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Translating and Adapting the Postt for Formative Assessment of Indonesian Preservice Science Teachers’ Pedagogical Orientations

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TRANSLATING AND ADAPTING THE POSTT FOR FORMATIVE ASSESSMENT OF INDONESIAN PRESERVICE SCIENCE TEACHERS’ PEDAGOGICAL ORIENTATIONS

by
Listiani

A thesis submitted to the Graduate College in partial fulfillment of the requirements for the degree of Master of Arts
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TRANSLATING AND ADAPTING THE POSTT FOR FORMATIVE ASSESSMENT OF INDONESIAN PRESERVICE SCIENCE TEACHERS’ PEDAGOGICAL ORIENTATIONS

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Indonesia has experienced problems in teacher quality, especially science teachers. Regarding this problem, a teacher-training program, in which preservice teachers are directed to use the most appropriate science teaching methods, is important to prepare qualified teachers. Having formative assessments for assessing Indonesian preservice science teachers’ teaching orientations is important. Therefore, the Pedagogy of Science Teaching Test (POSTT) was translated and adapted into Bahasa as a formative assessment for preservice science teachers. There were eight steps to translate and validate the POSTT into Bahasa (Indonesian language). The translation and validation processes involved eight experts in the target language and eight science content experts. A pilot study was conducted in Indonesia to validate the transadapted POSTT. There were 55 Indonesian preservice biology teachers involved in the pilot study. The data was analyzed using SPSS software. The results show that item responses were varied among POSTT items. Respondents selected different options for each item. According to the results, transadapted POSTT is understandable and fits with Indonesian culture. The transadapted POSTT is valid and can be implemented in Indonesia.
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CHAPTER I

INTRODUCTION

Having a formative assessment for preservice science teachers’ teaching orientations is crucial in order to improve teaching quality. The quality of teaching determines students’ understanding of concepts. Therefore, teachers should be well prepared during their training. Traditional teaching methods emphasizing on lectures and note-taking seem to be more popular for most Indonesian preservice science teachers. Few Indonesian preservice teachers, especially preservice biology teachers, incorporate active learning in teaching science when they prepare lesson plans. Most of them prefer teaching science based on textbooks. It is important to know preservice science teachers teaching orientations early so they can be directed to use the most appropriate methods for teaching science. However, because there are no formative assessment instruments, especially for examining preservice science teachers’ teaching orientations, available in Bahasa, translating and adapting instruments from other languages is essential. One formative assessment that has been developed to evaluate preservice science teachers’ teaching orientations is the Pedagogy of Science Teaching Test (POSTT) (See http://www.wmich.edu/science/inquiry-items/). A pilot study of POSTT was conducted to show that this instrument can be used as a formative assessment of Indonesian preservice science teachers’ pedagogical orientation. Hence, the translation and adaptation of POSTT in Bahasa will also be beneficial for Indonesian science education.

Indonesian science education has experienced complex problems for a long time. Although the government has tried to solve these problems, they are all interconnected to one another. This complexity is also related to other problems experienced by Indonesia,
such as economic, political, and social obstacles. The economy of Indonesia has influenced education in terms of budget allocation. The political environment affected educational regulation and decisions, while the social sector accumulated those problems. In short, educational problems in Indonesia are like a cycle that requires serious consideration from several aspects to resolve.

Some studies indicate that today’s education in Indonesia has not changed since the 1970s, particularly for the quality of teachers, even though the Indonesian government has applied certain regulations and programs for improving the quality of education such as teacher certification and curriculum reformation. Regarding this, research conducted by Thair and Treagust (1997) showed that Indonesia experienced serious problems in education, especially in secondary science education, that were related to the quality of science teachers and the process of teacher certification. Education has become one of the crucial issues that the government has been concerned with for a long time.

Indonesia had been colonialized by Dutch for around 350 years and declared its independence on August 17, 1945. Twenty-five years after Independence Day, Indonesia tried to improve many sectors of Indonesian society, especially education. However, it was still difficult to provide appropriate education for Indonesian citizens. One of the most prominent issues was that Indonesia experienced a teacher shortage during this period. Thair and Treagust (1997) mentioned that the Indonesian government decided to apply emergency training in order to solve this problem. Most teachers got their certification through a two-year, post-secondary course during the 1970s that was aimed to fulfill the junior secondary teacher shortage. It was also noted that students who were
enrolled in emergency teacher education programs had insufficient knowledge, especially in science. Most of them failed to pass the entry exam for the university science program or educational faculties of university (Thair & Treagust, 1997). In Indonesia, there is a national selection for entering a program in public universities and each private university has its own entry exam. As a consequence, students who failed to pass those exams only had a chance to enroll in the emergency teacher education course. However, according to the regulations from the Ministry of Education and Cultural Affairs number 6 and 7 (1961), the emergency courses were integrated into Faculty of Teacher Training and Education, which has been controlled by the Indonesian government until now.

The reason emergency courses existed after Independence was that many students failed to pass the entry exam for educational faculties of university while Indonesia required many teachers to improve their education. Since the Indonesian government applied emergency courses to solve the teacher shortage problem, this resulted in unqualified teachers affecting the quality of secondary education. Today, there are still many Indonesian teachers who have the same qualification as teachers in the era of 1970s. Moreover, some of the teachers from the 1970s are still teaching today and with similar qualifications. This causes the quality of education in Indonesia to remain similar with that of the 1970s.

Besides the quality of enrolled students, the teacher education institutions also experienced some other problems. The first problem was related to the coordination between those institutions and school systems. Ideally, the two should communicate to discuss what schools need and how the teacher education courses could be adjusted to meet these needs. Since there was no communication, it led to the second problem, which
was a poor design of teacher-preparation courses that resulted in unqualified teachers. Azhar (2009) mentions there are many complaints from schools that most of the novice teachers who are in apprenticeship are not professional. Most of them have low teaching quality. Apprenticeship is one of the ways that can be applied to assess preservice teachers’ teaching ability. Obviously, the way they teach reflects what they have learned during training.

The quality of faculty members has been entangled in the problem of teaching quality. In short, faculty members determined the quality of courses that are important for preservice teachers (Thair & Treagust, 1997). It was also noted that ineffective learning methods were found in many classrooms in which teachers did not encourage students to think creatively. A study conducted by Anggraeni (2009) showed that few Indonesian science teachers used student-centered instructional methods. Most Indonesian science teachers are not student centered because during training, preservice teachers are not encouraged to use active learning methods. The Indonesian government expected that Active Learning In Higher Education (ALIHE) to be implemented in teacher training programs, but very few teacher training institutions adopted an active learning approach (Guru Masa Depan, 2013).

Although the government had noticed the situation and prepared other trainings to improve teaching quality, the condition did not change significantly. Many teachers preferred applying traditional methods that were teacher-centered and textbook oriented that do not give students opportunities to develop their own ideas (Thair & Treagust, 1997). Anggraeni, Aryani, Hamdiyanti, Sanjaya, and Hernawati (2009) studied preservice biology teachers’ performance in Indonesia. The results showed that preservice biology
teachers preferred using traditional teaching approaches. Their self-efficacy of pedagogical content knowledge was very low which affected their teaching method orientations. As a consequence, they avoided high-risk approaches and selected easy approaches dominated by teachers with students only listening and memorizing concepts. This shows that there was no significant improvement in Indonesian science teaching for more than thirty years. Obviously, if Indonesia wants to improve education, a decisive action should be made quickly and in an appropriate way.

One of the best ways to improve the quality of Indonesian science teaching is through education training institutions (Meirina, 2013). Education training institutions should examine students’ pedagogical content knowledge and students’ teaching orientations, because early recognition of preservice teachers’ teaching orientation will be helpful for the revision of the teaching method courses. Methods instructors need to acknowledge their preservice teachers’ teaching orientations and explain the best teaching methods to achieve effective learning (Morine-Dershimer & Kent, 1999). Early recognition of pedagogical knowledge is important for preservice teachers because the teacher training program is the best way to direct them into the right teaching methods. Hence, preservice teachers’ teaching orientations can be assessed during the period of study where they are learning about pedagogy and know how to think of their teaching method.

After assessing preservice teachers’ teaching orientations, teacher education institutions will be able to revise their courses. This will be beneficial for the institutions because they can improve their quality after assessing their students. Good quality teacher education institutions will produce good quality teachers.
There are vast methods and techniques to examine teachers’ pedagogical content knowledge. According to Baxter and Lederman (1999) there is no best method to assess pedagogical content knowledge (PCK). However, five techniques have been noted that can be applied to evaluate teachers’ PCK. Those techniques are paper-pencil tests with multiple choice exams, concept maps, pictorial representations, interviews, and multi-method evaluations (Baxter and Lederman, 1999). Each test has advantages and disadvantages because there are no perfect tests. Many researchers conduct research on finding valid and reliable instruments that can be applied to examine PCK and its related components. A recent study conducted by Cobern, Schuster, Adams, Skjold, Muğaloğlu, Bentz, and Sparks (2014) resulted in an instrument to assess pedagogical orientations called the Pedagogy of Science Teaching Test (POSTT).

The POSTT is a formative assessment tool that can be applied to examine preservice science teachers’ pedagogical orientations. This assessment provides problem-based items that are beneficial for novice teachers to brainstorm their notions and knowledge of teaching approaches. The benefit of POSTT for novice teachers is reasonable because this instrument is a multiple-choice test where the possible responses consist of four classroom situations designed to present different teaching approaches: didactic direct, active direct, guided inquiry, and open inquiry (Cobern, et al., 2014). In addition, using POSTT, preservice science teachers do not have to teach in the real classroom to show their teaching method preference in teaching a certain topic.

Through answering POSTT items, preservice science teachers are expected to integrate their prior knowledge of pedagogy with problems given in the instrument. Through this instrument we are able to determine the preservice science teachers’
teaching method orientations, and then provide them further knowledge about the advantages and disadvantages of their preferred methods. As a result, preservice teachers can enhance their pedagogical knowledge.

