INVESTIGATING PRESERVICE SECONDARY SCHOOL SCIENCE TEACHERS' PRACTICES ABOUT INQUIRY-BASED INSTRUCTION DURING SCHOOL PRACTICUM

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Abstract. Inquiry-based learning is widely called for 21st century science classroom. It is an important instructional tool for engaging students to investigate scientific knowledge and construct habit of mind in science. This study employed qualitative methods to explore three preservice secondary science teachers' practices about inquiry-based instruction during school practicum. Data were collected by lesson plan analysis, interview, and classroom observation. The empirical results showed that preservice secondary science teachers engage 5E lesson plan to their classroom and style of inquiry-based instruction be differenced. Connected between theory and practices need to be discussed for teacher preparation program.

Keywords: preservice teacher, teacher preparation, inquiry-based learning, school practicum

Introduction

Everyone can learn and understand science. Students observe and predict natural world that surrounding them by scientific inquiry for knowledge sharing and constructing. The 21st century, they are invited to science classroom facing with science in the world of endless changing (Bouillion & Gomez, 2001). Challenges in science classroom concerns instructional practices, which are not only describe or transfer knowledge to all students, but they should have tools for inquiring by themselves, integrating process and methods, and approaching necessary skills to science teaching and learning (Rutherford, 1964; Anderson, 2002). These can help students to meet the goal and philosophy of science teaching (King, 1991; Abd-El-Khalick, 2005).

Scientific knowledge is now growing with diversity of knowledge construction process and expanding via social media. Inquiry-based learning is a key

process to bring students face with world of science. However, content-based or rote learning play role in traditional classroom, but it should not limit nature of learning for 21st century learners. The 21st century classroom should have variety of instructional practices, especially incubating learning habit to do with inquiry. Inquiry-based learning engages students to understand nature of science and how to construct knowledge by themselves (Lederman, 1999; Bell & Lederman, 2003; Bybee, 2002; Nuangchalerm, 2009; 2013).

Inquiry-based learning in science teaching at school levels is driven by national science education policy. It has been widely recognized to school science and mathematics such a long time. School accepted inquiry for science classroom, but it was just dialogue through reforming education. However, inquiry-based learning seems to help students meet the real science than history of science or lecturing science classroom. Teachers are vital mechanism to promote scientific inquiry for students and push them to have positive mind in science. The quality of teacher becomes a key factor to motivate understanding of science and nature of science (Dostál & Klement, 2015; Serafín et al., 2015). Teaching science by inquiry-based instruction, is considered to be effective to facilitate students' development of science understanding (Minner et al., 2010).

Preservice teachers are key to reforming science education. They are typically found it challenging to adopt inquiry approaches in their teaching. That is, science and art of teaching in the 21st century skills because inquiry is a successful tool for constructing of they had learned and applied into real life situations. However, some studies show that they could have inadequate understanding of inquiry-based learning and knowledge of communication and questioning (Moyer-Packenham & Milewicz, 2002). In general, studies on preservice teachers' knowledge tends to focus on what they do not know than on their sense making (Ponte & Chapman, 2006), including the nature of their knowledge that supports inquiry-oriented teaching. This study investigates preservice secondary science teacher deal with inquiry-based instruction during school practicum. The results use for bridging the gap program of study between university (theory) and school (practice) in the teacher preparation program.

Methodology

The teacher preparation program in Thailand launched 5-year program in B.Ed. for teacher education. The program determined 4 years for course of study and 1 year for school practicum. Teacher preparation program must engage students to enroll at least 160 credits. ***G***eneral education > 30 credits**,** ***t***eacher profession > 50 credits**,** ***c***ore course > 74 credits, and elective course > 6 credits**.** Teacher profession should reach cognitive understanding, profes-

sional experiences, and competency. Cognitive standards consisted of language and technology for teachers, curriculum development, learning management, psychology for teachers, measure and evaluation in education, classroom management, research in education, innovation and ICT in education, and teacher profession.

Professional experiences can be started while taking courses in university and during school practicum. Competency consisted of learning managerial skills, language and communicative skills, thinking skills, technology for learning skills, and moral and ethics, curiosity, and social service. Three preservice science teachers enrolled 164 credits of 70 subjects in university, 30 credits of general education courses, 46 credits of educational courses, and 6 credits of elective courses. To make a connected between courses of study and inquiry-based instruction, we provide information of enrolled courses of education as Table 1.

