Biochemistry course achievement of pre-service chemistry teachers at one of Islamic institution of teachers training program in Bandung

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Abstract. The aims of this research was to analyse the achievement of Islamic institution of teachers training preservice chemistry teacher on biochemistry theory course and biochemistry laboratory course. It was a qualitative research with case study. The instruments used includes the documentation study of students’ academic grades for the last three years, interview guides, and students’ learning difficulties questionnaires of biochemistry. The analysis result of biochemistry theory course of the students in 2012, 2013 and 2014 shows that the grade of the students was distributed in the grade of C, except in 2013 that was in the grade of B. This findings different from the biochemistry laboratory course that was distributed in the A grade. Students categorize that biochemistry theory course and biochemistry laboratory course in the difficult category (33.1%). Biochemistry theory course and biochemistry laboratory course were placed in the same semester, but not done in an integrated manner. Biochemistry laboratory course has been done after the students completed the biochemistry theory course test. It is suggested biochemistry course should be conducted in an integrated manner, therefore lectures on biochemistry theory course and biochemistry laboratory course were mutually supported in learning.

1. Introduction
The population growth of productive aged (15-64) was higher than the unproductive aged (children aged 0-14 and elderly people aged ≥ 65). The population of productive aged will reach its peak in 2020-2035 when the percentage at 70% [1]. The productive human resources need to be utilized in order to be transformed into more skilled and competitive human resources through education. Moreover, application of ASEAN Community would change the migration of human resource competitively and education should be accommodate the needs of Indonesian society to compete.

In the learning process, teachers’ role is very important. It can be said that one of the important factors of successful learning depends on the role of the teacher. One important factor in improving the performance of science (chemistry) teachers in the process of preparing the science teacher [2]. Hence, it seems that efforts to improve pre-service teacher should be continuously done.
Biochemistry has an important role in understanding topics of medicine, chemistry and biology curriculum. The curriculum of chemistry education in the location of research placed biochemistry theory course and biochemistry laboratory course in same semester but it is not done in integrated manner. Biochemistry laboratory was done after students done biochemistry theory course test. Biochemistry course was placed in students’ last year study before they written a scientific paper.

Biochemistry as a branch of chemistry is one of the compulsory course for the pre-service chemistry teacher. This course is a brief material for pre-service teachers to conduct teaching-learning processes in high school on molecular structure material and reaction of organic compounds. This is one of the competence for chemistry graduates. Several studies stated that biochemistry course are difficult for the pre-service teachers to understand and often occur to misconception [3,4]. A meaningful learning approach among students may be important, especially aptitude and achievement motivation [5,6]. Other studies was analysed critical and creative thinking skills for pre-service chemistry teacher on biochemistry course were not balanced [7]. From the results of the research analysis has not been conducted a study of the analysis achievement of biochemistry theory and biochemistry laboratory then see the relationship between the achievement. This study aims to perform an analysis to explore the responses and achievements of pre-service chemistry teachers in biochemistry theory course and biochemistry laboratory course

2. Method
The method used in this study was a case study that aims to capture the real condition that occurs in the teaching-learning process of the biochemistry theory course and biochemistry laboratory course. Participants in this research were 30 pre-service chemistry teachers at one of Islamic institution of teachers training at Bandung in 2015. They are enrolled on biochemistry theory and biochemistry laboratory course, with a lecturer of biochemistry course. The focus of the observations on this case study was to analyse the students’ achievement in the biochemistry theory course and biochemistry laboratory course. Student achievement documentation studies conducted for the last three years that include biochemistry theory course and biochemistry laboratory course. The instruments used were interview guides and questionnaires on the level of difficulty of the biochemistry course.

3. Result and discussion
Biochemistry was a compulsory course to be taken by the pre-service chemistry teacher in chemistry education curriculum. Biochemistry was placed in last year before students get teaching practice at schools. Biochemistry consists of 3 credits, covering 2 credits of theoretical and 1 credit of laboratory. The topics of theoretical biochemistry were carbohydrates, lipid, amino acids, protein, enzyme, vitamins and minerals, hormones, carbohydrate metabolism, lipid metabolism, protein metabolism, vitamins and minerals metabolism, and nucleic acids.

The analysis of student achievement in biochemistry courses was conducted during the last three years, i.e. 2012, 2013 and 2014, through document analysis. Results of student achievement analysis can be seen in figure 1.

![Figure 1. The percentage of biochemistry theory grades.](image-url)
In general, figure 1 shows the students’ grades on the biochemistry theory during the last three years at most on the grade of C, except in 2013, the highest percentage in the grade of B. In 2012, the percentage of student grade of C was 39.2%, the grade of B was 29.4%, the grade of A and D was 15.7%, and no student earned the grade of E. In 2013, the student percentage of the grade of B was 73.8%, the grade of C was 26.2% and no students get the grade of A, D and E. In 2014, the student percentage of the grade of C was 87.5%, the grade of D was 12.5% and no students who get the grade of A, B, and E. The analysis of student grades on biochemistry laboratory is shown in figure 2.