Because of the benefits of using POSTT as a teaching orientations assessment, it is important to translate and adapt this instrument into several languages in order to be applied in non-English speaking countries, such as Indonesia. Indonesia is a developing country that needs to improve its science teaching quality (Caroline & Wahyuni, 2013). As mentioned earlier, most Indonesian science teachers prefer traditional teaching methods instead of active learning approaches (Thair & Treagust, 1997). It is possible that this is caused by their lack of pedagogical knowledge and exposure to various problem-solving based cases. In fact, Indonesia does not have a specific formative assessment for pedagogical orientations. Having this instrument in an Indonesian version will be important and useful for teacher education institutions so that they are able to assess their students’ teaching orientation during the training.

The purpose of the study in translating and adapting POSTT into Indonesian is to provide a valid and reliable instrument to assess pedagogical orientations for Indonesian preservice science teachers with respect to the teaching of biology in secondary schools. The focus is biology because the secondary teacher education system in Indonesia is subject specific, such as biology education, and not generally integrated into science subjects. This Indonesian version of POSTT is expected to be widely applicable for Indonesian educational institutions.
CHAPTER II
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Indonesian Science Teaching

Teacher Quality

The quality of teachers plays an important role in facing global issues, such as international competition, social and geographical student diversities, and information technologies. The difficulties of defining teacher quality are due to the complexity of effective teaching. There is no specific definition of what is a ‘good’ teacher, except that effective teaching is student-centered (OECD, 2008). Quality of teachers is about teachers’ pedagogical skills and also about creating learning environments that meet students’ needs. Both factors influence students’ learning outcomes.

There are many possibilities to measure teacher quality. One of the ways that is generally applied to assess teaching quality is the students’ achievement. There are several institutions that assess students’ outcomes representing the teaching quality. One of these institutions is the Programme for International Student Assessment (PISA) that assesses students’ learning in reading, mathematics, science and problem-solving. The 2012 results show that Indonesia ranks 62nd out of 64 countries (PISA, 2012) in mathematics, science, and reading. Related to the results of the PISA survey, one Indonesian education experts says that Indonesia needs to improve the teachers’ quality (Caroline & Wahyuni, 2013) because the quality of teachers will influence student achievements (CTP, 1999).

Specifically in the Asian region, the Third International Mathematics and Science Study-Repeat (TIMSS-R) research showed that in 1999, Indonesia ranked 32nd in science
and 34th in mathematics out of 44 countries. Other evidence showing the quality of education in Indonesia comes from a survey conducted by the Asia Magazine in the Asia Pacific area. From this survey of 77 universities, the best four universities in Indonesia ranked only 61st, 68th, 73rd, and 75th in higher education (Sugiarti, 2012). These surveys indicate that the quality of Indonesian science teaching is not good. Student achievement can be used as a parameter of teaching and teacher quality (Rebell & Hunter, 2004). When students earn low scores, it means that teachers are not well prepared.

Teachers’ qualification is one of the factors that determine teaching quality (Hightower, Delgado, Lloydy, Wittenstein, Sellers, & Swanson, 2011). Sugiarti (2012) says that the quality of teachers in Indonesia is low and should be improved if Indonesia is to have better educated students. Unqualified teachers result in ineffective teaching and learning. Teaching is not merely about transferring knowledge but facilitating students to be active in acquiring information. However, this is not happening in most Indonesian science classrooms. Science teachers fail to integrate the nature of science (Anggraeni, et al., 2009). Students end up memorizing science concepts (Muslim, Suhandi, & Karniawati, 2013). Students have few opportunities to express their ideas because the classroom is teacher-centered. As a result, students wait for the teacher’s command to answer questions. This teaching and learning process relies highly on textbooks. As Thair and Treagust (1997) explained, most Indonesian science teachers prefer traditional teaching methods instead of active and student-centered learning.

Along with the fact that most of Indonesia’s science teachers are not sufficiently qualified, there are many teachers who teach in more than one school. Sometimes teachers teach in more than two schools. This means that their work exceeds their
teaching capacity (Thair & Treagust, 1997; Joewono, 2013). Obviously, this causes teachers not to have adequate time to prepare good lesson plans and improve their teaching knowledge. As Indonesian teachers’ salaries are low, they focus on having many classes to teach because they need to have more income. They are less concerned with what and how they will teach. As a consequence, most of them implement traditional methods that are teacher-centered, instead of designing active learning lessons that encourage students to think actively in the classroom.

It cannot be denied that infrastructure plays an important role in supporting teaching. In Indonesia, there are not many schools that are equipped with adequate facilities, such as laboratories, the latest technologies, and proper buildings.

“For infrastructure, for example, the building of our many schools and colleges is damaged, the ownership and use of learning media is low, library books are incomplete. While no laboratory standards, inadequate use of information technology and so on. In fact there are many schools that are not have its own building, no libraries, no laboratories and so on.” Sugiarti (2012, p. 79)

Indeed, these conditions affect the teaching quality. Although a complete laboratory is not needed, science teaching requires a laboratory for students to do some experiments and to explore some of their ideas. Furthermore, the latest technologies will support students’ investigations of phenomena to improve understanding. The school building should be a convenient place for students to study. Obviously, those factors limit the teaching and learning process. As a result, even if teachers are qualified, their teaching will be limited by those problems.
It can be concluded that the survey results on students’ achievement reflect the low quality of science teaching in Indonesia. There are two factors that influence the quality of science teaching; they are human resources and the infrastructure. Teaching quality is determined by the quality of teachers and is supported by facilities.

**Pedagogical Orientations**

Basically, good science teaching methods are based on active learning. Although many researchers conduct studies on science classrooms, little research has been about how Indonesian science classrooms are conducted. Many teaching approaches have been proposed in Indonesia but there are few implementations in real classroom situations. There are many possibilities for why Indonesian teachers are not implementing active learning methods. For example, Indonesian teachers may have limited access to research results on effective science teaching. Thair and Treagust (1997) found that teachers dominate the teaching and learning process and if there is a laboratory activity, students are following the laboratory worksheets instead of being encouraged to think creatively. This is typically the way Indonesian science teachers conduct lessons.

Thair and Treagust (1997) studied Indonesian science teaching during the 1990s. They found that the most common teaching approaches in teaching science were teacher-centered. Although student-centered methods were found, it was only during teacher training. Typically, inservice teachers dominate the classroom from the beginning to the end of class. Students are given few opportunities to explore their knowledge about science topics. Thair and Treagust (1997) observed lessons that were highly based on textbooks in which students answered questions from textbooks and wrote their answers.
on the board. In short, teachers controlled what students did in the classroom and students were not encouraged to think by themselves.

Along with what Thair and Treagust (1997) found, similar teaching approaches were also found by Wiyanto, Sopyan, Nugroho, and Wibowo (2006). In science class, students are not given opportunities to explore or find their own ways in discovering science concepts because teachers fully control the class. The teacher’s activities were explaining the topic, questioning, and giving assignments. Students’ responsibilities were listening, taking notes, answering questions, asking questions, and doing homework. There was no active learning process that gave students a chance to develop and enrich their understanding by doing science and solving problems. This means that teachers are not integrating the nature of science in teaching. Their teaching methods are based on concept memorization and confirmation. Indeed, the laboratory activities are confirmation activities in which students verify information from textbooks through some experiments. This traditional approach is widely found in many Indonesian science classrooms. Instead of facilitating, teachers are dominating the class while students are listening and taking notes.

It can be concluded that in conducting science classes, teachers prefer to use traditional methods that are textbook and teacher-centered and limit student activities. There is no variation in teaching approaches. Laboratory activities are aimed to confirm information that has been learned. Students are not encouraged to think critically while learning. They rely on teachers’ explanations because their main activities are listening to the lecture and taking notes. There is little active learning that can be found in the science classrooms of Indonesia.
The Role of Indonesian Government and Educational Institutions

The Ministry of Education and Cultural Affairs

The Indonesian government has a responsibility to monitor the educational system. Through the Ministry of Education and Cultural Affairs, the government communicates all of the education regulations. The Ministry of Education and Cultural Affairs collaborates with several institutions to implement the regulations, such as teacher training institutes (LPTK) and non-government organizations (NGO) that concern education. There are at least four regulations that have been noted as efforts to improve the educational system in Indonesia. First, the government has changed and revised the curriculum several times over more than 30 years (Putra, 2011). Then, the reformation in Indonesia decentralized the educational system (Sumintono, Said, & Mislaln, 2012). There are also various trainings conducted to improve the quality of teachers and educational staff. Through implementing the Ministry of Education and Cultural Affairs regulation number 62 in 2013, the teacher certification program is expected to improve teachers’ qualification (Permendikbud, 2013).

Considering the diversity of geography and culture in Indonesia, the government is committed to provide the best education for all of Indonesia. Along with this diversity, there are many problems affecting education, such as Indonesian social and political developments since the 1960s. The basic principle of Indonesian curriculum focuses on moral education that is derived from the nation’s five basic philosophical principles, religion, and citizenship studies. These five basic philosophical principles are: Believe in the one and only God; Just and civilized humanity; The unity of Indonesia; Democracy led by the wisdom of deliberations among representatives; and Social justice for the
whole of the people of Indonesia. Indonesia’s Research and Development center was evaluated, and the curriculum was revised in order to prepare Indonesian citizens for global development (Galam, 1997). That is, from the 1960s to 2011, there were six curriculum reformations in the Indonesian educational system (Putra, 2011). After that, the Curriculum of 2013 was proposed and implemented in 2014 (Permendikbud, 2013). Political, economic, and other factors of Indonesian culture have affected research and development on Indonesian curriculum and brought about reformation.

Putra (2011) says that the era of curriculum reformation came when the old Indonesian regime ended and the new regime started. The first curriculum was the Curriculum of 1968. It was very simple and focused on nine lessons without any connection with facts or life phenomena. Those lessons were: Religion, Civic Education, Bahasa (Indonesian language), Local language, Physical Education, Mathematics, Natural Sciences, Arts, Family Welfare Education, and Vocational Education (Rahmad, 2014). As the world has developed, the Curriculum of 1968 did not meet the requirement of preparing Indonesians to be ready for modernity. Consequently, the Curriculum of 1975 was proposed and approved by the Ministry of Education and Cultural Affairs. The wide implementation of this curriculum started in 1976. Research and development on the Indonesian curriculum continued and found that the Curriculum of 1975 was irrelevant to the socio-economic plan, unsuitable to pupils’ cognitive understanding, and overloaded in material (Galam, 1997). As a result, this curriculum was replaced by the Curriculum of 1984. This curriculum complemented the previous one by emphasizing the process skill approach. According to this curriculum, teaching and learning processes should be based on Student Active Learning (SAL). However, because of its focus on
teaching approaches and a disregard for the content, the curriculum of 1994 was proposed to complete the 1984 curriculum. The implementation of this curriculum was based on the Government Regulation number 2/1989 about the national educational system.

