Fifth Year Pre-service Science Teachers' Struggles with and Learning About Teaching Science Through a-Year-Long Field Experience

Chatree Faikhamta

ABTRACT

Field experiences are components of any teacher education program in which pre-service teachers learn how to teach in real situations. This study sought an understanding of 33 fifth year pre-service science teachers' struggles with and learning about teaching science during their one-year field experience. This qualitative study based on an interpretative paradigm was drew upon written reflections, focus group interviews and observations of seminar sessions. Data analysis was inductive involving categorical aggregation, followed by a search for data correspondence and patterns to bring it to conclusion. Problematic issues for most of pre-service science teachers were unclear learning outcomes in lesson plans, rarely probing students' prior knowledge, classroom management, and misconception in science concepts. Despite the struggles they experienced, pre-service science teachers had learned and broaden their pedagogical content knowledge. The recognitions of patterns of pre-service science teachers' struggles and learning could be seen to be a basis for reflecting on and rethinking about the components of science teacher preparation program.

Keywords: pre-service science teacher, field experience, pedagogical content knowledge

บทคัดย่อ

การฝึกประสบการณ์วิชาชีพครูเป็นองค์ประกอบหนึ่งที่สำคัญของหลักสูตรการผลิตครู ซึ่งทำให้นิสิตนักศึกษาครูได้เรียนรู้การสอนในสถานการณ์จริง งานวิจัยนี้มีจุดมุ่งหมายเพื่อศึกษาการเผชิญปัญหาและการเรียนรู้ของนิสิตฝึกประสบการณ์วิชาชีพครูวิทยาศาสตร์จำนวน 33 คน ระหว่างการฝึกประสบการณ์วิชาชีพ 1 ปี โดยใช้ระเบียบวิธีวิจัยเชิงตีความ เก็บรวบรวมข้อมูลจากสมุดบันทึกสะท้อนความคิดของนิสิต การสัมภาษณ์กลุ่ม และการสังเกตการณ์อภิปรายกลุ่มย่อย วิเคราะห์ข้อมูลโดยใช้กระบวนการอุปนัยเพื่อจัดกลุ่มข้อมูลและหาความสัมพันธ์ของข้อมูลเพื่อสรุปเป็นประเด็น ผลวิจัยพบว่าประเด็นปัญหาที่นิสิตเผชิญในระหว่างการฝึกประสบการณ์วิชาชีพคือ นิสิตเขียนจุดประสงค์การเรียนรู้ไม่ชัดเจนในแผนการจัดการเรียนรู้ ไม่สำรวจหาความรู้เดิมของนักเรียน มีปัญหาในการควบคุมชั้นเรียน และนิสิตมีแนวคิดคลาดเคลื่อนในเนื้อหาวิชาวิทยาศาสตร์ อย่างไรก็ตาม ขณะฝึกประสบการณ์วิชาชีพ นิสิตได้เรียนรู้และพัฒนาความรู้ในเนื้อหาบูรณาการวิธีสอน จากผลการวิจัยนี้จะนำไปสู่การปรับปรุงและพัฒนาหลักสูตรการผลิตครูวิทยาศาสตร์ต่อไป

คำสำคัญ: นิสิตฝึกประสบการณ์วิชาชีพครูวิทยาศาสตร์ ฝึกประสบการณ์วิชาชีพ ความรู้ในเนื้อหาบูรณาการวิธีสอน

Faculty of Education, Kasetsart University, Bangkok 10900, Thailand.

INTRODUCTION

In many teacher preparation programs, field experience is a key component that attempts to bridge academic coursework and the realities of classroom teaching (Beeth and Adadan, 2006). Field experience is considered as a place where pre-service teachers learn how to teach a particular content topic to specific students in real classrooms. Based on a social-constructivist perspective, field experience offers pre-service teachers opportunities to construct or reconstruct their own knowledge and beliefs through support and guidance from knowledgeable persons (Watson, 2006), collaboratively working with other people such as cooperating teachers, supervisors, parents, other pre-service teachers and others (Bell and Gilbert, 1994; Watson, 2006), and reflecting on their own and other's ideas (Abell and Bryan, 1997). Pre-service teachers also have opportunity to actually work with students which serves as the preparatory activity before they assume the full responsibilities of an in-service teacher. In school atmosphere, pre-service teachers can negotiate classroom management, school policies, organization, lesson planning, and their own positions within the social structure of the schools.

