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Mastering of Pedagogical Content Knowledge in Students of Natural Science Education

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Abstract

Improving the quality of human resources requires qualified education and qualified teachers. The Law of The Republic of Indonesia number 14 in 2005 concerning Teacher and Lecturer opens opportunities for all bachelor of S1/D4 programs to become a teacher. This opportunity is a challenge for Bachelor of Sciences Education in competition against Bachelor of Sciences to become a teacher. This study was a combination of observation and interview. The purpose of this study was to explain how to prepare undergraduate students of Sciences Education Program facing competition to become teachers. The result of this study concluded that the mastering of pedagogical content knowledge (PCK) becomes important for the students of Natural Sciences Education Program to show their advantages in employment competition, so it needed to raise awareness about PCK among the stakeholders of education in Indonesia, and the teaching experience program (PPL) can be extended.

Keywords: pedagogical content knowledge, teacher, bachelor of natural science education

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INTRODUCTION

Indonesian development needs competent human resources. The qualified human resources is a product of qualified education, then the qualified education needs qualified teachers either. Therefore education for candidate teacher must get attention from the government and the stakeholders of education.

On the occasion of The National Teacher's Day in 2018, Minister of Educational and Culture said that government opens access for Bachelor of Science to become a teacher. It will raise the quality of the teacher in Indonesia, because Bachelor of Science has more technical knowledge than Bachelor of Education (Jawapos, 26 November 2018). So then teacher profession in Indonesia can be fulfilled by bachelors of all university, either science study program or educational science study program graduated, it is based on The Law of The Republic of Indonesia number 14 in 2005 concerning Teacher and Lecturer Article 8, 9 and 10. In 2013, the educational program students had accused these articles, but Mahkamah Konstitusi Republik Indonesia (Constitutional Court of Indonesia) rejected this accusation on March 28, 2013, so either Bachelor of Science or Bachelor of Science Education can become a teacher (Republika.co.id, 29 March 2013). The profession of the teacher is not exclusive for Bachelor of Education. Therefore every bachelor can become a teacher as long as he or she is competent for it.

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This situation makes big and tight competition between educational bachelor and sciences bachelor in employment as a teacher.

Based on PGRI's (Indonesian's Teacher Association) data, the population of all teacher in Indonesia in 2017 was 3.017.296 person, either civil (PNS) or private teacher. This amount was based on the status of the school, level of the school, qualification, and certified teacher, also the civil status of the teacher (Kompas, 21 February 2018). According to an official of Direktur Jenderal Guru dan Tenaga Kependidikan Kementerian Pendidikan dan Kebudayaan (Ministry of Education and Culture), the requirement of the teacher in state's school in 2018 was 733.000 person (Metrotvnews, 9 March 2018). This data showed that Indonesia still needs more teachers.

The other problem of education in Indonesia was the quality of the teacher. Based on PGRI's data in 2017, 42 percent of Indonesia's teacher still was not yet bachelor (they were not graduate of S1/D4 program) (Kompas, 21 February 2018). Furthermore, the chief of The Indonesian Teacher Association (IGI) admitted that the quality of Indonesian teachers is below the standard. In 2015, the average score of teachers in The Teacher's Competence Exam (Ujian Kompetensi Guru - UKG) was 53, it meant two points below the teacher's minimum competencies standard (Standar Kompetensi Minimum - SKM) score (Jawapos, 26 November 2018). The other current teacher's problem was almost 50 percent of 3 million teachers were not qualified for teaching in the classroom, this unqualified teacher result from the lacking of pedagogic understanding and sciences capability (Kompas, 21 February 2018). This situation showed that the mandate of Article 9 of the Law of The Republic of Indonesia number 14 in 2005 concerning Teacher and Lecturer was not yet fulfilled. The unqualified teacher may result in unqualified students too. Thus Indonesia's education targets such as improving the quality of human resources and the creation of scientifically literate society will fail. Glaze (2018) stated that the goal of science education is building a scientifically literate society, while the definition of science literacy is an ability to problem solve, make evidence-based decisions, and evaluate information in a manner that is logical.

The background of this study was the current educational problems related to unqualified teachers. This is related to an opinion concern Bachelor of Science Education has less knowledge than the Bachelor of Science, it makes the fewer opportunities for Bachelor of Science education to become a teacher. The aim of this study was how to prepare the students of natural sciences education in professional teacher's competition because Indonesia needs quality citizens that resulting from quality education. The methods of this study were a combination of observation and interview. The target of the observation was undergraduate students of science education program, especially the performance of students in 5^{th}-semester. Then the target of the interview was educators in Jakarta and surrounding areas. The reason for the selection of this region was because many favorite schools in Jakarta and surrounding areas are targeted by applicants as teachers.