The Indonesian government and other stakeholders attempted to improve the quality of education with the Curriculum of 2004, known as a competence-based curriculum. Students should have knowledge competency, skills, and have principles in every activity. The reason for implementing this new curriculum was to respond to the changes in the educational system that were created after decentralization. After two years, the 2004 Curriculum was replaced by the 2006 curriculum. The implementation of the Curriculum of 2006 referred to Government Regulation number 20/2003 about the national education system, Government Regulation number 19/2005 about national standards of education, the Government Regulation number 23/2006 about the content standard and competency standard, and was based on the guidance for developing the curriculum that was issued by BNSP. According to the 2006 curriculum, the schools have authority to develop the curriculum in accordance to their requirements (Putra, 2011). Indonesia has faced various problems that caused the government to make revisions to the Curriculum of 2006 and propose the 2013 Curriculum (Permendikbud, 2013).

Besides reforming the curriculum, the Indonesian government collaborated with several public and private sectors to provide various training to improve teacher quality. In 1975, the Ministry of Education and Cultural Affairs organized and developed a training called Pemantapan Kerja Guru (PKG) (Strengthening the Work of Teachers). The training, which was proposed for inservice teachers, was an assisted training project of a United Nations Development Program (UNDP)/United Nations Educational
Scientific and Cultural Organization (UNESCO). Through this training, teachers were encouraged to apply their own experiences and knowledge in classroom teaching as well as learning from other teachers. The training was aimed to eliminate the use of teacher-centered learning (Thair & Treagust, 1997).

The Indonesian government also held training related to the new curriculum. For instance, training for socializing the Curriculum of 2013 (Kemdikbud, 2013). In addition, some non-profit organizations, such as Sampoerna Foundation, through Sampoerna Foundation Teacher Institute (SFTI) also provided training to develop teachers’ professionalism to meet the needs of Indonesian youths (SFTI, 2009). There are also other training opportunities provided by teacher training institution that are aimed to improve teachers’ competency (Jalmo & Rustaman, 2010).

After the collapse of the new regime in 1998, the government attempted to reform all public sectors including education. Starting from 2001, all of those sectors were managed at district level. With the reason that centralization resulted in poor quality, the education system was changed from centralized to decentralized (Sumintono et al., 2012; Mutmainah, 2007). Mutmainah (2007) also says that within bureaucracy, powerful people always dominated the decision-making. In order to provide authorities to schools in developing the policy and curriculum based on the framework, the government reformed the system to be decentralized. This change was expected to give freedom to schools to explore and discover their resources.

Furthermore, the government had noticed that teacher qualification determines the quality of education. Then, through the Ministry of Education and Cultural Affair regulation number 62/2013 about structuring and equity distribution of teachers, the
government regulated requirements for teacher qualification and certification. This regulation emphasized teacher qualification in which teachers should teach based on their fields. The government also managed teacher certification programs for inservice teachers, with certified teachers getting monthly additional incentives. The Ministry of Education and teacher training institutes (LPTK) organized this certification program (Permendikbud, 2013). Education quality is important and required serious considerations from several sectors, such as, government, public and private institutions.

The teacher certification program is aimed to improve teacher quality. Rebell and Hunter (2004) say that teacher certification is important to prepare what teachers need to know and be able to conduct lessons based on national standards. Indonesian teacher certification ensures the quality of inservice teachers and improves their professional competencies. Teachers who have a four-year college or university degree, sufficient post-graduate teacher professional training credit, and a minimum 24-working hours per week are eligible to be certified. Related to the exceeding of teachers’ working hours because of their low income, this certification program is also purposed to solve that problem. A certified teacher will get a professional allowance that is equivalent to his or her base salary (World Bank, 2010). Those efforts show how the Indonesian government is concerned about the quality of education.

The Indonesian government plays an important role in managing education. Through curriculum and education system reform, the government controls the quality of education. Training and teacher certification programs are designed to improve teacher qualifications for better education.
Teacher Training Institutes (LPTK)

The quality of teacher training institutes determines the quality of teachers. Qualified teachers are important to the provision of good education for students. In these institutions, preservice teachers learn pedagogy as well as content knowledge. Because of its importance, the teacher training institutes should consider their curriculum and focus on how to prepare preservice teachers to be ready to implement the national curriculum when they teach in schools (Rebell & Hunter, 2004). Teacher training institutions in Indonesia have been established since the 1960s and they play important roles in providing good education for Indonesians.

In Indonesia, the major training for teachers has taken place in the colleges of teacher training and education attached to universities and various other public and private education institutions called teacher-training institutes (Lembaga Pendidik Tenaga Kependidikan – LPTK). In 1963, the first institutions for teacher education were Secondary School Teachers’ Colleges (Institut Keguruan dan Ilmu Pendidikan – IKIP). Besides IKIP, there were also colleges of teacher training and education (Fakultas Keguruan dan Ilmu Pendidikan - FKIPs) that were integrated into the public universities. The FKIPs provided teacher training programs for provinces that did not have IKIPs. Because of its wide function, in 1999, IKIPs were given authority to develop non-education fields and changed their name to University (Thair & Treagust, 1997; Guru Masa Depan, 2013). Apart from several names changes, the main role of LPTKs never changed. These institutions have responsibility in teacher preparation and certification for preservice and inservice teachers. Besides preservice teachers, there are many inservice teachers who are enrolled in education colleges in order to upgrade their qualification due
to their diplomas not meeting requirements for teaching and certification. Hence, universities that have FKIP are called LPTKs. These are the only institutions that formally prepare and issue certificates for teachers.

The quality of education depends on the quality of LPTKs because these institutions are responsible for producing professional and qualified teachers. In order to fulfill those responsibilities, the LPTKs should consider the training process, such as, the administration, faculty members, curriculum, and facilities. Those factors determine the quality of the alumni (Azhar, 2011). As Rebell and Hunter (2004) mentioned, teacher-training institutions are places where preservice teachers sharpen their professionalism.

To achieve highly qualified teachers, the teacher training institutions should teach the preservice teachers about the learning standards based on the government regulations. It is also important to prepare preservice teachers to be ready to conduct lessons in a range of class situations. Obviously, due to its responsibility in providing qualified educators, the role of LPTKs is important and the quality of LPTKs should be managed properly.

Regarding managing their qualities, instead of internal factors, the LPTKs also have to consider student recruitment that should be done carefully by selecting eligible and qualified candidates. The quality of inputs determines the outputs. Although it is challenging, selecting the right candidates and providing the right training for preservice teachers are important for better education quality (World Bank, 2011). It is expected that the outputs of LPTKs are able to compete in the global world. In fact, high school graduates are not interested in being teachers because of reasons such as the low salary. As a result, most of Indonesian teachers are people who failed to enroll in preferred departments such as medicine and engineering. The minimum requirement test for
teacher training colleges is relatively low so that is easy to achieve. Increasing the minimum requirement will be important to improve the quality of the inputs (Azhar, 2011; World Bank, 2011).

Furthermore, following the government laws and regulations for teachers, all training for elementary and secondary schools in LPTKs should be a four-year college. After completing the four-year course, all teachers are required to attend post-graduate professional training in order to meet the ratification of the 2005 Teacher Law. This new regulation is aimed to provide better preparation for improving teacher qualification and eligibility to be certified. As mentioned before, the minimum requirements for teacher certification are a bachelor degree in education and attending the post-graduate professional training (World Bank, 2011).

The Indonesian teacher training institutes (LPTK) play an important role in preparing qualified teachers. Since the time of their founding, LPTKs have improved their quality by changing the name of the institution and adding more fields of study. The name of LPTK was changed based on the government regulation, which means that the government has managed and regulated all teacher training institutions. Having more varied fields of study in LPTKs will result in teachers in various subjects. Therefore, every teacher can focus on and be expert in their field. Apart from that, other enhancements for LPTKs focused on the internal and external factors that directly affect the quality of their outcomes. In order to have good quality teachers, the institutions where teachers are educated should be considered and reformed as the world changes.
Research and Findings on Indonesian Science Teaching

Teacher Training Education and Certification

Indonesia experienced a severe crisis in education a few years after the declaration of Independence in 1945. Considering the importance of the quality of education, the Indonesian government has tried to provide qualified teachers by establishing teacher-training institutions to train them. Indonesian teacher training institutes (LPTKs) are the only institutions that organize teacher education and issue teacher certificates (Thair & Treagust, 1999). In order to improve the quality of LPTKs, there were reformations on teacher education and regulations based on research and development on the quality of Indonesian education. The reformation resulted in changes in the process to earn teaching certificates. Besides having a qualification of a four-year college education, Indonesian teachers also have to attend a professional training called PPG (Program Profesi Guru).

There were various teacher-training programs in Indonesia from the 1960s to 1980s. The teacher-training institutes provided three kinds of teacher education. A three-year diploma was aimed to educate teachers who were going to teach junior secondary schools, an additional two-year diploma course was for those who decided to teach senior secondary schools, and a two-year post-secondary course was for special teacher training in order to fill the shortage of junior secondary school teachers (Thair & Treagust, 1999). As the teacher qualification requirements in Indonesia improved, it affected the length of training (Guru Masa Depan, 2013). Starting from 1990s, most of Indonesian preservice teachers spend at least four and half years of full time study to earn teacher certification. The universities offer four different training programs: primary, junior secondary, senior
secondary, and vocational (USAID, 2009). Various teacher training programs offered in the universities show that there have been changes in Indonesian teaching education where all of Indonesian teachers must complete a four-year college course to be eligible in teaching at all educational levels. However, those teachers should specify their education, which means that they are trained based on what school level they are going to teach.