In the context of Thai teacher education, field experience is a highlight in a five-year teacher education program. Since 2004, a four-year teacher program has been refined to be a five-year teacher education program deeming as a new hope for improving quality of Thai teachers. Based on the program, pre-service teachers are intended to develop their pedagogical content knowledge (PCK) (Shulman, 1986) and bring this kind of knowledge in real situations. Pre-service teachers are also expected to implement constructivist-based teaching strategies as suggested by the National Education Act (Office of the National Education Commission, 1999). To realize those expectations, pre-service teachers are required to take a-four-year coursework and a-year-long field experience in schools. The extension of the fieldwork duration to an entire year for pre-service teachers to obtain better understanding of teacher's roles, curriculum development and implementation, as well as student's growth promotion.

Since a five-year teacher education program was first offered, there has been a lack of research on its success, especially in regard to field experience. Unlike, the four-year program, this kind of research was found comprehensive. It was found that in a four-year program pre-service teachers had difficulties in interpreting the learning standards from the curriculum documents, and perceived misunderstanding of the concepts, principles, and processes involving in a learner-centered teaching approach (Faikhamta and Roadrangka, 2005). As attention paid to a whole year of pre-service science teachers increased, the present study was seen that it was a challenge to investigate what pre-service science teachers struggled with their teaching and what they learned about teaching specific science contents. It was hoped that the research findings would eventually be used to further the refinement of the current science teacher education program response to the national learning reform.

Research questions

1. What problems related to teaching science did the fifth year pre-service science teachers encounter during a-year-long field experience?

2. What did the fifth year pre-service science teachers learn about teaching science during a-year-long field experience?

RESEARCH METHODOLOGY

A qualitative research procedure based on an interpretive paradigm (Patton, 2002) was used to build a phenomenological account of teaching practice as experienced by pre-service science teachers. As a researcher, I viewed educational environments such as classrooms and schools as a complex world. I thus believe that an interpretive methodology can provide appropriate directions to conduct the research in order to reach the answers

to the research questions.

Context of the study

The participants in this study were 33 fifth year pre-service science teachers enrolling in a 5-year teacher education program at Kasetsart University, Thailand. During the final year, they spent an entire year or two semesters of 18 weeks in local primary or secondary schools. The pre-service teachers were expected to teach science for 8-12 hours a week and to conduct science extracurricular activities in the first semester, and to do classroom action research in the second semester. Their teaching was supervised by university supervisors and school cooperating teachers at least four times a semester.

Data collection and analysis

In order to understand pre-service science teachers' struggles with and their learning about teaching science, multi-method evaluations were used throughout the research process. The methods included reviewing of written reflections in logbooks, observation of seminar sessions and focus group interviews. Logbook was the main source of data. It was designed to engage pre-service teachers to reflect on and discuss their knowledge, learning and problems from field experience.

To analyze data, data from written reflections in logbooks, field notes and interview transcripts were combined in order to enhance validity (Patton, 2002). In the first step, I began with a particular incident from pre-service science teachers' written reflection in logbooks and transcripts of seminar discussion. Then identified indicators for the categories of "struggles" or "learning" and coded them on documents. Sub-categories such as learning about teaching strategies, probing techniques were identified and coded thereafter. These codes were compared among their consistencies and differences. The consistencies between codes revealed tentative categories. In the second step, incidents were compared to initial versions of categories. New incidents were considered whether they exhibited the category properties. In the last step, categories and their properties are reduced, refined, and finally linked together to formulate themes to explain the meaning of data.

