Pre-service teachers’ perspectives: pedagogical challenges of teaching mathematics on sea-teacher project

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Abstract In order to cope with rapid changes in 21st century, preparation of pre-service teachers is viewed as crucial to the quality of teacher workforce. This article presents the findings of a study of Indonesian-Thailand pre-service teachers that participated in SEA-Teacher Project. This study used qualitative method to describe pre-service teachers’ perspective on pedagogical challenges as they participated in observations, assist in teaching, teach and reflect. Drawing from participant field notes, surveys and semi-structured interviews, by open-questions this study seeks to investigate the problems. During those phases, this study gathered the pre-service teachers’ field notes that indicates some challenging pedagogical experiences influenced their perspective in teaching mathematics. The findings reveal that language becomes their major challenge in delivering material (80%) that affected their perception in explains a topic, concept or procedure in mathematics. Some of them overcame this problem by developing learning media. Pre-service teachers are given the opportunity to do practice teaching, but some of them (30%) are given only 2-3 meetings, that causes pre-service teachers couldn’t develop variation of teaching strategies. Pre-service teachers did not have enough time to learn school’s curriculum and resulted in students having difficulties in developing lessons plan. They then try to keep the curriculum in their home country (40%) or used the lesson plan as an example in school (60%). Some obstacles experienced by pre-service teacher (20%) as they have to taught large classes (up to 50 students). They had to work hard in order deal with different characters of students so the class remain conductive. In deal with misconception when students make mistakes in working on a problem 90% of them only give the right answer, without exploring the possibility of a misconceptions. In practice only 30% of them identify the cognitive demands of students who are taught during the observation activity and assist of teaching. Limitations on school infrastructure such as LCD, computers, and internet inhibit the pre-service teacher to develop ICT based learning (50%) but they overcome the limitation by developing students’ worksheet and contextual mathematics model.

1. Introduction
Teachers and educational institution facing rapid development of educational changing in the 21st century. Competence and skills have become an essential part in apply knowledge, in order to cope with changes. It requires students to be flexible, to take the initiative and lead, and to produce something new and useful. The challenges faced by teachers in implementing 21st century learning, they were able to witness students thinking skills improve; see the desire for them to have responsibility for doing the various tasks assigned to them; use technology to communicate and share with their group members, both in and out of class; to listen attentively and give their peers a chance to answer when they of themselves think they know the answer to a question; and give themselves a chance at solving which before they may not even attempt [1]. Responding to the rapid development
of students, teachers need to open space to develop students’ characteristics: Critical Thinking and Problem Solving, Creativity and Innovation, Communication, and Collaboration. Teachers required a mindset that best adapted to the significant changes in learning; teachers who develop strategies for engaging with and constructing new knowledge, this means teachers need to have growth rather than fixed mindsets [2].

The preparation of pre-service teachers is viewed as crucial to the quality of teacher workforce in 21st century [3]. The ways in which candidates are prepared to be teachers have a critical influence on what teachers can do and what their students learn, yet very few countries have an effective system for educating teachers and many programs lack proven practices and are a long way behind the best [4]. Mathematics as a lesson that some students find difficulties, in fact has a big role to improve student skills where they need to solve problems in real life. Teacher educators should make pre-service teachers realize that mathematics teaching and learning was very complex that many factors take effects, teach more teaching strategies, and introduce pre-service teachers to do self-reflection [5]. This needs had to be done, so that when they start teaching at school they can change students’ perspective about mathematics as a difficult lesson. Thus, the pre-service teacher must understand and apply pedagogical content knowledge (PCK) as intersection of specific content and pedagogical knowledge in teaching. In mathematics PCK includes conceptual and procedural knowledge in mathematics, pedagogy, and curriculum [6]. Chick, Baker and colleagues PCK frameworks in mathematics are divided into three main categories: (a) Clearly PCK: teaching strategies, student thinking, student thinking-misconceptions, explanations, cognitive demands of task, appropriate and detailed representations of concepts, knowledge of resources, curriculum knowledge, purpose of content knowledge; (b) Content knowledge in a pedagogical context: profound understanding of fundamental mathematics, deconstructing content to key components, mathematical structure and connections, procedural knowledge, methods of solution; (c) Pedagogical knowledge in a content context: goals for learning, getting and maintaining student focus, classroom techniques [6]. Teaching is not just transferring knowledge to students, more than that teachers are required to be able to provide understanding about what is taught. Therefore teacher educators and pre-services must master the concept of effective and professional teaching and master the characteristics of students, as a whole in PCK.

| Clearly PCK Category                      | Evident when the teacher…                                                                                                                                 |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Teaching Strategies                      | Discusses or uses strategies or approaches for teaching a mathematical concept                                                                             |
| Student Thinking                         | Discusses or addresses student ways of thinking about a concept or typical levels of understanding                                                        |
| Student Thinking - Misconceptions        | Discusses or addresses student misconceptions about a concept                                                                                              |
| Explanations                             | Explains a topic, concept or procedure                                                                                                                     |
| Cognitive Demands of Task                | Identifies aspects of the task that affect its complexity                                                                                                  |
| Appropriate and Detailed                 | Describes or demonstrates ways to model or illustrate a concept (can include materials or diagrams)                                                        |
| Representations of Concepts              | Discusses/uses resources available to support teaching                                                                                                      |
| Knowledge of Resources                   | Discusses how topics fit into the curriculum                                                                                                               |
| Curriculum Knowledge                     | Discusses reasons for content being included in the curriculum or how it might be used                                                                      |