During the training, preservice teachers are prepared to be qualified in teaching. The courses are designed and consist of subject matter knowledge, pedagogy knowledge, method courses, and practical experiences. The preservice teachers are given opportunities to practice their knowledge in real classroom situations by doing microteaching or apprenticing in schools (USAID, 2013). Those courses are designed to meet requirements for teaching at each level of school. Once preservice teachers select their focus (for example, teaching primary schools) then all of their courses are directed to educate and prepare them for teaching that focus. What has been designed for Indonesian teacher preparation is aimed to encounter educational challenges, such as diverse learners, content standards, and contemporary classrooms. Apprenticeship is one of the mentoring programs in which preservice teachers learn from their mentors in schools. Those are important for improving teacher professional development (UNESCO, 2006).

Since the Indonesian government had concerns about the quality of teachers in Indonesia, law number 14/2005 and government regulation number 74/2008 have regulated that the quality of Indonesian teachers should be improved. In order to improve teacher quality, teachers should complete a four-year college degree called S1/D-IV or
bachelor’s degree and attend post-degree teacher professional training (PPG – *Program Profesi Guru*) (World Bank, 2010; Dirjen Dikti, 2010). This professional education is aimed to prepare teachers for specific professionalism to meet the national standard of education and gaining a teacher certification. Professional teachers are important for better education quality in Indonesia.

Indonesian teacher education has experienced changes in order to improve its quality. There have been revisions regarding teacher qualification requirements for teaching that influence the length of the preservice school’s year. As the institution that is responsible for providing qualified teachers, teacher training institutions have designed courses that are important for teaching in schools. In order to be professional teachers, they have to attend a post-degree teacher professional training (PPG) that trains teachers to be professional. The most prominent factor in improving the quality of education is having qualified and professional teachers.

**Science Curriculum**

Besides qualified teachers, curriculum also determines the quality of education. Therefore, it is important to design and revise the curriculum to enhance it in order to meet the globalization needs. Every citizen should be ready for international competitions, and for this, a good education is required to prepare society (Depdiknas, 2007). Many international assessments of student achievement have been conducted regarding the quality of education in some countries. Most of the assessment results show that Indonesia ranks lower than other Asian countries, especially in mathematics and science education. From these results, it can be concluded that student achievement
reflects the quality of education (Depdiknas, 2007). Based on those results, the Indonesian government should respond by evaluating the curriculum, especially science curriculum and reforming science curriculum in addition to considering the quality of science educators (Caroline & Wahyuni, 2013).

Regarding the globalization era, Trefil (2008) mentioned that science is important for society and people should be educated to be scientifically literate. Along with this, the Indonesian department of national education responded to this requirement and prepared Indonesians to be ready for modernization. As a consequence, understanding science and technology becomes crucial for preparing people to be actively involved in their social lives and to be responsible. Science curriculum can be the answer to providing life experiences in understanding science concepts and processes. Therefore, the Indonesian science curriculum has been designed to prepare Indonesian students to acquire local and global issues, use their critical thinking for responding to the development of science and technology and its effects, contribute to the development of science and technology, and selecting the best career. The Indonesian science curriculum also emphasizes active learning, in which students are given opportunities to explore knowledge systematically and discover facts, concepts, principles, and science processes for scientific literacy (Depdiknas, 2003). This means that the Indonesian government has noticed that science curriculum is crucial for Indonesians and should be designed appropriately.

The main point of science education is exploration and practice to give thorough understanding instead of memorization. The Indonesian science curriculum is also designed to provide opportunities for students to acquire information through direct observations and practices. These will be beneficial for them to develop their
competencies by discovering and understanding nature scientifically (Depdiknas, 2003). Furthermore, science and technology cannot be separated and will always be part of science development (National Research Council, 1996). Considering the development of technology and information in every aspect, the Indonesian government has reformed the curriculum and emphasized student understanding of information and technology based on the curriculum of 2013. Through this new curriculum, Indonesian students are expected to be productive, creative, innovative, and effective. The curriculum of 2013 is science based, which has been designed to avoid memorization (Retnaningsih, 2013). Because of the importance of science, the latest version of Indonesian curriculum is based on science in order to prepare society to be scientifically literate.

The Indonesian government has considered the role of curriculum, and science curriculum in particular, for providing qualified education for Indonesians. In the era of globalization, people have to be ready for global competition. Thus, science and technology are part of modernization and require society to be scientifically literate in order to get involved in this development. Hence, the Indonesian government has revised the curriculum and emphasized scientific understanding in the latest curriculum so that Indonesians will be ready to face global challenges.

**Preservice and Inservice Science Teachers’ Teaching Orientations**

There must be a differentiation between preservice and inservice teachers teaching orientations due to their knowledge and experiences (Smith, 1999). The way teachers understand what students need also will be different between preservice and inservice teachers. Regarding knowledge, understanding subject matter knowledge, and
pedagogical knowledge influence the way teachers select methods for teaching (Driel & Berry, 2010). In addition, experiences also affect teachers’ self-efficacy (Czerniak & Schriver, 1994). The more confident teachers the more they vary their teaching methods. In Indonesia, although it is not obvious, inservice teachers conduct lessons slightly different from preservice teachers.

Some research showed that Indonesian science teachers prefer to conduct lessons using traditional methods, which mostly are teacher centered. Thair & Treagust (1997) found that teachers dominated the classroom by presenting and explaining the lesson without providing opportunities to students to be actively involved in discussions. Specifically, Wiyanto et al. (2006) found that secondary science teachers typically use few science activities. In fact, learning science will be beneficial if students are given opportunities to explore and observe objects directly. Conversely, student activities in Indonesian classrooms are generally listening, taking notes, and answering questions. Some teachers may be able to design laboratory activities. However, these activities are for confirming science facts instead of acquiring science processes. Research conducted by Sumintono et al., (2010) showed that some Indonesian science teachers think that laboratory activities are important to find science facts and principles. Although their perception of laboratories was different from those of science education but was still good for student activities. Unfortunately, there are many schools that are not supported with adequate utilities for student activities. As a result, many teachers are not able to practice science due to facility limitations and so end up using lectures and textbooks.

Furthermore, Sumintono et al., (2010) also found that inservice science teachers think that integrating laboratory activities can improve student learning motivation and
creativity. This means that inservice teachers consider student-learning processes instead of asking them to memorize science facts (Smith, 1999). Although it is not completely presenting science as a process, some Indonesian science teachers realized that learning science should not be focused on textbooks and memorizations. Experienced teachers tend to have sufficient subject matter and pedagogical knowledge that can be reflected in the way they prepare their lesson.

In the case of Indonesian preservice science teachers, Anggraeni et al. (2009) conducted a study on biology preservice teachers and found that they did not design their lessons based on active learning. As Driel and Berry (2010) mentioned, most preservice teachers’ lack of teaching knowledge and experiences influence their teaching orientations. Similar to inservice teachers, preservice teachers are highly textbook oriented and select topics based on what is presented in textbooks instead of choosing contextual materials (Anggraeni et al., 2009). Preservice teachers are less likely to encourage their students to think creatively and tend to focus on non-experimental student worksheets. Smith (1999) mentioned that novice teachers might have low self-efficacy in teaching so they are not brave enough in selecting challenging approaches. As a result, they will not take risks, choosing to use simple methods to handle their classrooms. Wardani (2008) said that preservice science teachers, during their training, should be encouraged to develop their understanding of science concepts because this is important for improving their teaching approach in the real classroom. Due to their lack of knowledge of subject matter, pedagogy, and experiences, Indonesian preservice science teachers avoid active learning approaches and dominate the classroom.
Indonesian preservice and inservice science teachers’ teaching orientations are slightly different. Although basically most of them apply traditional approaches, inservice teachers have better self-efficacy, teaching knowledge, and experiences than preservice teachers. As a consequence, experienced teachers design more varied lessons and were more concerned about student-learning processes compared to novice teachers. Inservice teachers realize that students should be given opportunities to explore science and learn science concepts while preservice teachers focus on textbooks and student worksheets. Both preservice and inservice teachers should be trained adequately to improve their teaching orientations.

**Pedagogical Content Knowledge**

**Definition of Pedagogical Content Knowledge (PCK)**

In the 1986, Lee Shulman introduced the term Pedagogical Content Knowledge (PCK) and explained how PCK is important for teaching (Shulman, 1986; Driel & Berry, 2010). Shulman (1986) argued that PCK is beyond the teachers’ content knowledge. Although teachers are well-qualified in certain subjects, it does not guarantee that they can teach the subject effectively (Kind, 2009). Teachers should understand that there are many ways to organize topics for classroom instruction. Further research has found that effective teaching depends on PCK. Teachers who have appropriate PCK may be able to overcome students’ misconceptions of topics (Driel & Berry, 2010). Apart from the importance of PCK in education, there are not many teachers and teaching institution instructors who understand what PCK is, how PCK becomes important, and what the components of PCK are (Kind, 2009).
Shulman (1986) defined PCK as integration between content and pedagogical knowledge that results in good teaching practice (Bond-Robinson, 2005). This means that in order to achieve effective teaching, subject matter knowledge is not the only prominent aspect in teaching but teachers should also be able to understand the students’ learning process including students’ preconceptions and misconceptions (Driel & Berry, 2010). Kind (2009) argued that ‘subject specialist’ teachers do not always possess good teaching skills and understand the teaching process. This means that in addition to subject matter knowledge, there is other knowledge that should be mastered, such as pedagogical and curriculum knowledge (Shulman, 1986). These knowledge areas should be combined together in teaching. The combination is called Pedagogical Content Knowledge (PCK).

The development of PCK is important for the continuing education of teachers (Driel & Berry, 2010). According to Shulman’s (1986) perspective on teacher knowledge, there are three categories of “content knowledge” for teachers: subject-matter content knowledge, subject-matter pedagogical knowledge, and curricular knowledge (Kind, 2009). Content knowledge relates to concepts and their nature. Pedagogical knowledge is about methods for representing concepts. Curricular knowledge is the design or framework for the teaching of a particular subject (Shulman, 1986). Hence, these aspects of knowledge contribute to the quality of teaching. Since teaching is a complex process, science teachers are expected to have an understanding of the components of PCK because it improves their professional status and the process of education (Kind, 2009).