RESEARCH FINDINGS

Struggles with teaching science

Through written reflection in their logbooks, pre-service science teachers were asked to reflect on their problems, struggles and comments both from cooperating teachers and supervisors about their teaching. Table 1 includes several emergent themes and coded on "struggle" across all pre-service science teachers' reflective statements. Pre-service science teachers reported that during their field experience they had faced many obstacles in teaching science. Especially at the beginning of their field experience, several pre-service science teachers were concerned with designing and organizing activities when they planed their lessons. It was quite difficult for them to think of how to write expected learning outcomes and how to begin and sequence learning activities. Some reflected that learning outcomes they intended to reach were too general and did not show what science concepts or skills the students were expected to obtain.

In teaching practice, many pre-service science teachers were challenged by the complexity of teaching and student learning. They generally felt that they rarely probed student prior knowledge at the beginning of the lesson. Even though some asked questions at the stage of lesson introduction, those questions did not related to science concepts they were going to teach. When they asked student questions, they accepted or rejected student answers and then went to another concept, rather than asking students to give reasons. They thought that asking further questions took time, so they seldom paid attention to student conceptions. Additionally, some pre-service science teachers reflected that they struggled to ask students content-specific questions. They asked students questions, but most of questions

Table 1 Pre-service science teachers' struggles identified during student teaching

Coding category	Specific struggle	Exemplar of reflective statement
Lesson planning	Unclear and not specific learning outcomes	(As the supervisor suggested)...my lesson plans was not clear. It had to be improved and the learning outcomes should be more content - specific. (F051)
Teaching strategies	Rarely probing students' prior knowledge	After teaching, I found that I didn't ask students questions to elicit their prior knowledge on what they knew about rock and properties of igneous rock, sedimentary rock, and metamorphic rock. (F011)
	Rarely focusing on science process skills	As the supervisor suggested, I did not focus on science process skills when I taught. Students could not formulate hypothesis, identify variables and even understand objectives of the experiment. (F011)
	Seldom further probing or asking questions	As I brought my supervisor's suggestion about further probing students' conceptions into the classroom, I found that it took time. (F61)
	Using difficult questions	I found myself using very difficult questions, and sometimes the questions were not related to each other. So students were confused and could not answer my questions. (F21)
Classroom management	Inappropriate classroom management techniques	I didn't know appropriate techniques in managing my classroom. So my big deal is classroom management. (F81)
Content knowledge	Inappropriate organizing science concepts	(As my supervisor suggested)...science concept was not clear. It's not clear what concept I taught or what the key concept in the lesson. ...I taught many concepts at the same time. So it confused students.(F11)
Time management	Interruption of school extra activities	School has many activities while I have many topics to teach. So most teaching strategies I used was lecture. (F21)

were quite difficult for students to answer.

Classroom management was another problematic issue for the pre-service science teachers. They found it difficult to think about techniques to cope with students' misbehavior, especially in a diverse group of students in a classroom. They reported that students especially whose academic ability was below average and sat at back of the classroom did not pay attention to their learning activities. Those students could not answer or seldom responded to their questions, only those of high performance understood what were taught. The pre-service science teachers discussed the fact that a number of students in each class had also affected their classroom management. Since each classroom had forty to sixty students, it was difficult for them to assign students into a group of four members.

Another concern was the limitation of science conceptual understanding. Some pre-service science teachers discussed that science concepts were too complex and difficult for them. They felt that they held misconception for many science

concepts. This concern inhibited them to choose key concepts and design learning activities. They noted that when planning the lesson, they put many science concepts in one topic, so they could not appropriately sequence science concepts they were going to teach.

The final pre-service science teachers' struggle was time management. Throughout their teaching practice, pre-service science teachers discussed that there were many extra school activities that affected the timetable of their teaching and they could not teach as planned. They mostly coped with this by omitting some science concepts, and changing the hands-on experiment activities to lectures. With the limitation of time, they explained science concepts by writing on the blackboard, instead of preparing hands-on activities for students.