DISCUSSION

Kola (2013) stated that science education is very important for the development of a nation so that every nation take it very seriously in all institutions of learning. Many of the developed nations were able to achieve so much in science and technology because of science education. Kind (2009) stated that "Although many successful science teachers are academically well-qualified in their specialist subjects, possession of a good Bachelor's degree in a science subject is not a de facto guarantee that someone will teach

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that subject effectively". This statement showed that no guarantee that bachelor's degree in a science subject will be better than a bachelor's degree in science education because Bachelor of Science is not taught to transfer knowledge to others as a teacher must do. It means although they are getting of best of science subject it is no guarantee they can transfer their knowledge to their student which can influence them. In order to the learning process will do effectively, so it needed pedagogical knowledge which accompanied it. Anwar *et al.* (2014) stated that the teacher as an agent of change should improve their capability in teaching in the classroom. Teacher candidates also accustom their capability to arrange the learning process. The teacher should understand about Pedagogical Content Knowledge (PCK).

L.S. Shulman introduced the term of PCK firstly in 1986. According to Shulman (1986), "pedagogical knowledge goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching. Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult". Shulman's statement showed that the learning process on sciences subject matter will connect to the pedagogical knowledge of the teacher. It means how a teacher teaches in order to reach the learning targets.

According to Sarkim (2015), based on analyzed PCK researches, there is a relationship between the structure of the teacher's knowledge, learning activities in the classroom, and the achievement of student learning outcomes. There are four PCK sources. The first source is the subject matter which is taught. Someone would get the knowledge when they learn about science after the knowledge is a part of them, they will transfer it to their student at the school. The second source is the learning experience. One's learning experience since elementary school until university will result in a certain understanding in their mind about the meaning of learning. The third source is an educational institution. PCK capability is generated by efforts of teacher's candidates while they learned education and learning theories. The fourth source is teaching experiences. So then the more often someone practices, the more skilled.

Furthermore Sarkim (2015) stated that elements or components of PCK consist of 1) knowledge of important concepts of sciences (such as physic, biology, chemistry, or math); 2) knowledge of pre-concept and misconception; 3) knowledge of appropriate methods of representation and explanation; 4) knowledge of specific aspects of the sciences. Sukardi *et al.* (2017) stated that "PCK covers the knowledge of content and pedagogy such as teaching knowledge (the subject knowledge and their belief in that, and how to teach it), curriculum knowledge (what and when to teach), assessment knowledge (why, what, and how to assess), the knowledge of students' comprehension toward the subject, and instructional knowledge".

According to Rahmadhani *et al.* (2016), in PCK a teacher should understand and can integrate the content knowledge toward the knowledge of curriculum, learning, teaching, and student, besides that the teacher mastered in the certain subject matter. The knowledge can guide the teacher to string up the learning situation which suitable for the individual student and student group needs. According to Glaze (2018) that students who leave natural science and science education programs should be adequately prepared for scientific practice, teaching, research, and mentorship, representing the highest levels of literacy. Further, Anwar *et al.* (2016) stated that PCK is knowledge, experience, and skill which was acquired by experiences in the class.

The first results of observations showed that 5th-semester students of the science education program were not ready to teach in front of the class, they depended on their note, they often read their note while presentation. After their presentation, sometimes they were not ready to answer the question from the audiences.

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The second results of observations showed that on Jakarta and its surroundings, the level of interest in becoming a teacher was high, especially being a teacher in a favorite school. In the other hand, the favorite schools determine high criteria for their prospective teachers. The recruitment procedural was a teacher candidate would send the application to the qualified schools. However, the qualified school would choose a teacher candidate who competent and qualified. Generally, the school management would choose a candidate who graduated from sciences program, because they thought this candidate more qualified in the major subject than a bachelor of education. This results also were based on interviews with three informants who involved in the teacher's recruitment. This was because there was still a shortage of qualified natural science teachers when teaching in front of the class. The natural science is an attractive science but rather difficult to study it. A study of natural science need planning of the learning process in order to can reach the learning target. Leonard (2018) stated that the learning process must be fun, but understandable for the student. The ability to design this fun atmosphere must be controlled by the teacher, so the aim of the learning can be reached. Further Al-Shara (2015) stated that some educators believe that the absence of pleasure in the education context a leading cause of low achievement that does not reflect the actual and true potential of students.