This study employed case studies allowing us for in depth examination of the situation (Stake, 1995). Three preservice science teachers are purposively selected. During school practicum, we investigate preservice teachers' instructional practices in the first semester of academic year 2015. Preservice teacher 1 and 2 [P1 and P2] are female and assigned to teach general science for grade 8 students. Preservice 3 [P3] is male and assigned to teach general science for grade 9 students. They learn how to be good science teachers to be, working with cooperating teacher, and supervised of how to practices in school with university supervisor.

The main sources of data were interviews, classroom observations and teaching documents. The open-ended interviews during the semester included their understanding about teaching practicum and inquiry-based instruction. Classroom observations were conducted for lessons including and not including inquiry approaches. Data from the observations included teacher-student interactions about science lesson. Documents consisted of lesson plans, preservice teacher prepared science activities and records of their reflections on science teaching.

Table 1. Courses of education in university

Year of study	Credit
First year	
Foundations and philosophy of education	3
Essential information for teaching profession	3
Education technology and communication in	2
contemporary education	3
Professional experience 1	

Second year	
Psychology in the classroom	3
Learners developing activities	2
Inclusive education	3
Third year	
Educational assessment and evaluation	3
School hygiene	2
Curriculum and instruction in sciences 1	3
Curriculum development and management	3
Design and developing learning	3
Fourth year	
Classroom action research	3
Curriculum and instruction in sciences 2	3
Professional experience 2	3
Classroom management	2
Seminar and developing teacher experience	2
Fifth year	
Practicum in school setting 1	6
Practicum in school setting 2	6

Findings

The lesson plan is so theorist and emphasized on inquiry-based learning, 5E as BSCS recommended with *engage, explore, explain, extend,* and *evaluate* found from three preservice teachers' documents. The concept of inquiry-based lesson plan is contributed and propagated by the Institute for the Promotion of Teaching Science and Technology (IPST), but may be different in each classroom contexts. Preservice science teachers give a feedback to lesson plan that standard-based curriculum determined them to teach for standard and its indicator of students' learning. They design and manipulate science lesson by themselves as well as think, create, monitor, and measure what students should know and competence.

They have different beliefs about students' learning, their knowledge of science, connecting between science teaching theory and practices, and their pedagogical knowledge of engaging students through inquiry-based learning. Three preservice secondary science teachers differed in how they planned and conducted their lessons during their practicum teaching, but they exhibited some key similarities that seemed to characterize their sense making of using inquiry approaches.

Preservice teacher 1 [P1] emphasizes on 5E learning, inquiry-based learning is implemented, but she pays attention in the lesson than process of inquiry. She ignores to work with some questioning and following necessary sentences to empower students' inquiring mind. Students show their confusing with lesson by asking of what they have to do in the classroom. She is mostly

less explanation, not clear of task instruction, and dominantly assigned worksheet to classroom activities.

[R]: *Why don't make questioning to monitor students' understanding?*
[P1]: *Students can read instruction in the worksheet.*
[R]: *Worksheet is just a paper, you should give them more explanation and questioning.*
[P1]: *I think that they keep silent, it assume to me they understand of what I taught.*
[R] : *You're sure of what you taught them !!, they understood at all.*
[P1]: *Ummmm… not sure.*

The silent classroom, traditional classroom of teacher-centered approach, is generally found in the less inquiry. She confidently understands the silent classroom means good students and easy to teach and manage classroom. However, positive reinforcement through questioning is so important in the inquiry-based learning. But she ignores to do with students. Even though students can be participated classroom activities by working and learning together. Explaining and questioning make a bridge between teacher and students, also learning atmosphere by inquiry let them to have conceptual versus procedural understanding. Deep understanding of the science is not always present or demonstrated with use of the inquiry approach.

Preservice teacher 2 [P2] emphasizes on experiment that is a heart of discovering science, let students to meet scientific concept, and promote nature of science. Inquiry-based learning conduct in classroom to engage of what students think and do through experimental activities, but students less science process skills. The instructional practices, she focus on knowledge integration among lectures, experiments, interactive learning, and group learning. It explains how students learn science through inquiry and why their ideas are important.

[R]: *What is your lesson today?*
[P2]: *I plan students observe change in color when reaction is occurred.*
[R]: *How do you know they understand experiment?*
[P2]: *Just read worksheet and search some information from internet, talking with* friends, and take a note on paper.
[R]: Enough for inquiry-based learning?
[P2]: *Not enough to my classroom, but I think it can leads students to nature of* science as well.

