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The Teaching Problems in Biotechnology A Preliminary Research Toward Teachers' of Secondary School in East Bandung

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Abstract. This paper presents a preliminary research to identify the teaching problems faced by teachers in the field of biotechnology lesson and alternative solution to solve it. Ethnographic research design used case study. The population of fourtheen secondary school in East Bandung selected by purposeful sampling. Selection of secondary school commonly used for teaching practices and final research of prospective teachers. Sample of eight secondary schools. Each secondary school is repersented by one teacher in the twelfth grade. Sample was selected of four teachers on public secondary school and four teachers on private secondary school. Research instruments were questionnaire and interview guides.The questionnaire and interview guides that were difficult topics taught, difficulties were faced by the teachers in biotechnology teaching, efforts of the teachers to overcome the difficulties, developed in aspects of biotechnology learning and assessments during biotechnology learning. The data were analysed descriptively. The results indicated that those 62,5 percent teachers thought that topic of biotechnology are too broad. The difficulties were faced by the teachers when delivering content of modern biotechnology, the limited time allocation and facilities practical work. The practical work of conventional biotechnology by using biological agents was easily found in surrounding environment.The Efforts of the teachers to overcome the difficulties done by using various methods of learning such as lecture, demonstration, practical work, discussion, and assigning students to other learning resources. The teacher tried to develop other aspect of biotechnology learning for students such as entrepreneurship, thinking ability and scientific work, spiritual, appreciation to science and technology in the future and to empower their own power point. Assessments during the learning consists of knowledge, skills, product, and attitude. Implications of this study is the need analyzing to debrief prospective teachers to develop Biotechnology lesson can be adapted to the conditions of East Bandung and preparation to face global challenges.

INTRODUCTION

One of the important topics in modern science curriculum and grows fast in the 21st century is biotechnology which has an important role in human life. Rapid development in biotechnology requires the students to improve scientific literacy so that they can decide how to behave towards development of biotechnology in life and society [1]. Thus, teachers have lots of challenges in teaching biotechnology through science education [2]. Research result in Australia that challenge in teaching of biotechnology including the difficulty of the subject matter and a lack of practical work that was suited to the content of the teaching unit. Many teachers may not have the knowledge and experience to adequatly teach biotechnology. Teachers perceive a lack of appropiriate practical work to be an obstacle to their teaching of biotechnology [3]. In Indonesia, especially in West Java that teachers have difficulty in explaining biotechnology because they have not yet understood the basics of biotechnology knowledge. Teachers have not found the right way of learning. Teachers have difficulty obtaining adequate resources. Teachers experience difficulties in English language skills so that they have difficulty learning the resources of teaching materials [4]. The curriculum 2013 of biotechnology learning in secondary school associated with Science Environment Technology Society (SETS) [5]. The study

of biotechnology learning that adapts to the curriculum 2013 with SETS have been done, for example SETS can improve learning achievement in biotechnology and student activity [6], development of biotechnology teaching materials [7]. Biotechnology is regarded as a very important development for both scientific and economic progress [2]. Thus, biotechnology education is important for the development of a country. Indonesia are demanded to do efforts to prepare qualified human resouces in facing the global. Furthermore, there comes the term the "21st century skills" framework ask demands to have the technology and information skill properly, to work and to survive use life skills [8].

One of the classic problems in Indonesia is the increase of the graduation rate each year that is always followed by a rise of unemployment. In February 2015 people who work with bachelor degree and upper are only by 8.29 percent [9]. One of the learning developed by the developed countries is a STEM (Science-Technology-Engineer-Mathematics), for example in the United States work requests based on STEM expanding more rapidly than the conventional one [10] so that requiring highly skilled people with degrees in Biotechnology course [11].

To synergize the University graduates with the needs of the workforce, Presidential Decree number 08 of 2012, regarding KKNI (Indonesia National Qualifications Framework) was released [12]. STEM learning in Indonesia is suited with the Indonesia culture. The condition is suitable to KKNI in term learning outcomes that should be done by graduates according to the graduate profiles. Graduate profiles on Biology Education of Islamic State University of Sunan Gunung Djati are Biology Educators of secondary school with good personality, knowledgeable and up-to-date, capable in carrying out professional duties which educative and Islamic-based approach to the integration of scientific and Islamic and responsible for execution of tasks based on ethics of science and profession. Educational Researcher additional profiles, Edupreneur [13].

To synergize STEM learning (lectures) with the Biology Education graduates, Religioun value is added in accordance with the characteristic of Islamic Education Institutions and Art (art) as the additional support profiles which is Edupreneur. Thus, STEM has the addition word become STREAM which is the acronym of Science-Technology-Religioun-Art-Mathematics. In addition, STEM learning can develop the habits of mind such as other systems thinking skills, creativity, optimism, collaboration, communication, and ethics agreement [10]. Therefore, Technology Science Social Environment adjustment SETS is held and STEM by preparing the prospective teachers who will teach biotecnology in secondary school is adapted to the graduate profiles. Such approach is STREAM.

