Competency of Pre-Service Biology Teachers on the Academic and Pedagogical Aspects

Y Wibowo*, A Kurniawati, and R C Handziko
Department of Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Indonesia

* Corresponding author: yuni_wibowo@uny.ac.id

Abstract. This study aims to determine the academic and pedagogical competencies of undergraduate (undergrad) students of Biology Education Department FMIPA UNY. This research is a descriptive study with survey techniques. The populations in this study were all undergrad students of the Biology Education Study Program 2016/2017 academic year. Samples were taken purposively as many as 95 undergrad students who participated in the microteaching and Field Experience Program (PPL) activities in 2016. Instrument in this study included questionnaire on academic and pedagogic abilities. The subjects in this study were biology lecturers majoring in microteaching, undergrad students who took microteaching courses in the 2016/2017 academic year, and biology teachers who guided the PPL in high schools in Special Region of Yogyakarta (DIY). The results of the research data were analyzed descriptively by looking at the percentage of the academic and pedagogical abilities of the undergrad students. The results showed that Biology Education Study Program students had academic and pedagogical competencies in good categories.

Keywords: teachers’ competencies, academic aspect, pedagogic aspect

1. INTRODUCTION

The scope of teachers’ competencies listed in the Teacher and Lecturer State Law (UUGD) and Government Regulation (PP) No. 19/2005 includes four components, namely: (1) personality competencies, (2) pedagogical competencies, (3) professional competencies, and (4) social competencies [1,2]. Personality competency is a personal ability that reflects a steady, stable, mature, wise, authoritative personality, becomes a role model for students, and has a noble character. Social competency is the teacher's ability to communicate and interact effectively with students, fellow educators, education staff, parents or guardians of students, and the surrounding community. Pedagogic competency is the ability to manage learning which includes understanding of students, designing and implementing learning, evaluating learning outcomes and developing students to actualize their various potentials [3]. Finally, professional competency or academic competency is the mastery of wide and deep learning materials. A teacher must own these four competencies.

Teacher competency is developed through professional education, which is systematically organized. These four competencies must be mastered seriously and always be improved so that the quality of learning becomes better, especially academic and pedagogical competencies. Both of these competencies have a major influence on students' learning motivation [4]. Therefore, this should be of particular concern, especially the development of professional or academic and pedagogical competencies, reflected in the conditions in the field.

The pedagogical communication competency profile of teachers in North Maluku is based on a research showing that this competency does not yet have a high value. The pedagogical communication aspects measured in this study consisted of 6 aspects, namely: a) relationship building skills, b) variations in teaching methods, c) ability to motivate students, d) ability to create a comfortable atmosphere in the classroom, e) ability to be exemplary, and f) the ability to develop learning media. The results of the research on the six aspects of pedagogical communication of teachers are in the range of 4.9 to 6.0 from the maximum score of 10.0 [5]. This means that the teacher's pedagogical competence in the field, especially pedagogical communication, does not
fully achieve the expected maximum score. Another broader study is the measurement of pedagogic and professional competencies of teachers in the region of Tegal, Indonesia. The study shows that the result is moderate, while the personality and social competencies of teachers are classified as high [6]. The two results of this research reinforce the need for Education Institution (LPTK) attention in developing the competence of pre-service teachers.

Biology Education Study Program as a part of Universitas Negeri Yogyakarta as one of the LPTK in Indonesia facilitates students to develop themselves as pre-service biology teachers. Biology Education Study Program students as pre-service biology teachers must also master the four teacher competencies [7]. Biology Education Study Program students have taken six semesters to master the four competencies through various subjects at the university level and study programs.

The development of pedagogical competencies in students start in the first semester in the basic education subjects and educational skill courses. There are 42 credits of educational subject areas to develop the students’ pedagogical competencies. Pedagogic competency is very important to be mastered by Biology Education Study Program students as pre-service biology teachers. This is because the main focus of the LPTK is to prepare pre-service teachers. For this reason, this competency must be truly mastered by the undergraduate students. This is the case with the development of academic or professional competencies as well.

Mastery of biological material includes mastery of curriculum material in subjects in high school or vocational school and scientific substance that included the material, as well as mastery of scientific structure and methodology. In the Biology Education Study Program there are 78 credit courses and theories to increase the mastery of biological science. The subject of scientific enhancement is studied since the first semester. In addition, students can improve the teaching of scientific material through student organization (ORMAWA) activities related to biological science. There are several organizations that support the science of Biology, among others Bionic (bird watchers), BSG (karst region), AROWANA (study of Lepidoptera), and HERBIFORUS (study of plants).

