faced with the stage of chemical reactions in metabolism, students tend to just memorize the stages of the reaction, but the meaning of each phase is not well understood and difficult to understand, along with the occurrence of some common misconceptions. This misconception occurs due to students’ the inability to directly observe all stages of metabolic reactions at the molecular level. This is in line with a research by Meir et al. (2005) which suspected that the misconceptions that occur were due to the inability to directly observe the process of diffusion and osmosis at the molecular level.

Based on the results of research and field experience, the most difficult concepts mastered by high school teachers in class XII is carbohydrate catabolism or respiration (49%) (Hamidah et al., 2009). The same result is also showed by many high school biology teachers from various regions in Indonesia. The teachers of class XII mention that the most difficult materials to explain are enzyme, carbohydrate catabolism, anabolism of carbohydrates, the linkage between the catabolism and anabolism, the linkage between the metabolism of carbohydrates, fats, and proteins. Likewise, in terms of teaching materials and students’ mastery of the subject, the difficulties that occur are mainly on the metabolism (Hamidah & Nuryani, 2008).

Understanding the abstract concept is a great difficulty and challenge for either school or college students, which mostly lead to misconceptions. The limitations of media that were used in delivering lessons of abstract concepts have motivated some researchers to present the biochemistry material by utilizing computer technology in the form of animation or visualization as that of Roberts et al. (2005) with the physical models of three-dimensional molecular visualization and computer programs to help students understand the abstract concepts better and Ouyang et al. (2007) who present the lecture material with the aid of biochemistry multimedia device.

Based on the categories that make biochemistry considered as a difficult subject, it is necessary to consider how teachers teach and how students learn biochemistry. Both of these are closely related to the learning methods used in the lectures in class. In spite of the fact that there are many ways to create an effective teaching, all of those require three particular concerns: 1) the material being taught, 2) the most appropriate strategies to teach the subject, and 3) how students learn (Xiaoyan, 2003).

Thus, from the description above, it becomes compulsory for us to develop a biochemistry course program by knowing the prospective biology teachers’ perception on how the biochemistry course profile is in terms of its material characteristics and way of learning.

**Method**

This research is a descriptive study that concerns about the biochemistry material identification. Identification includes materials that are considered difficult by students and the things underlying their difficulty, and how the learning strategies that are expected by the students of prospective teachers so that the biochemistry materials in concern can be attractive and easy to understand.

The study involved 42 students of biology education class from batch 2009/2010 in an LPTK in the province of Aceh as the research subject. The data for this study is retrieved by using an open and closed questionnaire using Likert Scale. Research data both in the form of qualitative and quantitative are presented descriptively. Then, the data obtained are presented in graphical form, analysed and interpreted to see the prospective biology teachers’ perception on the biochemistry course profile.

**Results and Discussion**

**Level of Difficulty of the Biochemistry Subject on Concept Level**

Based on the results of the analysis of questionnaires given to students, the writer obtained the results presented in Figure 1.
Based on the results presented in Figure 1 it can be explained that the difficulty level of biochemistry subject from the students’ point of view occurred on the topic of carbohydrate catabolism with percentage of 27.3%, carbohydrate anabolism topic with the percentage of 19.4%, lipid catabolism topic with the percentage of 16.8%, protein catabolism topic with the percentage of 14.5%, lipid anabolism topic with the percentage of 12.2%, and the topic of protein anabolism with the percentage of 9.8%.

On the carbohydrate catabolism topic, the students stated that the thing that makes it difficult on this topic is the use of many complicated chemical reactions. In this topic, students should understand the stages that occur in each reaction pathway including the substance structures, enzymes, coenzymes and cofactors involved. In addition to that, this topic is considered difficult because students need to link one stage of catabolism to other stages which are taught at separately.

On the topic of carbohydrate anabolism, a deeper understanding of how the mineral nutrients and molecules enter into the plant is needed. Moreover, in order to understand how water and nutrients enter the plant, students need to understand the anatomical structure of the plant, especially the root. Another concern is that the number of nutrients needed by plant is too much, along with their functions and deficiency symptoms.

Whereas, on lipid catabolism topic, the difficulty was due to its chemical reaction with a long carbon chain. In this topic, students also need to understand many reaction chains even though not as many as in carbohydrate catabolism and anabolism topics. Additionally, students must understand the energy produced by a variety of lipids.

The lipid anabolism topic is also considered difficult although it is not as complicated as the lipid catabolism. This is because many chemical formulas and carbon chain in various lengths to form various fatty acids are used in this topic. Students also need to know the enzymes and coenzymes involved in the process.

The topic of protein catabolism is also considered difficult. In this topic, students have to remember many kinds of amino acids produced to be converted into intermediate compounds in the primary metabolism process to produce energy. Therefore, this topic is considered difficult since there are a number of precursors for the primary metabolism which are important in forming various amino acids that the students need to know.

Biochemistry Learning
The results show the prospective teachers students’ questionnaires analysis to find out the biochemistry learning is presented in Table 1. The information in Table 2 shows nine things considered important by the prospective biology teachers in response of how biochemistry learning should be. Among all the nine things, over 50% agreed that learning biochemistry will be easier with the aid of computer animation. Furthermore, it is necessary to relate their learning with everyday life and thus with the example they can presume in daily life.
Table 1. Responses of the prospective biology teachers on biochemistry learning (%)

<table>
<thead>
<tr>
<th>No</th>
<th>Statement</th>
<th>Number of Student</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Using computer animation</td>
<td>25</td>
<td>59.52</td>
</tr>
<tr>
<td>2</td>
<td>Associated with everyday life and provided an example in life</td>
<td>21</td>
<td>50.00</td>
</tr>
<tr>
<td>3</td>
<td>Using a practical method</td>
<td>18</td>
<td>42.85</td>
</tr>
<tr>
<td>4</td>
<td>Discussion with questions and answers</td>
<td>17</td>
<td>40.47</td>
</tr>
<tr>
<td>5</td>
<td>Discussion with a problem</td>
<td>12</td>
<td>28.27</td>
</tr>
<tr>
<td>6</td>
<td>Using a learning innovation</td>
<td>12</td>
<td>28.27</td>
</tr>
<tr>
<td>7</td>
<td>At the end of the quiz</td>
<td>10</td>
<td>23.80</td>
</tr>
<tr>
<td>8</td>
<td>Given examples of cause and effect</td>
<td>8</td>
<td>19.04</td>
</tr>
<tr>
<td>9</td>
<td>There should be a summary / hand-out</td>
<td>7</td>
<td>16.66</td>
</tr>
</tbody>
</table>

In learning biochemistry, students need a detailed and profound fundamental understanding since this subject is the basis for learning the development in other courses such as Plant Physiology, Animal Physiology, Genetics, Microbiology, Biotechnology, Nutrition and Health Sciences, Agriculture and Forestry.

Conclusion

Based on the results showed above, it can be concluded that three topics considered difficult in biochemistry are carbohydrate metabolism (27.3%), lipid metabolism (16.8%), and metabolism of proteins (14.5%).

According to the students, these learning topics become difficult because they require an understanding of the structure of the compounds, enzymes, coenzymes and cofactors that are required for chemical reactions and phases in a chemical reaction.

To facilitate the understanding of biochemistry learning, the students believe in some aspects that will enable them to understand the subject better, including: the use of computer animation in learning, given the association and examples in the daily life, using a learning method in form of discussion and question and answer, discussion with a problem, given laboratory activities, given hand out and finally quizzes.

References