Practice field experience give pre-service teacher opportunities to develop their PCK. Furthermore, international experiences give positive effects on an individual, including increased self-confidence, adaptability, intercultural sensitivity, open-mindedness, and global awareness [7]. SEAMEO with “Pre-service teacher Exchange in Southeast Asia” (SEA-Teacher) project provide opportunity for pre-service teachers to have teaching experiences (practicum) in schools in other countries in Southeast Asia [8]. The participants are 4th year students whose major are in math, science, English and pre-school. During the one month period, students’ roles and responsibilities are
assigned weekly (observe, assist in teaching, teach and reflect). This study is derived from larger SEA-Project implementation, exploring whether Indonesian and Thailand mathematics pre-service teachers experienced pedagogical challenges during SEA-Teacher Projects. This study focussed to analyse how pre-service students’ perception about pedagogical challenges during those four phases of international practice experience related to clearly PCK indicators.

2. Methods
Qualitative research designed was used in this case study where focuses on pre-services perspective on pedagogical challenges as they participated in observations, assist in teaching, teach and reflect in host school of different country (Thailand and Indonesia). This method chosen as the basis for data collection and analysis was appropriate given that the researchers sought to describe and interpret data arising from discovery, insights, and analysis [9]. This study involved 10 mathematics pre-service teachers, each 5 from Indonesia and Thailand who participated in the SEA-Teacher Project in 2017. Drawing from participant field notes, surveys and semi-structured interviews, by open-questions this study seeks to investigate the problems that have been raised. Interviews were conducted in the mother language so that the researcher and interviewees can explored their experiences in greater detail. Focus group discussions were also conducted to collaboratively between participants, mentor teachers, and lecturers to discuss the challenges during their teaching at school. The pre-service teachers were also asked to reflect their achievement per week. Data that has been collected is analyzed to be presented in descriptive form. Finally, recommendations based in lesson learned are provide for designing next international practice experienced to developing pedagogical knowledge of pre-service teachers. Thus the things that become difficulties for the participants can be prepared before they carry out the SEA-Teacher program so that when they encountered the same problems it can be immediately found the solution. Additionally this study explored deeply embedded perception pre-service teacher in overcome problems in implementation of SEA-Teacher phases.

3. Results and Discussion
Explanation. Based on the results of participant documents analysis and confirmation with in-depth interview, language becomes their major challenge in delivering material, as not all students master English. That became an impact on their abilities to communicate effectively, empathetically and courteously to the students. 80% of participants stated that challenge affected their perception in explains a topic, concept or procedure in mathematics. The challenges of pre-service teachers usually start when they experience difficulty transferring theory and knowledge from college preparation programs into practical application within the classroom [10]. Some of them overcome this problem by developing learning media (power point slide, math’ contextual model, etc.) so that the material can be delivered to students even though there are language barriers. When students still have difficulties in receiving materials in English, then Pre-service teachers repeat the explanation. There are some teacher mentor who are not fluent to speak English. Some Pre-service teachers are also have difficulty to discuss about problem they faced in class with teacher mentor. Limited time is also an obstacle for them to discuss with the supervisor. To overcome this obstacle, focus of class discussion in which pre-service teachers are increasingly encouraged to voice their opinions on the relationship between theory and practice, through the lens of critical reflection on what they perceive to be the lecturers’ and teacher mentors’ views [11]. If there is a problem the language can be facilitated by translator.

Teaching strategies. Pre-service teachers also engaged with face to face classes that provided further knowledge in teaching techniques with reflective learning opportunities [12]. After doing assist in teaching, pre-service teachers are given the opportunity to do practice teaching, but some of them (30%) are given only 2-3 meetings. This causes pre-service teachers couldn’t develop variation of teaching strategies due that limitations. Most of them used explanation strategy to deliver mathematics material with teacher-centered learning and did not stimulate students to be active. Preparation programs often failed to translate effectively into classrooms [13]. Some of them who have more time to teach used teaching strategies such as discussions, question and answer, games, and demonstrations. Based on the discussions, the pre-service teacher argued that the strategies they learned during their time at college were not stimulant applicable. This is because class conditions are different from
theory, where strategies can be effective in one class, but not in another class. Even one of them said that he handled a class that was very passive so that the explanatory strategy, discussion and others did not change the class conditions at all.