The P2 is able to associate the concepts and procedures they held as patterns with specific inquiry-based learning by internet. As belief, knowledge can be

understandable through the network, but skills and scientific mind must be implemented in the classroom activities. She believes that experiment will make real science to students and enhance nature of science as well as students perceived.

The questioning method is so important to stimulate students' inquiring mind. She listed her question about experiment and prior knowledge, but less waiting time promoting thinking skills to students. That is an empirical result, she decided to gain students' perception inquiry through content-based and experiment-based approaches. She needs to empower students' to think and inquire questioning much more.

Preservice teacher 3 [P3], is a preservice science teacher employed inquiry-based learning through less speaking, but game learning help his students to share ideas and construct knowledge as well. However, he reflects to program of study that inquiry-based learning should be implemented during 4-year study and 1-year school practicum.

[P3]: *I don't understand how to teach, but I know what science in the classroom are.*
[R]: *Why do you think like that?*
[P3]: *That's really, I know less psychology in the classroom because it is so theory, not practical, but…I know how to inquire knowledge to me and my students.*
[R]: *How?*
[P3]: *4-year study in the university, we learn 5E, 7E and so on by theorist view, less practical. Our lesson plan is very good writing, but it is not effective in the real classroom.*
[R]: *How do you solve this problem?*
[P3]: *We learn to use inquiry from theory into practices by employing various kind strategies of teaching. Then, we make a connection between 4-year study and real situation during school practicum.*
[R]: *Great !!.*

He invited inquiry-based learning to students by game and strategies of teaching. He also guided the students to think about what they learnt about the concepts and summarized the key ideas. A brief outline of the lesson, allows group learning include the ongoing teacher-student interactions that occurred to facilitate the students' thinking, inquiry, and sharing processes. Their students fun and happy to learn science is very impossible.

Discussion

The beliefs of preservice teachers in the area of inquiry-based learning need to be discussed. They use of inquiry approaches in their theory of teaching,

but practical seems to be much more improved. The 4-year university study should incubate teaching profession and teaching science to them. Also beliefs in the teaching strategies, psychology in classroom, and instructional practices are important that preservice science teachers should be (Mansour, 2009). Nuangchalerm & Prachagool (2010) investigated 67 preservice science teacher' beliefs during school practicum. Participants were exposed to instructional strategies, inquiry-based teaching, including models of teaching. They believed that mostly less capable of performing persuasive pedagogical practices than more generally accepted practices. Supervision is necessary, they need supervisor and cooperating teacher provide them how to teach and do a good research.

However, course of study in university should be incorporated theory into practice much more. The program of study needs to gain more courses of instructional practice, especially curriculum and learning design, inquiry-based instruction, and classroom practices. Inquiry-based learning is not only theoretical value, but also it needs practical value in science classroom. Preservice science teachers can implement its fruitfulness into real situations. Crawford et al. (2000) argues that one of the key characteristics of a teacher establishing an inquiry-based learning environment. It can help students learn new things through inquiring mind and seems to scientists do. This will help students understand that the ways of talking and thinking in science is different from those in students' everyday experiences. Nuangchalerm (2012) studied 43 preservice science teachers about inquiry-based instruction for enhancing pedagogical content knowledge. The finding indicated that it can enhance pedagogical content knowledge to preservice teachers. This point of view could be made preservice teachers' knowledge and understandings key ideas of science teaching.

Three preservice secondary science teachers showed the connected between courses of study and school practicum, preservice teachers' beliefs and conceptions of inquiry-based instruction, concepts and procedures to science classroom, students and instructional practices when they support inquiry-oriented teaching approaches. This study indicates that the preservice teachers constructed an image of inquiry-oriented practice that involved understanding science as different patterns, beliefs, and practices (Cakir, 2008; Schutz, 2014). This connection is important to provide the novice science teachers with an intention of curriculum and instruction to help them to see way of learning and understanding science.

This connectedness is necessary for preservice teachers to make sense of how to transform theoretical pedagogical knowledge into practical knowledge. The findings suggest that preservice secondary science teachers could transform theory to practice regarding inquiry teaching if they construct a relevant,

integrated view of curriculum and instruction. Also, courses of study and learning design for 4-year university, is important to provide them with experiences that treat novice teacher in area of knowledge and competence.

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