The current educational problem was related to the teacher's quality who teach in front of the class. Too many teachers who still under qualified (unqualified teacher). Besides that, the lack of teacher must be solved immediately in order to the national educational aims will be reached. Based on Article number 3 The Law of The Republic of Indonesia number 20 in 2003 concerning National Educational System, the aim of Indonesia's National Education is to develop learners potential so that they become persons imbued with human values who are faithful and pious to one and only God; who possess morals and noble character; who are healthy, knowledgeable, competent, creative, independent; and as citizens, are democratic and responsible.

It is a common sense that a graduate of the S1/D4 program (bachelor program) has the desire or hope to become a teacher in a special or favorite school. In the other hand, the school management has certain criteria for their new teacher. One of the criteria was the university's name which the applicant was graduated. Generally, the favorite school chooses the applicant who graduated from the famous university and from the science study program. The reason for its criteria was the management thought that a teacher who graduated from a science study program would capable in science subject matter so their students are smarter and excellent compared to other school students. This situation results in the competition of employment between a graduate of educational and teaching university versus a graduate of the scientific university.

Kind (2009) has stated that no guarantee for a teacher who graduated from a scientific university would be better than a teacher who graduated from educational and teaching university. Kind's statement showed that the skills come from the individual's abilities, not depending on the university where someone has studied. In a learning process, a teacher should be mastered on content knowledge and also mastered on pedagogical knowledge. It is important because the students have heterogeneous characters. Student's characters are so diverse because they came from diverse family's background, also different on the intelligent level and their need. The diversity of the student's background makes the teacher cannot give equal treatment to all students.

The students of science education study programs (such as biology education, math education, physic education, and chemistry education) actually have an advantage in time and opportunity compared to the students of science study programs. This is because when they are studying they have studied the pedagogical subject matter and science

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subject matter simultaneously. At this time students are taught about pedagogical content knowledge (PCK) and they should master the PCK. If teachers or prospective teachers master pedagogical content knowledge, they will be able to integrate content knowledge into pedagogical knowledge and curriculum, according to individual and group of student needs so that learning and education goals can be achieved, as said by Rahmadani *et al.* (2016) and Sukardi *et al.* (2017) that teachers must master knowledge about teaching, and curriculum in addition to mastering teaching material.

The educational and teaching university (Lembaga Pendidikan Tenaga Kependidikan - LPTK) plays a role in the development of PCK, in addition to improving the quality of its education, as well as to improve the quality of its graduates to be able to compete in employment. This is in accordance with Sarkim's opinion (2015), one source of PCK is an educational institution where students gain knowledge. The educational and teaching university (LPTK) is a place where the reproduction of teachers' understanding of learning and teaching occurs. PCK is built through the conscious efforts of prospective teachers in learning theories of education or learning and also due to the passive involvement of someone as a student. According to Widodo (2017), the educational and teaching university teach science material, pedagogic and teaching materials (such as teaching technique and learning strategies) simultaneously, this learning model is the best model in the development PCK of the prospective teacher. This model is better than another model that requires science graduate to take professional education (Pendidikan dan Latihan Profesi Guru - PLPG program).

In order to improve the competitiveness of LPTK graduates, the LPTK as an educational institution and its lecturers need to work together to improve the mastery of the PCK abilities of their students. Besides that, the teaching experience program (Program Pengalaman Lapangan - PPL) can be extended and the duration of implementation is extended, so students are more confident to teach in front of the class, as said by Anwar *et al.* (2016) and Sarkim (2015) that PCK is acquired by experiences in the class. These efforts are needed in order to the LPTK graduates are able to compete against a graduate of the scientific university in filling job vacancies as professional teachers. If it fails then many of the LPTK's graduates will be unemployed or work not as teachers. According to Adi Putra *et al.* (2017), in order that teachers to be able to integrate teaching, they should have a balanced PCK, because integrate teaching is influenced by the selection of important content that must be submitted to the students, the depth of the content, the reasons for choosing the teaching procedures and some other things.

CONCLUSION

From the discussion above, it can be concluded that: 1) The mastering of pedagogical content knowledge (PCK) becomes important for students of Natural Sciences Education study program to demonstrate their superiority compared to a graduate of the scientific university, 2) It needed to raise awareness about pedagogical content knowledge (PCK) among the stakeholders of education in Indonesia. So then students of the Science Education program should deepen their PCK as capital to become a teacher. Their lecturer should be teaching their student's pedagogical knowledge and content (subject) knowledge completely, and 3) The teaching experience program (PPL) can be extended, so students will more confident to teach in front of the class.

It is recommended that further research could examine teaching abilities between Bachelor of Science and Bachelor of Science Education.

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