Curriculum knowledge. Before practicum period of SEA-Teacher Program in host’s country, 70% pre-service teacher try to know about school curriculum, in order to prepare materials and models of learning but the limited information about the school that will be used for practice causes knowledge about the curriculum is still shallow. In the stage of assist in teaching pre-service teacher has done activities such assistance to develop the learning materials, prepare learning activities in class and manage the classroom. But some Pre-service teachers did not have enough time to learn school’s curriculum and create the learning goals. This resulted in students having difficulties in developing lessons plan that fit the school curriculum. They must adjust to the conditions of the school curriculum immediately after they are placed either in the middle school or high school. They then try to keep the curriculum in their home country (40%) or used the lesson plan as an example in school (60%). The discussion with teacher mentor is limited in how they apply the lesson plan that has been prepared, but not specifically discussed why the material is chosen in relation to the curriculum (purpose of content knowledge).

Student thinking. Some obstacles experienced by pre-service teacher (20%) as they have to taught large classes (up to 50 students). They had to work hard in order deal with different characters of students so the class remain conductive. Classes with students that are quite a lot of challenges are also in teaching, this is related to how to adjust to the way students think that is heterogeneous. Recognized by the pre-service teacher, that grouping students into small groups makes it easier to organize and guide them in understanding a mathematical concept. Unlike pre-service teachers who get small classes, it is easier for them to accommodate students’ way of thinking. This is because it is clearly seen between students with high and low thinking abilities, so they can immediately give different treatment for them. Another challenge is faced by 20% of them who teaching classes that almost all of their students are have high capability. In the first time teaching practice is carried out, students easily can accept the material, even the questions given are too easy for them so that it does not take long to complete. On the other hand, pre-service teachers do not prepare high order thinking skills. This is surprising because students show that they can work on more challenging problems than that. Less than optimal preparation from the pre-service teacher leads to the failure of learning high-level problem solving skills.

Student thinking-misconceptions. Although during the implementation of the practice of field experience the material is delivered by pre-service teachers, misconceptions in mathematical should not occur to students. This is greatly influenced by their competence to master mathematical concept and their ability to deliver the material with appropriate and detailed representations of concepts. Besides that, pre-service teachers must immediately correct students’ misconceptions when they are found in class. This is not done by most of them (90%), when students make mistakes in working on a problem they only give the right answer, without exploring the possibility of a misconceptions. Misconceptions that are not handled will affect the learning of the related material further.

Cognitive demands of task. All pre-service teachers learn about cognitive stages when they go to college. In practice only 30% of them identify the cognitive demands of students who are taught during the observation activity and assist of teaching. This has an impact, some of them did not learn the cognitive objectives of the learning carried out and did not adjust the assessment instruments developed. They only develop questions as a form of assessment. Thus learning activities are less able to facilitate cognitive development of students. On the contrary 30% of them have tried to identify the cognitive level of students. With the help of teacher mentor they try to adjust the lesson plan along with appropriate assessment instruments so that the master accommodates the students’ cognitive demands.

Knowledge of resources. Limitations on school infrastructure such as LCD, computers, and internet inhibit the pre-service teacher to develop ICT based learning (50%). 50% of them can carry out learning with power point media. But the power point media does not guarantee that they can deliver the material properly. This is because the power point developed is only one direction, so it does not stimulate the development of students’ ideas (30%). Some of them (20%) have developed power point
media that insert good questions that lead students to construct mathematical concepts. The constraints of the limited technology do not prevent pre-service teachers from using instructional media, 10% of them transform power point media to student worksheets. While others prepare a contextual mathematical model media because coincidentally the material is taught close to everyday life.

4. Conclusion

Based on data analysis and conclusion, it can be concluded that some pedagogic challenges experienced by pre-service teachers during the implementation of SEA-Teacher. This affects their perception of teaching mathematics in class. Language is a challenge in explaining a topic, concept or procedure in mathematics, because not all students master English so it needs tools such as learning media. The limitations of teaching time (usually scheduled for 1 week) are a challenge for them to implement teaching strategy so that most of them use learning strategies that are still teacher-centered. Different curriculum in host country causes the pre-service teacher to have to adapt especially in terms of the preparation of the lesson plan and its overall completeness. More than those who simultaneously imitate the lesson plan in school without further reviewing the purpose of content knowledge. The ability to understand student-thinking and misconceptions with different types is a challenge for those who mainly teach large and heterogeneous classes. The cognitive demands of task are not considered by most of them, as a result they have not identified the cognitive level of students to adjust learning goals and assessment. Limitations on school infrastructure such as LCD, computers, and the internet inhibit the pre-service teachers to develop ICT based learning, but they try to develop alternative media like student worksheets and contextual mathematics models. From the results of the analysis, lesson based recommendations were learned to provide next international practice, including: pre-service teacher preparation must be carried out maximally, especially in mastering pedagogical content knowledge. It is related to language, content, and host country curriculum mastery, ability to use teaching strategies, ability to deal with different types of students thinking, ability to correct mathematical misconceptions, and the ability to utilize various learning media to support constructing mathematical concepts to students. In addition, the flexibility of time and facility support and guidance from teachers to carry out teaching practices also required pre-service to try various strategies and evaluate the results to develop their pedagogical competencies.

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