Learning about teaching and learning science

In this section, the teachers' learning about teaching and learning science during field experience is addressed. Despite the struggles they experienced, the pre-service science teachers also noted several themes emerged and coded as "learning" as shown in Table 2. These learning included more understanding of lesson planning, teaching methods, student learning, classroom management and using learning materials. Many pre-service science teachers reported that they had learned how to write a good lesson plan. As they mentioned in logbooks, the correct form of lesson plans should include learning outcomes, concepts, teaching and learning process, learning materials and evaluation. Particularly, some indicated that learning objectives or learning outcomes in the lesson plans should cover cognitive, science process skills, scientific attitude and attitudes towards science.

Another learning theme expressed by a significant number of pre-service science teachers was teaching techniques. The pre-service science teachers became to realize the importance of conducting hands-on activities, probing student prior knowledge, asking questions, and concluding lesson. In some cases, they confronted with new ideas and knowledge. For instance, when they provided students opportunities to conduct hands-on activities, their students became more interested and participated in learning science. So the pre-service science teachers claimed that hands-on activity was important to science teaching and learning. Pre-service science teachers' learning was supported by cooperating teachers and university supervisors. For example, they noted that they had learned how to introduce the lesson from specific feedback and advice from their cooperating teachers and supervisors.

Even though pre-service science teachers had struggled with lesson introduction at the beginning, they improved and developed their teaching as suggested by cooperating teachers and supervisors. Pre-service science teachers thought that probing student prior knowledge should be conducted at the beginning of the lesson rather than asking students what topics they were going to learn. They also found that timing delay was very important. When they gave students time to think, they could understand more about students' ideas and conceptions.

Pre-service science teachers counted understanding their student learning characteristics as their knowledge gained from their student teaching experiences. They described that being a teacher in the real classroom help them know the characteristics and abilities of their students. Understanding individual characteristics led them to think how to design teaching and learning activitie, responsively.

Classroom management was another important specific learning. Pre-service teachers reflected that using cooperative learning and group work techniques could help them control their classrooms. Some reported that at the beginning of teaching, they had problem with classroom management. Even though they asked students to work in groups, their students did not want to work with their peers. When the time passed, the students would be familiar with working cooperatively and understand their roles. The final learning theme was learning materials. Pre-service science teachers reflected that providing learning

materials could encourage students' learning and attention. They became aware that effective learning materials should help students understand an abstract science concept. So, they thought that concrete learning materials such as pictures and household apparatus needed to be prepared prior to teaching and use in learning activities.

Table 2 Pre-service science teachers' learning identified during field experiences

Coding category	Specific learning	Exemplar of reflective statement
Lesson planning	Components of lesson plans	I've learned correct form of lesson plan. The lesson plans should include content, learning outcomes, concepts, teaching and learning process and evaluation. Detail in each topic is different. The student teaching made me improve and develop lesson planning. (F02)
Teaching techniques	Hands-on activities	I've learned that in teaching and learning science, students have to do hands-on activities because it can interested students more in science. (F05)
	Lesson introduction	I've learned from my supervisors' suggestion that lesson introduction should be related to science content by probing students prior knowledge rather than asking students what topics they are going to learn. (F13)
	Questioning	I spent much more time to wait for students' answers. I gave them time to think. I asked them individually which I think it took more time than asking all students at the same time. But I think this way is better, it can help me know whether my students understand or not. (F23)
Student learning	Individual differences	I've learned that students in my classroom have low, moderate and high ability, so I have to use a variety of classroom management techniques. I've learned that as a teacher, this is my responsibility.
Classroom management	Asking students individually	If we can remember students' name, the students would be proud of themselves and this can help me to control the classroom and decrease students' misbehaviors. (F 61)
	Group work and cooperative learning	It's quite difficult for students to be a member in a mixed-ability group which they were not familiar with. But later, they understood and could work with their peers cooperatively and properly. So, it's easy for me to manage the classroom. (F21)
Learning materials	Preparation of learning materials and apparatus	If I asked students to prepare or bring materials or household chemicals from home, they would be more interested in the activities. They were eager to participate in and enjoyed learning activities. (F22)