There are very specific courses owned by educational students specifically pre-service teachers, namely microteaching subjects and Field Experience Program (PPL). These two courses are applications of various subjects that have been studied before. Mastery of biological and educational scientific material was applied to this course. A good understanding of biological and scientific materials will carry out these two subjects well. Besides that, during the learning process of microteaching and PPL courses students can improve their knowledge so that at the end of this course students have a good understanding of teacher’s competency.

This study aims to determine the competency of undergraduate (undergrad) students as pre-service biology teachers, especially in this case, pedagogical and professional competencies. The results of this study are expected to provide information about the description of the competency of undergrad students in the Biology Education Study Program. Information on students’ competencies can be used to improve learning programs and activities in the Biology Education Study Program in the following years.

2. LITERATURE REVIEW

2.1. Teachers’ Competencies

Teachers are professional educators with the main task of educating, teaching, guiding, directing, training, assessing, and evaluating students in the formal education pathway, as well as at the level of primary and secondary education, including early childhood education. As professional educators, teachers are required to 1) master the substance of in-depth study, 2) can carry out educational learning, 3) have good personality, 4) have commitment and attention to students.

The Teacher and Lecturer State Law (UUGD) stated that competence is a set of knowledge, skills, and behaviors that must be possessed, internalized, and mastered by teachers and lecturers in carrying out professionalism tasks [2]. Teachers and lecturers as professionals are expected to have standards, namely:

a. Educators must have academic qualifications and competencies as agents of learning, physically and mentally healthy, and have the ability to realize national goals.
b. Academic qualifications are proven by a diploma and/or certificate of relevant expertise.

c. Competencies as a learning agent include: pedagogical, personal, professional, and social competencies.

   In practice, the four teacher competencies are a unified whole. Sorting it into four competencies is used to facilitate understanding of each competency. As competent teachers, they must also master the understanding of the characteristics of students, mastery of the field of study in terms of science and education, have the ability to carry out educational learning, have the willingness and ability to develop professionalism and personality in a sustainable manner.

   Pedagogic competency is basically the ability of teachers to manage learning. This competency, a distinctive one, which distinguishes teachers from other professions consists of seven aspects of abilities, namely 1) recognizing the characteristics of students, 2) mastering learning theory and learning principles, 3) being able to develop curriculum, 4) learning activities that educate, 5) understand and develop the potential of students, 6) communication with students, and 7) assessment and evaluation of learning

   Professional competency can be seen from the teacher's ability to keep up with the latest developments because the development of science is always dynamic. This is a competency that teachers must continue to develop with learning and reflective actions. Professional competency is the ability of teachers to master learning materials widely and deeply, which includes: concepts, structures, scientific or technological or artistic methods that are coherent with the teaching material, understand the relationship of concepts between related subjects, and apply scientific concepts in daily life. Sub-competency in mastering scientific structures and methods has essential indicators mastering the steps of critical research and study to deepen the knowledge or material of the field of study.

   These four teacher competencies are obtained and developed when pre-service teachers undergo education in college. The teacher competencies are obtained through activities in educational subjects and fields of study. Personality and social competencies are increasingly strengthened through activities in ORMAWA. Teacher competencies need to be improved because the increasing challenges of the age.

2.2. Microteaching

   Microteaching is a teaching exercise that is organized, where there is an undergrad student having a role as a teacher and others as students in the class. Brown (2005) states that microteaching is the practice of teachers and pre-service teachers teaching with a small number of students within 10 to 15 minutes [8]. These training activities are sometimes recorded with cameras to be observed and analyzed by those who practice together with the supervisor. McLaunghiln and Moulton (2005) stated that:

   "Microteaching is as performance training method designed to isolate the component parts of the teaching process, so that the trainee can master each component one by one in simplified teaching situation" [8].

   Allen and Ryan (2005) stated that microteaching remains as a real teaching but in a micro form so that it is easily controlled [8]. This micro-form includes almost all components in teaching (interaction), namely the number of students is around 10 students, the time allocation is 10 to 15 minutes, the teaching material is limited, and the skills are focused on certain teaching skills. Widhiya Ninsiana (2005) states that microteaching is a small-scale model, namely the number of students is limited to 5 to 15 people [9]. Classrooms are reduced to half the size of a standard class. The implementation of learning is limited to 10 to 15 minutes, and a supervisor's evaluation of about 5 minutes per person. The material is limited by several simplified sub-topics.

   Microteaching is the initial training in forming teaching competencies through actualizing basic teaching competencies. Microteaching is a learning method based on the performance of the technique carried out by training the basic competency components of teaching in the learning process so that prospective teachers are truly able to master each component individually or several
components in an integrated manner in a simplified learning situation. Microteaching is an integral part of PPL courses for the undergrad students [3].