As the research on PCK has developed, there have been more findings on the components or aspects that are prominent for PCK. Driel and Berry (2010) say that there
are four themes relevant to the development of PCK. The factors that contribute to the development of PCK are the role of subject-matter knowledge, teaching experience, student learning focus, and the design of teacher education. According to Magnusson, Krajcik, and Borko (1999), science teaching orientation is part of PCK and this teaching orientation is influenced by knowledge of science curricula, knowledge of students’ understanding of science, knowledge of instructional strategies, and knowledge of assessment of scientific literacy. Although each study resulted in different components of PCK, basically, the researchers were searching for aspects that improve PCK and teacher quality.

There are many factors that determine the quality of teachers. A prominent factor is PCK, that is the integration among several teaching aspects, such as content knowledge, pedagogical or instructional strategies knowledge, curriculum knowledge, students’ understanding knowledge, assessment knowledge, and teaching experiences. Teachers should have that knowledge and be able to integrate it while conducting a lesson in the classroom. Thus, PCK is important for teacher qualification and performance.

**Pedagogical Content Knowledge of Preservice and Inservice Teachers**

There is much research showing that PCK is important for teacher quality and teacher performance (Shulman, 1986; Bond-Robinson, 2006; Kind, 2009; Driel & Berry, 2010). Since there are many factors that influence teachers’ performance and qualifications, the pedagogical knowledge of preservice and inservice teachers must be different as well. As teacher performances can be related to PCK, teachers who lack
PCK, will not be as good as the ones who have a high understanding of PCK. That is, the PCK of preservice and inservice teachers must be different in some ways, such as within components that develop PCK (Driel & Berry, 2010). Considering the importance of PCK, research conducted by Nuangchalerm (2012) suggested methods of improving preservice science teachers’ PCK. There are four ways that can be implemented to enhance preservice science teachers’ PCK: improving understanding of nature of teaching science, understanding inquiry-based learning, improving ability to design innovative lessons, and improving information and communication technology skills for teaching.

Observing preservice and inservice teachers in conducting a lesson in the classroom, Kind (2009) found that there are significant differences between the two types of teachers. Kind (2009) argued that PCK is the reason for the better performance of inservice teachers. The inservice teachers considered students’ learning processes instead of merely focusing on delivering topics, while the preservice teachers focused on giving scientifically accurate information without encouraging students to think critically. According to this, the preservice teachers have lower knowledge of students’ understanding of content and instructional strategies compared to the inservice teachers. Those are components of teaching orientation which is part of PCK (Magnusson et al., 1999).

Furthermore, as there are differentiations between preservice and inservice teachers’ PCK, several aspects can influence the improvement and development of PCK. Driel and Berry (2010) explained that the more experience teachers had the better their PCK. Conversely, novice teachers are less experienced so they have low PCK. Besides
experiences, understanding of context and subject matter and personal factors affect the level of PCK. Because of their experiences, inservice teachers manage their PCK better than novice teachers (Driel & Berry, 2010). Similarly, Magnusson et al., (1999) also mentioned that development of PCK depends on the balance of four integrated components. These components are knowledge of curriculum, knowledge of students’ understanding, knowledge of instructional strategies, and knowledge of assessment. Enhancing only one component results in an unbalanced practice of PCK. Thus, preservice and inservice teacher education should include all four PCK components.

Noticeably, the PCK of novice teachers should be improved for effective teaching. The main point of developing PCK is the ability of integrating the components of PCK in balance. According to Nuangchalerdm (2012), it is important to encourage novice teachers to implement and integrate PCK components in teaching practice. Enhancing only one component of PCK, such as subject-matter knowledge will not improve the PCK of preservice teachers. Therefore, teacher preparation should consider developing PCK for preparing qualified teachers (Driel & Berry, 2010). According to Smith (1999), expert teachers with their experiences are more able to implement their PCK in the classroom compared to novice teachers. This means that preservice teachers need to be directed in understanding PCK and how to implement it. Teacher preparation programs and short-term workshops are some ways to enhance novice teachers’ PCK (Driel & Berry, 2010).

Considering the quality of teachers and teaching, introducing PCK during teacher preparation is important. Due to different experiences, inservice teachers are more able to integrate their knowledge when conducting lessons than novice teachers. Hence,
introducing the idea of PCK during teacher training is important to enhance preservice teachers’ PCK.

**Teaching Orientation Assessment**

**Research on Teaching Orientation Assessment**

Regarding PCK components, specifically in science teaching, Magnusson, Krajcik, and Borko (1999) argue that one of the components of PCK is teaching orientations. Teaching orientations toward science teaching is about the goals and the nature of instruction. Each teaching orientation has goals and instructional characteristics. For instance, a didactic orientation is aimed to transmit the facts of science. The nature of this teaching orientation is that teachers present information through lecture or discussion and questioning students to confirm their understanding of science facts (Magnusson et al., 1999). Besides didactic orientation, there are some other orientations according to Magnusson et al. (1999): Process, Academic Rigor, Conceptual Change, Activity-driven, Discovery, Project-based Science, Inquiry, and Guided Inquiry.

It is important to evaluate teachers’ knowledge of PCK. Much research has been conducted in measuring PCK and its components using various methodologies and techniques. These techniques include paper and pencil tests (some are multiple-choice exams), concept maps, pictorial representations, interviews, and multi-method evaluations (Baxter & Lederman, 1999). Among those techniques, each of them has advantages and disadvantages. For example, multiple-choice exams have been criticized due to their poor criterion-related validity, inability to measure many important teaching skills, and being unable to represent minor teaching skills (Baxter & Lederman, 1999). Despite those critics, some researchers have developed valid and reliable instruments to
measure the components of pedagogical content knowledge focusing on teaching orientations (Schuster et al, 2007; Cobern et al, 2014).

Regarding the importance of providing valid and reliable instrument for conducting research in examining pedagogical content knowledge and its components, recent studies conducted by Schuster et al (2007) and Cobern et al (2014) focused on developing PCK assessment instruments. Using the components of PCK, those instruments were designed to support the preparation of preservice science teachers. The research that was conducted by Schuster et al (2007) resulted in an assessment instrument called the Pedagogy of Science Inquiry Teaching Test that was later refined as the Pedagogy of Science Teaching Test (POSTT; Cobern et al, 2014), with regard to the importance of other teaching approaches, that are not merely inquiry based (Cobern, 2014; personal communication). The POSTT items are designed to help elicit teacher PCK.

**POSTT for Pedagogical Orientations Assessment**

Assessing preservice teacher performance has become important in order to measure teacher competencies. Most assessments are performance-based with the basis of professional development (Wei & Pecheone, 2010). As a result, providing valid and reliable instruments that can show teacher competencies and performances are crucial. Wei and Pecheone (2010) also say that the most common format for assessing teacher candidates at the university level is formative assessment because this kind of test is able to generate detailed information of specific strengths and weaknesses of candidate performance compared to summative assessments. Information about candidate
performance will be useful to support his or her knowledge development as well as program improvement. The most recent research in developing a formative assessment for preservice teachers was conducted by Cobern et al (2014) and resulted in an instrument called the POSTT. This instrument provides realistic classroom scenarios with problem-based learning that leads teachers to exhibit their preference by selecting one of the given options. Those orientations represent teacher competencies in conducting a lesson in real classroom situations.

Considering the importance of teaching science for conceptual understanding, the POSTT was developed to provide an assessment for pedagogical content knowledge of preservice science teachers. The POSTT is a problem-based formative assessment of science teaching orientations (Cobern et al., 2014). Through formative assessments, the learning progress and students’ understanding are able to be identified and the teaching methods can be adjusted appropriately based on students’ needs (CERI, 2008; Wren & Cotton, 2008). Therefore, the POSTT can be applied to evaluate preservice science teachers’ progress and performance. Applying the POSTT in Indonesian teacher colleges is expected to improve the quality of student learning as well as evaluating school improvement based on test results (CERI, 2008).

As a formative assessment, the POSTT can be implemented broadly as well as improving preservice teachers’ skills of “learning to learn” (CERI, 2008). This means that teacher candidates are able to understand their learning and improve their understanding based on what they have learned. Furthermore, the POSTT provides a set of problems with four different teaching orientation options presented as the solutions. Those options are Direct Didactic, Active Didactic, Guided Inquiry, and Open Inquiry.
(Cobern et al., 2014). Within a set of given problems, the preservice teachers are expected to select the most appropriate answer based on their preference. There are no right and wrong answers because this assessment examines preservice teachers’ teaching orientations. The teacher candidates will also be exposed to the various ranges of methods that will indirectly enrich their knowledge of teaching orientations. Considering the difficulties of providing opportunities for preservice teachers to practice all of their pedagogical content knowledge in real classroom situations, the POSTT will be one of the best solutions.

A recent study conducted by Cobern et al. (2014) resulted in two forms of the POSTT (POSTT-1 and POSTT-2). Those two POSTT forms were piloted in preservice elementary science method courses. According to the results, each of the POSTT items was answered differently. This means that the preservice science teachers had various understandings of teacher pedagogical content knowledge so they viewed differently the possibilities in teaching approaches. Those results then can be used to evaluate student performance as well as the teacher. If students are selecting the least effective teaching approach to answer the problem-based questions, the school or educational institutions should make revisions in order to improve education quality.

Obviously, the benefits of implementing the POSTT outweigh its drawbacks, so this instrument will be beneficial for developing countries that struggle in improving their education quality, such as Indonesia. In fact, Indonesia has not developed a formative assessment for preservice teachers. Hence, translating and adapting the POSTT for Indonesian preservice teachers will be important for better education quality. In Indonesia, research on teacher candidates was limited on how they prepare and conduct a
lesson in the classroom (Anggraeni, 2009; Muslim et al., 2013) without exposing them to problem-based items.

Regarding the benefits of formative assessment, the POSTT was designed as a formative assessment to examine teacher candidate teaching orientations. This teaching orientation represents PCK understanding. Once the level of knowledge has been noted, it will be easier for educational institutions to make decisions on whether or not the system should be revised. Due to a lack of formative assessments for Indonesian preservice teachers, translating and adapting the POSTT into Bahasa will be important. The quality of Indonesian teaching now becomes the most prominent issue that should be considered by many stakeholders.