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

This study contributes understandings about pre-service science teachers' struggles with and learning about teaching science during their one yearlong student teaching. The findings illustrated that some themes of "learning" were similar to those of "struggles". Since field teaching experience is complex in nature, pre-service science teachers might face problems and learn from those problems at the same time through "reflection on" and "reflection in" their teaching (Abell and Bryan, 1997). Most Pre-service science teachers had struggles in bringing their pedagogical content knowledge (PCK) (Shulman, 1986) in teaching practice (Davis and Petish, 2005; Beeth and Adadan, 2006; Sadler, 2006). Despite the struggles they experienced, the pre-service science teachers also noted several themes of their learning. Their learning included writing learning outcomes in lesson plan, doing hands-on activities, engaging lesson, asking question, making lesson conclusion, being aware of individual differences, asking students individually, assigning group work and cooperative learning, and providing learning materials (Beeth and Adadan, 2006; Watson, 2006).

The findings of this study confirm the notion that a direct experience in teaching is a key element in teacher education program (Sadler, 2006). Field experience has a significant role in assisting the pre-service teachers gain the expertise and confidence in their content-specific teaching. Since pre-service teachers have learned from their cooperating teachers, supervisors and even their students, they could improve and develop their teaching. Cooperating teachers and university supervisors should collaboratively share ideas about pre-service teacher's learning and problems and give them comments by focusing on content-specific teaching (Abell and Bryan, 1997). Importantly, the cooperating teachers, university supervisors, or other stakeholders may use the findings of this study as information to guide their supervision.

Future research could investigate developing pre-service science teachers' ability to do classroom action research. The research could aim to explore how classroom action research on the teaching impact pre-service science teachers' teaching practice. Conducting classroom action research could be an effective tool to help pre-service science teachers reflect on their teaching practice, so it could encourage their understanding of teaching and learning in both theory and actions. This type of future research could provide data about an effective practice and guide the preparation of high quality science teachers.

LITERATURE CITED

Abell, S. K. and L. S. Bryan. 1997. "Reconceptualizing the Elementary Science Methods Course Using a Reflection Orientation." *Journal of Science Teacher Education*, 8(3): 153-166.

Bell, B. and J. Gilbert. 1994. "Teacher Development as Professional, Personal, and Social Development." *Teaching and Teacher Education*, 10(5): 483-497.

Beeth, M.E. and E. Adadan. 2006. "The Influences of University-Based Coursework on Field Experience." *Journal of Science Teacher Education*, 17: 103-120.

Davis, E. and D. Petish. 2005. "Real-World Applications and Instructional Representations among Prospective Elementary Science Teachers." *Journal of Science Teacher Education*, 16: 263-286.

Faikhamta, C. and V. Roadrangka. 2005. "Problems in Professional Experience Training of Student Teachers in the Project for the Promotion of Science and Mathematics Talented Teachers (PSMT)." *Songklanakarin Journal of Social Sciences and Humanities*, 11 (2): 151-164.

Office of the National Education Commission. 1999. *National Education Act 1999*. Bangkok: Office of National Education Commission.

Patton, M.Q. 2002. *Qualitative Research and Evaluation Methods*. California: Sage.

Sadler, T. D. 2006. "I Won't Last Three Weeks": Preservice Science Teachers Reflect on Their Student-Teaching Experiences." *Journal of Science Teacher Education*, 17: 217-241.

Shulman, L. S. 1986. "Those Who Understand: Knowledge Growth in Teaching." *Educational Research*, 15(1): 4-14.

Watson, S.B. 2006. "Novice Science Teachers: Expectations and Experiences." *Journal of Science Teacher Education*, 17: 279-290.