The general objective of microteaching is to prepare students as pre-service teachers to fully face teaching duties in front of the class by having knowledge, skills, and attitudes as professional teachers [10]. The basic skills of microteaching include skills in asking, explaining, opening and closing lessons, giving reinforcement, guiding small group discussions, teaching individually, teaching small groups, and managing classes [11]. In particular microteaching in Universitas Negeri Yogyakarta has the aim to:

1) understand the basics of micro teaching,
2) train students to prepare lesson plans,
3) form and improve limited basic teaching competencies,
4) establish and improve basic and integrated teaching basic competencies,
5) establish personality competencies,
6) establish social competency.

Microteaching can be used in pre-service education that is for pre-service teachers and for teachers or overseers (supervisors). For pre-service teachers, microteaching is preparation before practice in a training school in the PPL program. The microteaching course has a large influence on student performance in implementing the PPL program [12]. The benefits of microteaching for pre-service teachers if trained intensively are:

1) students are increasingly sensitive to the phenomena that occur in the learning process when becoming collaborators,
2) students become more prepared to carry out teaching practice activities in schools or institutions,
3) students can reflect on their competencies in learning,
4) students become more aware of the profile or education staff so that they can reflect off the teachers or education staff competencies.

Microteaching is carried out in the study program of each Faculty by a microteaching supervisor and coordinated by a study program level coordinator. This activity was carried out in the sixth semester and has taken at least 90 credits. The implementation of microteaching involves elements of microteaching supervisors, PPL staff, other related institutions such as schools or teaching practice institutions, teachers or instructors, and undergrad students or high school students. Microteaching lectures emphasize training, which includes orientation activities, learning observation in schools or institutions that will be used for PPL, and teaching practice with peer teaching models.

3. RESEARCH METHOD

This is a descriptive study to reveal the pedagogic and professional competencies of Biology Education Study Program students in the 2016/2017 academic year. The method used in this study is a census survey. This study was conducted at the Biology Education Study Program, Faculty of Mathematics and Natural Science, Universitas Negeri Yogyakarta. The time of the study was conducted from May 2016 to October 2016. The population in this study was all undergrad students of the Biology Education Study Program who undertook the microteaching course and carried out PPL activities in 2016/2017, which is 95 students. All data of these students will be collected in this research by census. The subject as a source of data in this study consisted of two parts, viz.: 15 lecturers of microteaching and 25 high school biology teachers who guided the students in carrying out PPL at the schools.

The instrument in this study was a questionnaire to reveal pedagogic and professional or academic competencies. Pedagogic competency includes the aspects of i) understanding of students, ii) ability to plan the learning process, iii) ability to carry out learning, iv) ability to manage classes, and v) ability to learn outside the classroom. Aspects of professional competency include: i) understanding the biological concepts, ii) understanding the biological material characteristics, iii) understanding the selection and organization of biological material, and iv) understanding based on basic competency (KD) in (senior) high school. The instrument was
developed using a Likert scale consisting of four categories namely less, poor, good, and very good.

The data in this study were collected through academic and pedagogic competency questionnaires collected from the lecturers of biology education study programs in the microteaching course and PPL tutors (supervisors). The research data were analyzed descriptively by finding the percentage of each category with the following formula:

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\text{Achievement Percentage} = \frac{\text{achievement score}}{\text{maximum score}} \times 100\%.
\] (1)

The highest achievement percentage shows mastery of student competency.

4. RESULTS AND DISCUSSION

4.1. Academic Competencies of Undergrad Students

Based on the assessment of microteaching lecturers and PPL tutors, the academic competencies of students of Biology Education Study Program is in the good category. This can be seen from the percentage of evaluation (Table 1), which are generally in the good category. Data on the results of student academic competency assessment by microteaching lecturers are shown in Table 1.

| No. | Aspect                                | Competency (%) |          |          |          |
|-----|---------------------------------------|----------------|----------|----------|----------|
| 1   | Biological terminology                 | 7              | 80       | 13       | 0        |
| 2   | Biological concepts                    | 0              | 33       | 67       | 0        |
| 3   | Relationships between biological concepts | 0              | 13       | 73       | 13       |
| 4   | Application of biological concepts     | 0              | 53       | 47       | 0        |
| 5   | Selection and organization of biological materials | 0              | 53       | 40       | 7        |
| 6   | Characteristic of biological materials | 7              | 60       | 33       | 0        |
|     | Total                                 | 2              | 49       | 46       | 3        |

Based on Table 1 above, the percentage of good and poor categories is balanced. In general, most students already have a good understanding of biological terms, and biological material characteristics. Meanwhile, students still have a lack of understanding in the aspects of biological concepts and the relationship between biological concepts. For the application aspects of the biology concept, the selection and organization of biological material is generally balanced between students who have good and poor understanding. On the other hand, students’ academic competency towards biological material in high school based on the assessment of the PPL tutors is presented in Figure 1.
Based on Figure 1, the PPL tutors’ assessment shows that most students (90%) have mastered the biology material, while there are still around 10%, which students are still lacking in mastering the biology material. Based on the assessments by lecturers and PPL tutors regarding academic competence, in general, students have mastered the biological material. However, for mastering biological material in more depth and linking between one and other biological materials, the result is still not good. There needs to be a deeper study of biological material during lectures through learning that is oriented to high order thinking skills (HOTS) such as problem solving, case analysis, and project groups. An understanding of the relationship between biological concepts also needs to be improved. Improving student understanding can be done through lectures that integrate several biological materials in certain cases. Students can conduct critical analysis of a biological issue. Students are trained to give in-depth and comprehensive opinions on the issues presented.