Figure 2. The percentage of biochemistry laboratory grades.

Figure 2 shows the grade of students in biochemistry laboratory was mostly at the grade of A. In 2012, the percentage of the grade of A was 86.3% and the grade of B was 13.7%. In 2013, the students' percentage of the grade of A was 73.2% and the grade of B was 26.8%. In 2014, the students' percentage of the grade of A was 75.0%, and the grade of B was 25.0%. In the meantime, no student has the grade of C, D, and E for those three years. This shows the differences in the grades of biochemistry practice and biochemistry courses. The grade of the biochemistry practice is better than the biochemistry course. It seems that practicum activities have not been able to help students to improve their understanding of biochemistry materials, even though biochemistry courses and biochemistry laboratory are placed in the same semester.

The interviews results with a lecturer of biochemistry also found that biochemistry courses difference with other chemistry education curricula. In general, the curriculum of chemistry education was formerly on biochemistry 1 and biochemistry 2. Biochemistry 1 discuss about the structure and function of biomolecules and biochemistry 2 discuss the metabolism of biomolecules. This is different from the curriculum of chemistry education in the research location. Biochemistry presented only in one biochemistry course, including the structure and function of biomolecules, as well as biomolecule metabolism with the same weight of credits.

Biochemistry seems to be a difficult concept for students. In other study, it has been found that students have diverse conceptions of biochemistry course, particularly on the topic of enzyme-substrate interactions and the primary and secondary structures of protein [8-11]. This is reinforced by a questionnaire analysis of the level of difficulty of biochemistry materials with categorized very easy, easy, difficult, and very difficult scale. The result of questionnaire analysis was shown in figure 3.
Figure 3. The analysis of difficulty level of biochemistry subject matter (1= Bioenergetics, 2= Carbohydrate, 3= Lipid, 4= Amino acid, 5= Protein, 6= Enzyme).

Figure 3 shows that as many as 33.1% of students categorize that biochemistry was difficult, 25.6% of students categorize as very difficult, 25.1% of students categorize as easy, and only 16.1% categorize as very easy. Most students categorizing very difficult on the topic of enzyme (42.2%) and protein (32.2%). Protein and enzyme have characteristics of the same topic. Enzyme are protein as biocatalysts more than 5,000 biochemistry reaction types. Students’ difficulty in understanding the topic of enzyme was when students proposed enzyme-substrate interactions [4]. A total of 24 students thought that the substrate enzyme’s interaction of electronic and geometric characteristics and only 2 people mentioned the enzyme-substrate interactions of three characteristics i.e. geometry, electronics, and stereochemistry. This is possible because of the students’ prior knowledge which was more familiar with lock and key models.

Meanwhile, Students’ difficulties when understanding the topic of protein were caused when students explore the primary and secondary structures [3]. When students draw the alpha helix interactions, many students do not associate the interactions of hydrogen bonds, as they describe them in the wrong positions on hydrogen bonding interactions. It happens also when students are asked to describe the beta sheet. There are still many students who do not describe the interaction of beta sheets with hydrogen bonds.

The result of the interview with the lecturer found that the biochemistry laboratory was done of one meeting after the student finished final examination of the biochemistry theory. Students were divided into five groups and each group performs a different laboratory activity consisting of five experiments. The biochemistry course method was used the questions-answers method.

This method does not seem to accommodate students to improve their performance. Questions-answers method is a method of learning focus on the lecturer-centred. In this method, the lecturer was regarded as the person who dominates in the class. The lecturer explains the learning material by proving the arguments and proving examples of questions, while the students listen and imitate the patterns given. Question-answer activities inserted in lecture methods do not accommodate all students to be active and engage in the course. This is proportional with previous findings that lecturer-centred learning does not develop student thinking skills really high [9,10]. Several other studies suggest that biochemistry course should be performed using problems as early learning units [12-14], such as the use of blood sugar context to explain carbohydrate metabolism, influenza context, and HIV to explain DNA replication and herpes context to explain Membrane transfer.
4. Conclusion
The grade of biochemistry courses was distributed in the grade of C, in the contrary to the grade of the biochemistry laboratory was more distributed in the grade of A. The students categorize the biochemistry topics in the difficult category (33.1%). Most students categorize the difficulty of studying biochemistry topics on the topic of protein and enzyme. Biochemistry course and biochemistry laboratory were placed in the same semester, but not done in an integrated manner. The biochemistry laboratory was done after the students complete the biochemistry theory test. It is suggested that biochemistry course should be conducted in an integrated manner with biochemistry laboratory cause biochemistry theory and the biochemistry laboratory were mutually supported the learning process.

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