This study was one of the initial steps to identify the difficulties of secondary school teachers in East Bandung area in Biotechnology teaching. Biology Education of The State Islamic University of Sunan Gunung Djati is located in East Bandung. The chosen secondary school were the school commonly used for teaching practise and as paticipants of prospective teachers' final research. The purposes of this study are to explore the problems faced by teachers in teaching in the field of Biotechnology and to find the solutions to overcome these problems. The solution is in accordance with the curriculum demands and can be adapted to the conditions of East Bandung for preparation to face global challenges. This study was conducted as the necessity analysis to equip prospective teacher candidates in biotechnology lesson. Prospective teacher who will teach biotechnology at secondary school in East Bandung.

EXPERIMENTAL

The preliminary research used etnographic design with case study. Ethnographic design are qulitative procedur for descibing, analyzing and interpreting a cultural group's sharred patterns of behavior, beliefs and language that develop over time. Case study is a variation of an etnography. Case study that deliberately investigates a program, an event, a process activity of a group of individuals based on extensive data collection [14]. This research investigated the teaching problem of biotechnology in secondary school in East Bandung. Data collection used qustionnaire instrument and interview guides instrument. The instruments have been validated by experts as advisory commission. The questionnaire and interview guides that were difficult topics taught, difficulties were faced by the teachers in biotechnology teaching, efforts of the teachers to overcome the difficulties, developed in aspects of biotechnology learning and assesments during biotechnology learning.

In East Bandung there are fourteen secondary schools. Secondary school sample by purposiful sampling. Purposiful sampling is a qualitative sampling procedure in which researches intentionally sellect individuals and sites learn or undestand the central phenomena [14]. Selection of secondary school commonly used for teaching practices and final research of prospective teachers. Sample of eight secondary schools showed more than half of the secondary school population in East Bandung. The sample number of eight considered representative for the preliminary research. Each sample school is represented by one teacher who teaches in the twelfth grade. Based on the curriculum that biotechnology is taught in the twelfth grade. The selection of teachers who became respondent based on the direction of the vice principal of the curriculum section at the school. Therefore, sample with eight teachers in the twelfth grade. Sample represented public secondary schools and private secondary

schools. The sample being the respondent consists of four teachers on public secondary school and four teachers on private secondary school.

This research distributing questionnaire to respondents teachers followed by individual interview. From eight respondents teachers taken purposiful sample of four teachers to individual interview. The four respondents are selected based on upper grade secondary school, middle grade secondary school and lower grade secondary schools of students' cognitive abilities. The interviewed respondents were one respondent from upper grade secondary school, two respondents from middle secondary school and one respondent from lower grade secondary school. The results of questionnaire and individual interview analysis were carried out descriptively to interpretation. The study was conducted in the third week of June until the second week of August 2016. The preliminary research conclusions based on the questions grid contained in the questionnaire and interview guides distributed to sample about of teaching problems in Biotechnology.

RESULT AND DISCUSSION

The secondary school population in East Bandung amounts to fourteen secondary schools. As already explained in the research method that the questionnaire has been given to eight teachers followed by four teachers for individual interviews. The results are based on the question grid contained in the questionnaire and interview guides. The results are presented in Table 1.

TABLE 1. The Research Results

No	The Questions Grid	The Research Results
1	The difficult of biology topics taught in twelfth grade and the reason it	In the twelfth grade, the teachers have difficulty in teaching the topic of Metabolism (87,5%), Modern Biotechnology (62,5%) Evolution (50%). These topics are considered as abstract, a lot of material should be delivered in a limited time and involves many chemical formulas and calculations.
2	The difficulties were faced by the the teachers in teaching	The difficulties were faced by the teachers expecially delivering content of modern biotechnology, the limited time allocation and facilities practical work
3	The Efforts of the teachers to overcome the difficulties	The Efforts of the teachers to overcome the difficulties done by using various methods of learning such as lecture, demonstration, practical work, discussion, and assigning students to other learning resource. The practical work of conventional biotechnology by using biological agents was easily found in surrounding environment. The teachers obtain materials teaching from textbooks, surfing internet, scientific journals and so on. Teachers also give assignments for students to look for other learning sources and made power point
4	The developed aspect of biotechnology learning	The teacher tried to develop other aspect of biotechnology learning for students such as entrepreneurship, thinking ability and scientific work, spiritual, appreciation to science and technology in the future and to empower their own power point
5	The assessments during biotechnology learning	The teacher assessed the cognitive, affective and psychomotor indicator. Cognitive by paper and pencil test and class discussion. Affective by assessing student co-operation during group work during lab work. Psychomotor by performance assesment during practicum. Assessment of portfolios from the results of the practicum report, power point created and practicum products, such as tempe, yoghurt, doghnuts. Based on the results, that way teacher assessment can be types of achievement targets grouped into knowledge, ability, product and attitude [15]. Assessment of knowledge target is obtained through the results of tests and class discussions. Assessment of skill target is obtained through performance during practicum. Assessment of product target is obtained the practicum report, power point created and practicum products. Assesment of affective target is obtained co-operation of students during practicum.