**Research Goals**

Indonesia has been facing complex problems in improving the quality of education. Although the Indonesian government has been collaborating with several institutions to provide adequate education for Indonesians, the problems have not been resolved. Teacher training institutions (LPTKs), as the only institutions for teacher preparation, play an important role in generating teachers. Therefore, quality of LPTKs should be improved due to their responsibility in preparing qualified teachers. This research focuses on translating and adapting the POSTT for formative assessment of Indonesian preservice science teachers’ teaching orientations. The validity of this translated and adapted instrument will be examined by applying the instrument to the target subjects, Indonesian preservice biology teachers. Considering the importance of
examining preservice teachers’ teaching orientation, this instrument is expected to be useful for improving the quality of Indonesian science teachers.
CHAPTER III

METHODOLOGY

This research is focused on instrument transadaptation (Montoya et al. 2011), which is translating and adapting POSTT as a formative assessment from English into Bahasa as the first language of Indonesia. The main reason for translating and adapting POSTT into Bahasa is because Indonesia does not have a formative assessment for examining preservice science teachers’ teaching orientations. The adaptation of this instrument is based on the differentiation of culture between the USA and Indonesia in teaching in the classroom and the terms that are used. Without reducing the main ideas of the original version, the Indonesian version of POSTT is expected to be useful for assessing preservice science teachers’ teaching orientations, especially preservice biology teachers.

Translation and Adaptation of POSTT for Indonesian Science Teachers Education

This study focuses on the process of translating and adapting POSTT into Bahasa so that it is available for research and improvement in Indonesia. Research on transadaptation (Montoya et al. 2011) of instruments showed that this process is complex because there should be many considerations such as how this instrument fits with the culture of the target language and how to find the most appropriate terms in order to minimize lost meaning. It should also be considered that a resulting high quality of transadapted instrument is important, which is determined by the expert teams that should do proper translation and review of the questions (Cohen, Gafni, and Hanani, 2007). Basically, the process of transadaptation consists of translation and back-
translation techniques, but this is inadequate to obtain an equivalent instrument (HSRI, 2005). As a result, in translating and adapting POSTT for Indonesian Science Teachers, adapted and modified methods from several references were applied (HSRI, 2005; Cohen, et al., 2007; and Sousha & Rojjanasrirat, 2010).

The pilot testing of the pre-final Indonesian version of POSTT to Indonesian preservice teachers is important. As teacher education for preservice science teachers for secondary school in Indonesia is separated into biology and physics, this study focuses on translating and adapting POSTT for preservice biology teachers of secondary school. Therefore, there are eight POSTT items selected based on the educational background of the respondents for the pilot study, who are preservice biology teachers. Those selected items are related to biology topics for secondary school because the preservice teachers are going to teach biology subject in the secondary school, so topics in the POSTT items should have correlation with what the preservice teachers have learned and will implement in real classroom situations.

Furthermore, the translation and adaptation process of POSTT followed these eight steps:

The first step was selection of a test form and suitable items (pre-translating adaptation). During this process, the researcher selected appropriate items to be translated into Bahasa. Some items needed to be revised by experts before being translated. It is important to examine the proper construct, dimension and operational definition of the instrument to the target group (HSRI, 2005).
The next step was transadaptation into the target language by professional translators. In this research, the translator was the researcher. Her first language is the target language of POSTT translation.

Then, critical independent reviews of the transadaptation by three bilingual reviewers were required. The aim of this stage was for the reviewers to criticize the transadapted POSTT version and compare it with the original version. The second purpose was that the reviewers should pay attention to the accuracy of the transadaptation, the clarity of the sentences, the difficulty of the words, and the fluency of the texts.

The translator then had to revise if there were critiques on the transadapted POSTT. The researcher was responsible for revising the transadaptation version according to suggestions from reviewers. However, the researcher who experienced teaching preservice biology teachers had consideration to accept or reject suggestions from reviewers because the reviewers were coming from various fields. This was because of the difficulties of finding bilingual reviewers who were also experts in biology education. From those three experts, one was an English teacher and the other one was a high school teacher. Both of them were currently studying education in the USA. The third reviewer was an expert in English and had experience in translation.

After the transadapted POSTT was revised, it needed to be translated back to the original language. In this step, an independent translator who was not involved in the earlier translation then translated the POSTT-Indonesian back into English. The first language of the translator should be the same as the source instrument language, which was Bahasa.
The sixth step was reviewing the back translation by the coordinators (thesis committees). The purpose of this stage was to compare the original and back translation of the transadapted POSTT to determine whether or not the original POSTT was translated into Bahasa appropriately. The committee members were the experts who have been conducting research on POSTT.

The seventh step was pilot testing of the pre-final version of the instrument in the target language. After the instrument was approved by the committee, it was then tested to the population, which was selected purposively. The participants were Bahasa speakers and preservice biology teachers. The purpose of testing the pre-final version of POSTT-Indonesian was to evaluate the clarity of the instructions, response format, and the items (Sousa & Rojjanasrirat, 2010)

Finally, after completing those previous steps, the final transadapted version of POSTT was ready to be implemented.

Validation of adaptation

The validation process of the transadapted instrument was based on a method adapted from Montoya, Llopis, and Gilaberte (2011). The process of validation was included in the translation process, where the committee compared the original and the back-translated POSTT by considering language comparability, similarity of interpretability, and degree of understandability. The language comparability means the formal similarity of words, phrases and sentences. The similarity of interpretability refers to similar interpretation of those two versions even though they are in different words. Lastly, the degree of understandability considers the comprehension of the content
although the words are different. Those are three things that should be noted in validating a transadapted instrument (Montoya, et al., 2011).

During the validation process, five experts compared the back translation of POSTT with its source. This process was slightly modified because none of those experts spoke the target language. The only person who spoke the target language was the researcher. As a result, the process of testing the comparability, interpretability, and degree of understanding was based on the back-translated POSTT. The researcher confirmed and explained her translation to the experts and made revisions when necessary.

Figure 1. The scheme of validation process of translating and adapting the POSTT (Adapted from Montoya, Llopis, & Gilaberte, 2011)
Field studies

The POSTT-Indonesian that had been approved by the experts through the validation process was then applied in Indonesia as the target country. Participants were selected from a targeted population in which the instrument would be used. In this case, preservice biology teachers at an Indonesian University who were in the sixth semester were selected as a sample. Sousa and Rojjanasrirat (2010) recommended that the minimum sample size required for this study between 10 – 40 individuals. In order to meet this requirement, there were 55 preservice biology teachers involved in this study. They were required to answer the eight questions on the POSTT-Indonesian, showing their teaching orientations in teaching certain topics.

The pilot study was conducted in a research methodology class. The researcher who was in the USA sent the instrument to the instructor of the research methodology class at the Indonesian university. The instructor of the research methodology class distributed the instrument to the students. After that, she collected the instrument and sent it back to the USA to analyze. The researcher then graded the data using codes before it was analyzed. The results of this study were determined by looking at the items individually.

Data Analysis

The data entry was presented as codes and would be interpreted based on preservice biology teachers’ responses for each question. Statistical software, SPSS, was used to analyze the data descriptively and plot histograms for each item of POSTT.
CHAPTER IV
RESULTS

Data Analysis

Two steps were taken to prepare the data for analysis. First, the data was carefully entered into a Microsoft Office Excel spreadsheet. To insure accuracy, the Excel spreadsheet was cross-checked with the original questionnaire forms and any errors corrected. Once the accuracy of data had been confirmed, the data in the Excel sheet was imported into SPSS 22.0 for Mac.

After the data was completely imported into SPSS, the next step was setting the variables and saving the original copy of the data file. In SPSS, type of data, values, and measures were set before the data is analyzed. All of the data were numeric including the demographic variables, which were gender and school year. The values for gender are male and female, coded as 1 and 2, while the year has four values; they are first year (1), second year (2), third year (3), and fourth year (4).

The original data was then copied for recoding. The original data contained the item response codes in the same random order as used for each POSTT item on the survey. These original item codes were recoded as follows: all Direct Didactic answers were recoded as 1, Active Didactic recoded as 2, Guided Inquiry recoded as 3, and Open Inquiry recoded as 4. This new data was then saved as a recoded data file. The original data file was kept as a backup. The recoded data then was ready to analyze using simple descriptive statistics and histograms.
Findings

The demographic data shows that most of the respondents are female and are in the third year of study (Table 1). The bar charts (Figure 2 and 3) show the number of respondents who selected each instructional orientation. The bar chart of every POSTT item represents teaching orientations of preservice science teachers in Indonesia.

Table 1. Demographic data of respondents

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequencies</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>17</td>
<td>30.9</td>
</tr>
<tr>
<td>Female</td>
<td>38</td>
<td>69.1</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School year</th>
<th>Frequencies</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>Second</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Third</td>
<td>46</td>
<td>85.2</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>100</td>
</tr>
</tbody>
</table>
Figure 2. High response of Inquiry-based teaching approach

Figure 3. High response of Didactic-based teaching approach
The pilot study of this instrument indicates that preservice science teachers’ responses are varied. Table 2 shows that none of the items received only one response. All eight items elicited two or more responses. Five of eight items (62.5%) have all four orientations that were selected at least once. Those are items 1, 4, 6, 7, and 8. The other two of eight items (25%), which are items 3 and 5 had three responses. Only item 2 had two responses selected (Figure 4).

Table 2. Item Response Variation

<table>
<thead>
<tr>
<th>No. of different choices</th>
<th>No. of item (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 (0.00%)</td>
</tr>
<tr>
<td>2</td>
<td>1/8 (12.5%)</td>
</tr>
<tr>
<td>3</td>
<td>2/8 (25%)</td>
</tr>
<tr>
<td>4</td>
<td>5/8 (62.5%)</td>
</tr>
</tbody>
</table>

Figure 4. Item Response Variation

There are six items that elicited a strong inquiry response, either guided inquiry (GI) or open inquiry (OI) (Figure 2). Items number 1, 7, and 8 elicited the choice of all four orientations while the three other items received two or three responses with respect to inquiry orientations being chosen most frequently. This means that for these particular items, one of two inquiry orientations was preferable. Besides inquiry-based instruction
response, there are two other items (items 4 and 6) that receive didactic instruction as the highest preference in teaching that science topic (Figure 3).