Table 2. PPL Tutors’ Assessment of Students on Mastering Biology Materials in High School

| No. | Biology Material                  | Mastery Percentage (Category) (%) |
|-----|-----------------------------------|-----------------------------------|
|     |                                   | Excellent | Good  | Poor  | Less |
| Grade X |                                  |          |       |       |      |
| 1   | Scope Biology                     | 8        | 88    | 4     | 0    |
| 2   | Unity And Diversity               | 21       | 74    | 5     | 0    |
| 3   | Virus                             | 7        | 75    | 19    | 1    |
| 4   | Archaebacteria and Eubacteria     | 6        | 85    | 9     | 0    |
| 5   | Protista                          | 4        | 84    | 12    | 0    |
| 6   | Fungi                             | 4        | 83    | 13    | 0    |
| 7   | Plantae                           | 11       | 84    | 5     | 0    |
| 8   | Animalia                          | 7        | 88    | 5     | 0    |
| 9   | Ecosystem                         | 15       | 74    | 11    | 0    |
| 10  | Pollution                         | 16       | 82    | 2     | 0    |
Based on Table 2, it is observed that there are still some materials, which the mastery is in the poor category of more than 20%, namely the materials of excretion systems and immune system in class XI, and the topics of heredity and mutation in class XII. Students’ mastery of these materials needs to be improved. Lectures need to provide opportunities for students to strengthen these materials through more in-depth study activities, presentations, and analysis of related cases. The increase in mastery of these materials can also be done through teaching practice of the materials in microteaching and PPL activities.

4.2. Pedagogic Competencies

Students generally master pedagogic competencies. Various pedagogical aspects related to high school learning are well understood. The full assessment of lecturers on student pedagogical competencies is shown in Table 3.

| No. | Aspect                  | Pedagogic Competence (%) |
|-----|-------------------------|---------------------------|
|     |                          | Excellent | Good | Poor | Less |
| 1.  | Students’ characteristic| 13        | 80   | 13   | 0    |
| 2.  | Lesson plan             | 7         | 80   | 13   | 0    |
| 3.  | Worksheet               | 13        | 73   | 13   | 0    |

Table 3. Lecturer Assessment of Student Pedagogical Competencies
4. Instructional media
   13  73  7  7
5. Instrument evaluation
   7  47  40  7
6. Opening
   7  73  20  0
7. Main
   0  87  13  0
8. Closing
   7  93  0  0
9. Class management
   0  93  7  0
10. Conducting evaluation
    0  53  47  0

Based on the assessment of lecturers, there appears to be a fairly high percentage of Poor categories, namely the ability to compile instrument evaluation and carry out evaluations. Mastery of both aspects can be improved through assessment and training in the biology learning assessment, microteaching, and PPL courses in schools.

| No. | Aspect                          | Excellent | Good | Poor | Less |
|-----|---------------------------------|-----------|------|------|------|
| 1   | Students’ Characteristic        | 14        | 54   | 31   | 0    |
| 2   | Lesson Plan                     | 30        | 57   | 13   | 0    |
| 3   | Doing Teaching                  | 38        | 52   | 10   | 0    |
|     | Outdoor and Laboratory Teaching | 37        | 39   | 15   | 10   |

Finally, the pedagogical competencies based on PPL tutors’ assessments are presented in Table 4. In Table 4, there are still Poor category in the aspects of outdoor and laboratory learning. Other aspect with Poor category is the aspect of understanding student characteristics. Understanding of these two aspects can be improved through learning strategy courses, applications in microteaching that provide opportunities for outdoor learning and laboratory activity, as well as training in PPL.

5. CONCLUSIONS

Based on the results of this study, it can be concluded that the pre-service teachers of undergrad biology students in Biology Education Study Program have Good category of academic and pedagogical competencies. In academic competencies the aspects that need to be improved are i) understanding biological concepts more deeply and ii) the relationships between biological concepts. On the pedagogical competencies aspects that need to be improved are i) planning and implementing biological assessment, and ii) outdoor and laboratory teaching. Biology Education students have the readiness to become biology teachers.

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