Based on the the following results of survey and interview, A difficult topic in the twelfth grade are: Metabolism (87.5 percent), Genetics (25 percent), Evolution (50 percent), Mutation (25 percent). Expecially, Modern Biotechnology (62,5 percent) because these topics are considered as abstract and involves many chemical formulas and calculations. This case is compatible with the initial study carried out [16] by distributing questionnaires to 41 Biology teachers showed that 36 percent teachers experience difficulty in the metabolism topics, genetics topics 22 percent and 20 percent cell topics.

On the topic of Biotechnology, the way teachers teach is with the help of media images (power point) with lectures, demonstrations, biotechnology lab existing conventional in the surrounding environment such as tempe, tapai, yogurt, doghnuts, class discussions, giving assignments to look for other learning sources through

surfing the internet, businesses, textbooks, dictionaries biology, scientific journals and so on. This variation is done to deal with a limited time of study because the topic of biotechnology is in the end of the semester before the final exam. Although in general, Biotechnology study result, compared to other topics are vary (some are high, some others are low) but students were more active and more open in dealing with the development of science and technology. Schibesi (2000) in [2] suggest that biotechnology topic can be taught in various techniques such as practice lab and study case.

Teachers are still difficult to delivering Biotechnology because the topic is too broad, it is involving a trully interdisiplinary. One important characteristics of the topic biotechnology in school education is the fact that it is such a complex issue that it should be taught in an interdisiplinary way [17]. Teachers experience difficulties mainly occur when describing the content of modern biotechnology. Teachers are inadequate on that material due to the abstract and hard to be practiced of modern biotechnology. Therefore, teachers only explain certain parts that are supposed to understand, such as on cloning. Another difficulty is the limited time because it is located at the end of the second semester for national exams in curriculum 2013. In addition, the teacher assigns students to create a power point of internet search results or other learning resources as a class discussion. Sometimes, teachers cannot convey biotechnology in the classroom because they feel the topic of biotechnology is hard to comprehend and detriment the students during the university entrance examination. Teachers are having difficulties in practice work in the classroom due to the limited equipment and lack of knowledge that influenced the students' academic capability [3,18]. However, in Netherlands, the majority of high school students have a low knowledge in Modern Biotechnology [19].

Based on the curriculum syllabus in 2013, especially on modern biotechnology, it should be presented and implicated for science, environment, technology, and society. In addition, based on the results of the comparison syllabus of Biotechnology in different universities inside country and abroad for Biology Department and Biology Education Department show further study on modern biotechnology to the direction of genetic engineering. Beside of that, teachers should present the topic of biotechnology as a whole both conventional and modern with a good mastery of the material content. Education of Biotechnology can provide opportunities for students to develop thinking skills, acquire new knowledge which is accurate, giving its own views, awareness of the risks and benefits of modern biotechnology. Teachers are required to prepare the subject material and provide the opportunity for students to develop information on topics that are considered biotechnology which is controversial [20,2].

For the assessment aspects, teachers carried out the assessment in the form of knowledge, skill, products and affective. Assessment of knowledge was carried out through a written test and a mastery of the content of the material in class discussions. Assessment skills was conducted performance during the practice. Rate products was performed through products practicum and student portfolios in the form of practical reports and power point created. Affective assesment was done through the assessment of behaviour and cooperation during the practice. Beside that, through the study of biotechnology, teachers try to develop entrepreneurship combined with other subjects such as the spiritual side, the ability to think and to do scientific work, and the appreciation towards science and technology. These development aspects must be done for further research in equiring Biology candidate teachers to teach Biotechnology with STREAM approach that is compatible with the graduates according to KKNI (National Qualification Framework of Indonesia) and support the 21st century skills.

CONCLUSION

In general, teachers have difficulty teaching of modern biotechnology because the subtopic is too broad and a trully interdisciplinary. Teachers already have made various efforts in teaching methods, several of learning resources, using the media and have begun to develop other aspects such as entrepreneurship, spiritual, thinking, scientific work, encourage students to appreciate science and technology along with using various assessment.

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