The spread of the responses were varied showing that each respondent selected at least three different orientations across the eight items, which means that no respondent selected only one or two responses for all eight items. Table 3 shows that more than 50% of respondents (32 preservice teachers) used all four responses to answer the questions while the rest of them used three different options (Figure 5).

Table 3. Student Responses Variation

<table>
<thead>
<tr>
<th>No. of different choices</th>
<th>No. of student (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 (0.00%)</td>
</tr>
<tr>
<td>2</td>
<td>0 (0.00%)</td>
</tr>
<tr>
<td>3</td>
<td>23/55 (41.81%)</td>
</tr>
<tr>
<td>4</td>
<td>32/55 (58.18%)</td>
</tr>
</tbody>
</table>

Figure 5. Respondent response variation
Discussion

Based on the pilot study, the responses are spread through the items. The data shows that there is only one item that has two kinds of responses and none of the items receive only one similar response form the respondents (Figure 4). The same was result also found in the pilot study of the original POSTT, in which the item responses are widely spread among four options (Cobern et al., 2014). It can be assumed that respondents understood the situations given in the items and they also already had adequate knowledge to determine what instruction they would prefer to apply to a certain topic (Cobern et al., 2014). Besides the data showing that the transadapted POSTT items drew various responses, the data also shows that each respondent selected various orientations in response to the eight items. Presumably, the respondents were using their knowledge in selecting answers for each item. This knowledge can be related to either pedagogy or content. If it does so, then this instrument can be applied to assess Indonesian preservice science teachers’ teaching orientations.

Noticeably, the POSTT item responses showed that some items earned high responses of inquiry-based teaching approaches while other items had didactic-based teaching methods. Interestingly, based on those items dominated with strong inquiry-based responses, the preservice science teachers exhibited different preferences in using inquiry-based teaching approaches, in which different science topic might be taught using different inquiry-based methods. For example, items 1, 3, 7 and 8 had both Guided Inquiry (GI) and Open Inquiry (OI) responses. However, the respondents preferred to select Guided Inquiry in response to questions 3 and 7 while Open Inquiry dominated responses in items 1 and 8 (Figure 2). Similarly, didactic-based approaches were also
spread depending on the topic (Figure 3). For those two questions, items 4 and 8, that were highly responded to based on didactic approaches showing that respondents preferred to apply Active Didactic (AD) to answer item 4 while using Direct Didactic (DD) for item 8. These differences in selecting a preferred method means that respondents show different teaching orientations in teaching a certain science topic, which is based on what students understand about various science teaching approaches that they believe can be applied in the classroom (Cobern et al., 2014).

Another interesting finding can be seen from Figure 5 showing that more than half of respondents used all four responses to answer the eight POSTT items. There are some factors that influence the way respondents were using four responses to respond to all POSTT items. Since most respondents are preservice biology teachers who are in the third year of school, they might have learned various teaching approaches that provide them ideas to implement in such a classroom situation as presented in the POSTT items (Cobern et al., 2014). Although the way preservice science teachers selected any item response was not far from their preference in selecting a certain teaching method, their experience in studying science pedagogies and teaching methods will also contribute to the process of selecting a preferred method of teaching. Therefore, preservice teachers who have little knowledge of pedagogy might have less variation of teaching approaches to apply in the classroom.
CHAPTER V

CONCLUSIONS

This study of transadapting POSTT items was not the first. Transadaption studies have also taken place in Korea, South Africa, and Turkey (Cobern et al., 2014). Following the success of those precedent projects, translating and adapting POSTT into Bahasa is also expected to have positive result and impact for the development of science education in Indonesia. Considering the quality of education in Indonesia, having a formative assessment for preservice teachers might be one of the solutions to improve teacher quality. Using this instrument, teacher training programs in Indonesia will be able to assess the preservice science teachers’ teaching orientation that represent pedagogy and content knowledge. These are important factors for training because preservice teachers learn how to teach appropriately during their preparation. Preservice science teachers’ teaching preferences are indirectly showing their orientations when they are teaching in the school. Therefore, the use of the POSTT instrument provides sets of classroom environment examples to promote preservice science teachers’ teaching orientations.

The Indonesian version of POSTT has been validated and applied into the target language. The result of the pilot study showed that all variables were valid and the transadapted POSTT instrument was understandable and fit into Indonesian culture. There were diverse responses from the participants, in which they were using all given options to answer the questions. Apart from that, each item also received various responses. None of the items had only one response from all respondents. This means that participants’ responses distributed widely through the options. It can be concluded that
this pilot study shows positive results for translation and adaptation of POSTT into Bahasa.

Considering the advantages of having a version of POSTT in Indonesian, it might be possible to translate and adapt more POSTT items since for this preliminary study only eight items were specified for preservice biology teachers. It is also possible to work with more science topics and various grades so that will make the use of Indonesian version of POSTT widely applicable for all Indonesian science teachers.
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APPENDIX A
The POSTT-Indonesian
1. Pemangsa dan mangsanya

Pak Budi sedang mengajarkan pokok bahasan tentang rantai makanan dan akan menjelaskan hubungan antara pemangsa dan mangsanya kepada siswa kelas VII. Pak Budi memiliki sebuah permainan simulasi komputer (*computer simulation game*) yang dapat digunakan untuk mengajarkan materi ini di kelas.

Berdasarkan pilihan berikut ini, cara mengajar manakah yang akan Anda pilih jika mengajarkan materi serupa?

A. Sebaiknya Pak Budi menjelaskan kepada siswanya tentang keseimbangan yang terjadi di alam dimana terdapat hubungan antara jumlah pemangsa dan mangsanya. Contohnya, Pak Budi menjelaskan bahwa dalam satu wilayah yang sama, populasi kelinci akan bertambah ketika populasi anjing hutan berkurang karena penyakit. Kemudian Pak Budi menampilkan permainan simulasi komputer (*computer simulation game*) untuk menunjukkan hubungan antara populasi kelinci dan anjing hutan.

B. Sebaiknya Pak Budi menjelaskan tentang keseimbangan yang terjadi di alam dimana terdapat hubungan antara jumlah pemangsa dan mangsa. Contohnya, Pak Budi menjelaskan bahwa dalam satu wilayah yang sama, populasi kelinci akan bertambah ketika populasi anjing hutan berkurang karena penyakit. Selanjutnya, dengan menggunakan permainan simulasi komputer (*computer simulation game*), siswa diminta untuk mengamati dan mencatat populasi kelinci selama sepuluh tahun dimana pada saat yang sama juga terjadi peningkatan dan penurunan populasi anjing hutan. Dengan demikian, siswa akan memahami konsep pemangsa maupun mangsa yang diterangkan oleh Pak Budi.

C. Sebaiknya Pak Budi bertanya kepada siswa tentang apa yang akan terjadi pada populasi kelinci apabila secara tiba – tiba banyak anjing hutan yang mati karena penyakit. Setelah melakukan diskusi, sebaiknya pak Budi meminta siswa untuk mengembangkan ide mereka dengan menggunakan permainan simulasi komputer (*computer simulation game*), dan mencatat perubahan yang terjadi selama periode simulasi, yaitu sepuluh tahun. Siswa akan mendapatkan data tentang hubungan antara pemangsa dan mangsanya sebagai bahan diskusi di kelas.

D. Sebaiknya pak Budi memulai pelajaran dengan menanyakan kepada siswa berkaitan dengan pengetahuan mereka tentang pemangsa dan mangsa. Dengan tanpa tanpa memberikan respon terhadap jawaban siswa melainkan hanya mendorong siswa menyampaikan pendapat, selanjutnya pak Budi menunjukan permainan simulasi komputer (*computer simulation game*) dan meminta siswa untuk melakukan praktik dengan menggunakan program tersebut sesuai dengan pemikiran mereka tanpa batasan tertentu. Pelajaran diakhiri dengan meminta para siswa menuliskan hasil temuannya.
2. Pewarisan gen

Setelah Pak Heri mengajarkan materi tentang pewarisan gen dan mendemonstrasikan penggunaan diagram Punnet sebagaimana terdapat pada gambar di samping untuk memperkirakan kemungkinan genotip dan fenotip keturunan kepada siswa - siswa kelas 7, beliau memberikan beberapa soal untuk dijawab oleh para siswa secara berkelompok sesuai dengan konsep yang sudah dipelajari.

Jika Anda mengajarkan materi ini, bagaimana Anda mengakhiri pelajaran berdasarkan pilihan berikut ini?

A. Karena siswa telah mendiskusikan beberapa soal dengan kelompok mereka dan mengembangkan pemahaman mereka sendiri terkait topik maka saya akan mengakhiri pelajaran sampai bahasan ini saja.
B. Saya akan memberikan jawaban kepada siswa
C. Saya akan meminta siswa menjelaskan jawaban mereka pada teman – teman sekelasnya. Ketika siswa memberikan penjelasan, saya akan membimbing mereka supaya mendapatkan jawaban yang benar.
D. Melalui diskusi kelas, saya dan siswa akan melakukan ulasan kembali terhadap jawaban yang benar.

3. Suksesi

Bu Gina baru saja mengajarkan materi perkenalan tentang suksesi tumbuhan pada siswa kelas VI. Siswa telah memahami bahwa suksesi dapat terjadi dengan cara terbentuknya komunitas baru dari habitat sebelumnya (Suksesi primer) atau dengan adanya beberapa perubahan pada komunitas asal akibat gangguan (Suksesi sekunder). Bu Gina melakukan kajian lanjut terhadap materi ini dengan cara melakukan kegiatan di sekitar sekolah dan beberapa tempat yang memiliki cukup banyak tumbuhan.

Jika anda mengajarkan materi serupa, berdasarkan pilihan berikut ini, manakah yang paling mendekati cara mengajar yang akan Anda lakukan?

A. Siswa diberi peta yang menunjukkan batas-batas area suksesi. Kemudian saya bersama para siswa berjalan ke seluruh area yang mengalami suksesi sambil menjelaskan kondisi tumbuhan berdasarkan areanya masing-masing.
B. Siswa diberi peta yang menunjukkan batas-batas area suksesi. Kemudian, siswa diberi tugas untuk mengidentifikasi jenis kehidupan tumbuhan di setiap area suksesi.

C. Siswa ditanya terlebih dahulu mengenai pemahaman mereka tentang pengidentifikasi suksesi dan cara mereka melakukan identifikasi. Kemudian saya membawa siswa menuju area hijau dan menugaskan mereka untuk menggambarkan suksesi di area tersebut serta membuat peta mereka sendiri.

D. Siswa dibawa menuju area hijau kemudian diminta melakukan pengamatan sebanyak yang dapat mereka hubungkan dengan suksesi yang baru saja dipelajari. Saya akan memberikan kesempatan kepada siswa untuk melakukan pengamatan dan pencatatan di lingkungan suksesi yang sesungguhnya berdasarkan pengetahuan dan pemahaman yang mereka miliki.

4. Fotosintesis


Bagaimana cara Anda mengajarkan topik tersebut di atas dan berdasarkan pilihan berikut ini, manakah bentuk evaluasi terbaik untuk pengajaran Bu Hamid?

A. Secara keseluruhan, materi ini dirancang dengan baik karena Bu Hamid mengawali pembelajaran dengan menjelaskan konsep fotosintesis dilanjutkan dengan kegiatan siswa untuk menunjukkan bahwa pembentukan klorofil dipengaruhi oleh cahaya.

B. Bu Hamid telah mengawali pelajaran dengan baik yaitu dengan menjelaskan konsep yang harus dipelajari oleh siswa. Tetapi kiranya kegiatan yang telah dipersiapkan oleh bu Hamid ini tidak perlu dilakukan karena memerlukan waktu yang terlalu banyak.

C. Pendekatan pengajaran yang digunakan oleh bu Hamid memiliki banyak petunjuk dan pengarahan. Akan lebih baik jika siswa menentukan sendiri prosedur pengaturan tanaman dan cahaya, pengamatan terhadap apa yang terjadi, dan perbandingan jumlah produksi klorofil pada daun.

D. Sebaiknya siswa melakukan pengamatan terlebih dahulu untuk menunjukkan bahwa cahaya mempengaruhi pembentukan klorofil, kemudian bu Hamid memberikan penjelasan secara rinci tentang proses pembentukan klorofil.
5. Kebersihan tangan : momen mendidik

Bu Simon mengajar siswa kelas 8 tentang di mana bakteri dapat ditemukan dan pengaruhnya terhadap manusia. Salah satu siswa kemudian bertanya, “mengapa kita harus menggunakan sabun pembersih tangan?”. Bu Simon kurang yakin mengenai cara terbaik untuk menjawab pertanyaan siswa tersebut sesuai dengan tujuan pembelajaran.

Jika Anda akan mengajarkan materi serupa, berdasarkan pilihan berikut ini, manakah yang paling mendekati cara anda mendidik siswa?

A. Saya akan mendorong siswa memikirkan jawaban terbaik untuk pertanyaan ini kemudian memberi mereka bahan serta waktu untuk melakukan uji coba.
B. Saya akan memberikan penjelasan singkat kepada siswa tentang cara kerja sabun pembersih tangan dan menghubungkannya dengan materi tentang bakteri yang telah dipelajari. Kemudian saya mengarahkan siswa kembali pada tujuan awal pembelajaran.
C. Saya akan memberikan penjelasan singkat kepada siswa tentang cara kerja sabun pembersih tangan dan menggali ide – ide mereka tentang cara – cara yang mungkin dilakukan untuk menguji efektivitas kerja sabun pencuci tangan tersebut. Setelah itu, saya akan menyimpulkan pembelajaran dengan menghubungkan ide – ide siswa dan tujuan pembelajaran.
D. Saya akan memotivasi siswa menyampaikan ide – idenya terkait dengan pertanyaan yang diajukan, termasuk cara mereka melakukan uji coba terhadap ide – ide yang ada. Kemudian, saya dan siswa akan melakukan uji coba terhadap beberapa ide. Pada akhir kegiatan pembelajaran, saya akan membuat kesimpulan dengan menghubungkan hasil pengamatan siswa dan tujuan pembelajaran.

6. Sistem klasifikasi Linnaeus

Pak Robi sedang memperkenalkan sistem klasifikasi pada siswa kelas 8. Beliau sudah menyiapkan 25 gambar makhluk hidup yang merepresentasikan 5 Kingdom, kemudian meminta siswa mengelompokkan gambar – gambar tersebut berdasarkan ciri – ciri yang dapat diamati. Setelah itu, siswa diberi kesempatan untuk melakukan diskusi tentang perbedaan yang terjadi diantara mereka dalam memilih karakteristik untuk mengelompokkan makhluk hidup. Di saat yang sama, pak Robi menjelaskan kepada siswa bahwa para ilmuwan telah menemukan jalan keluar untuk mengatasi masalah perbedaan cara pengelompokkan tersebut dengan
menerapkan sistem klasifikasi Linnaeus yang kemudian menjadi standar umum dalam mengelompokkan makhluk hidup. Kemudian pak Robi menjelaskan bahwa sistem ini menggunakan lebih banyak karakteristik makhluk hidup daripada yang tampak pada gambar atau foto, seperti jenis makanan yang dimakan oleh organisme.

Jika anda mengajarkan materi yang sama, bagaimana Anda melakukan evaluasi terhadap cara mengajar Pak Robi berdasarkan pilihan berikut ini?

A. Cara yang digunakan pak Robi sangat baik.

B. Meminta siswa untuk mengelompokkan gambar – gambar organisme secara mandiri akan membingungkan mereka. Oleh karena itu, sebaiknya pak Robi menjelaskan sistem klasifikasi Linnaeus secara rinci kemudian meminta siswanya untuk menerapkan sistem klasifikasi tersebut pada saat mengidentifikasi gambar-gambar organisme yang telah diberikan


D. Sebaiknya Pak Robi tidak menjelaskan tentang sistem klasifikasi Linnaeus tetapi langsung meminta para siswa untuk mendiskusikan alasan – alasan mereka dalam mengelompokkan organisme.

7. Bakteri


Berdasarkan pilihan berikut ini, apabila Anda mengajarkan materi serupa, metode manakah yang paling mendekati metode Anda dalam menindaklanjuti aktivitas pendahuluan pada kegiatan pembelajaran tersebut?

A. Saya akan lebih memilih untuk menjelaskan secara rinci bahwa bakteri dapat ditemukan hampir di semua tempat, kemudian menayangkan video tentang pertumbuhan bakteri di berbagai tempat. Cara tersebut lebih efektif daripada cara mengajar Bu Simon karena materi tentang bakteri ini merupakan sebuah fakta sederhana.

B. Saya akan menyampaikan bahwa bakteri dapat ditemukan hampir di semua tempat. Kemudian saya meminta siswa untuk mengambil sampel dengan cara
mengusap beberapa tempat berdasarkan daftar nama yang sudah mereka tulis dan membiakkan bakteri tersebut untuk mengkonfirmasi tujuan pembelajaran.

C. Saya akan meminta siswa melakukan pengamatan dengan menguji beberapa tempat yang menurut mereka bakteri dapat ditemukan dan tidak dapat ditemukan. Setelah melakukan pengujian dengan cara membiakkan bakteri, siswa melakukan diskusi tentang hasil pengamatan mereka, kemudian saya akan memberikan kesimpulan terhadap apa yang sudah mereka dapatkan untuk menghubungkannya dengan tujuan pembelajaran.

D. Saya akan mengajarkan kepada siswa cara melakukan pengusapan dan membiakkan sampel, kemudian memberikan kesempatan kepada mereka untuk memilih beberapa lokasi sebagai tempat uji coba. Setelah hasil uji coba terkumpul, siswa diminta untuk berdiskusi dan menyimpulkan hasil pengamatan mereka.

8. Klorofil

“Klorofil adalah zat warna (pigmen) alami yang ditemukan pada tumbuhan hijau. Klorofil merupakan zat warna utama penyerap cahaya matahari untuk proses fotosintesis.”

Penjelasan inilah yang diutarkan oleh Bu Ratri sebagaimana yang terdapat pada buku teks Ilmu Pengetahuan Alam kelas 8 dan beliau sedang mencari cara terbaik untuk mengajarkan peran klorofil sesuai dengan penjelasan tersebut.

Berikut ini adalah beberapa metode yang menurut bu Ratri dapat digunakan untuk mengajar materi tersebut. Jika Anda mengajar materi yang sama, manakah yang paling mendekati cara Anda mengajar?

A. Menugaskan siswa untuk membaca buku teks, khususnya tentang peran klorofil selama jam pelajaran. Kemudian Bu Ratri menampilkan slide mikroskop yang terdiri atas gambar sel dari berbagai bagian tumbuhan, yang menunjukkan bahwa sel yang biasanya terpapar cahaya matahari akan mengandung klorofil dan berwarna hijau.


C. Meminta siswa menggunakan mikroskop untuk mengamati preparat sel dari berbagai bagian tumbuhan, kemudian mengelompokkannya berdasarkan ciri-ciri utama. Selanjutnya, siswa diminta membaca buku teks untuk mempelajari tentang peran klorofil supaya siswa memahami hasil pengamatannya.

D. Menyiapkan beberapa preparat sel berlabel yang dapat diamati oleh siswa dengan menggunakan mikroskop. Kemudian memberi kesempatan kepada
siswa untuk memahami pengamatannya melalui diskusi kelompok. Beberapa buku teks telah disediakan sebagai referensi untuk siswa.
APPENDIX B
HSIRB Approval Letter for Research
Date: June 9, 2014

To: Bill Cobern, Principal Investigator  
    Brandy Skjold, Co-Principal Investigator  
    NFN Listiani, Student Investigator for thesis

From: Amy Naugle, Ph.D., Chair

Re: HSIRB Project Number 14-06-04

This letter will serve as confirmation that your research project titled “Translating and Adapting the POSTT for Formative Assessment for Indonesian Preservice Science Teachers’ Pedagogical Orientations” has been approved under the exempt category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may only be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., you must request a post approval change to enroll subjects beyond the number stated in your application under “Number of subjects you want to complete the study”). Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: June 8, 2015