The Development of Teacher Knowledge in 4th Year Science Teachers in Thailand Through Lesson Study

Kanyarat Sonsupap, Mahasarakham University, Thailand
Kanyarat Cojorn, Mahasarakham University, Thailand

The Asian Conference on Education & International Development 2016
Official Conference Proceedings

Abstract
The purpose of this study was to investigate how and what teacher knowledge preservice science teachers develop in contexts of Lesson Study. In order to gain the required in-depth data, a range of qualitative methods was used. These included lesson plan analysis, reflective journal, group discussions, concept maps, and documentations. Data were collected from a group of 4thscience student teachers. The data were analyzed by using Shulman's (1987) forms of teacher knowledge as an analytical framework.Preliminary findings showed that the student teachers developed different categories of teacher knowledge and raised awareness in the important of working collaboratively with their peers.

Keywords: Lesson study, teacher knowledge, science student teacher

Introduction

In recent decades there has been growing concern internationally with the contribution of education, particularly mathematics and science education, to national economic competitiveness in Thailand. As a consequence, the 1997 Constitution and the 1999 Education Act of Thailand provide a policy for using educational reforms with the aim of developing Thailand into a knowledge-based society, which is a pre-requisite for becoming a knowledge-based economy. The intention of these reforms was to provide the Thai people with equal access to life-long education and training, enabling them to acquire knowledge and capital to generate income and to eventually pull the country out of its existing economic and social crisis (Office of the National Education Commission, 2006). As part of developing a more productive workforce and competitive economy, Thailand has identified the need to improve the quality of mathematics and science education.

One way to improve science achievement for school children is through better science education for trainee teachers. Teachers play a significant role in the provision of quality educationas outlined in Thailand's 1999 National Education Act. The Act, therefore, intends that teachers become facilitators of learning and use different sources of knowledge. In order to accomplish the goal of better science education in schools and universities, the development of high quality teachers of science and technology begins in their teacher education program. Teachers need to be able to create a learning environment that enables students to learn and acquire knowledge for themselves. For this to occur, it is essential that teachers be true professionals and develop a range of forms of teacher knowledge.

The nature of teacher knowledge is unique. It is a special kind of knowledge teachers own that is characteristically different from scientific, technological, or other kinds of knowledge (Bishop&Denley, 2007). From Clandinin and Connelly's (1995) perspective, teacher knowledge is a "body of convictions and meanings, conscious or unconscious, that have arisen from experience (intimate, social, and traditional) and that are expressed in a person's practice" (p. 7) and "that has arisen from circumstances, practices, and undergoing that themselves had affective content for the person in question" (p.7). This view is similar to that of Tsui (2003), who suggested that teacher knowledge is usually embedded in teaching practice, oriented to a particular situation in which it arises and is often not clearly articulated.

Lesson study has been windly used in Japan for a long time.The Lesson process are: teacher work colaboratively to develop a lesson plan, teach and their peer observe the lesson to collect data on student learning, then use their observations and reflection to refine their lesson, and teach the revised lesson (Baba, 2007). According to Stepanek et.al. (2007), lesson study give teachers a chance to examine and reflect on their own teaching practice as well as other's. They also work together to find the most suitablke way to transfer their own content knowledge to their students. For these reasons, it is gaining popularity as an approach in a professional learning community practice in Thailand.

Shulman's Forms of Teacher Knowledge

Shulman's theory of teacher knowledge has had a major impact on the research of teacher knowledge. Shulman (1986a) highlighted the neglect of subject matter in effective teaching research. He pointed out that:

> In their necessary simplification of the complexities of classroom teaching, investigators ignored one central aspect of classroom life: the content of instruction, the subject matter. This omission characterized most other research paradigms in the study of teaching as well. Occasionally subject matter entered into the research as a context variable, a content characteristic for subdividing data sets by content categories. But no-one focused on the subject matter itself. No one asked how subject matter was transformed from the knowledge of the teacher into the content of instruction. Nor did they ask how particular formulations of that content related to what students came to know or misconstrue. (p.11)

Shulman and his colleagues referred to the absence of subject matter in the various research paradigms as the 'missing paradigm'. To address questions relating to the 'missing paradigm' of teacher knowledge, Shulman and his colleagues at Stanford University launched a research program called 'Knowledge Growth in Teaching' (Grossman, 1990) to answer the following questions: What are the sources of teacher knowledge? What does the teacher know and when did he/she come to know it? How is new knowledge acquired, old knowledge retrieved, and both combined to form a new knowledge base?

Teacher knowledge is characterized by concreteness and richness in contextual and personal experience (Hiebert, Gillimore, & Stigler, 2002). Shulman (1987) highlighted the importance of teacher knowledge in the fact that "teaching necessarily begins with a teacher's understanding of what is to be learned and how it is to be taught" (p.7). He identified four major sources for teacher knowledge: (1) scholarship in content disciplines; (2) the materials and settings of the institutionalised educational process; (3) research on social and cultural phenomena that affect what a teacher can do; and (4) the wisdom of practice. According to Barnett and Hodson (2001), each teacher relies on a store of collective teacher knowledge. Teachers can develop this knowledge by talking to each other and reflecting on classroom experiences. Wellington (2000) suggested that "teachers have a set of knowledge which they bring to the classroom and a set of knowledge which is developed and learned from their classroom experience" (p. 27).

Theoretical framework

The theoretical framework that influences the conceptualization of this study is Shulman's (1986, 1987) theory of forms of teacher knowledge. He listed categories of knowledge that contributed to successful teaching. Burgess (2006) stated that Shulman's forms of teacher knowledge "relates to the structures of how the teacher knowledge is organized, linked, and represented in the teacher's mind" (p. 2). Initially, Shulman (1986b) suggested three categories knowledge in teaching: (1) subject matter knowledge; (2) pedagogical content knowledge; and (3) curricular knowledge. Then in a following paper, Shulman (1987) reclassified teacher knowledge into seven types:

- content knowledge, which includes three subsets of content knowledge: substantive knowledge; syntactic structures; and beliefs about content matter;
- general pedagogical knowledge; broad principles and strategies of classroom management; and organization that appear to transcend subject matter;
- curriculum knowledge: knowledge of materials for particular instruction;
- pedagogical content knowledge (PCK): knowledge of how to teach specific content effectively;
- knowledge of learners and their characteristics;
- knowledge of educational contexts: knowledge of the working of the group or classroom; the character of communities and cultures and government agendas; and
- knowledge of educational ends, purposes, and values, and their philosophical and historical grounds.

Shulman (1987) claimed that the forms of teacher knowledge are interrelated. He argued that to teach effectively, each category of teacher knowledge cannot be treated separately; all of them have to bind together. However, teachers and preservice teachers are at different stages of development in their careers and may develop different forms of teacher knowledge at different times in their profession. There have been research studies of teacher knowledge for experienced teachers, beginning teachers and preservice teachers.

Methodology

Participants

In this study, the participants were 42 fourth year science student teachers who enrolled in curriculum and instruction in general science 2 course in the university in the Northeast of Thailand. Science student teachers were chosen because science is the area that researchers are familiar with and is the area of researchers' own teaching background. These student teachers had little prior teaching experience in school classrooms. Thus, researchers expected that teacher knowledge would develop in some way during the program.

Phases in the study

There were 3 phases in this study:

Phase I: Study of background and problems in studying pedagogy
Researchers began with doing literature review focus on how student teachers and preservice teachers learning to teach and their difficulties as background knowledge. Moreover, in order to explore student teachers' difficulty in learning pedagogy in the authentic context, instructors of curriculum and teaching methods courses were interviewed. The instructors states that student teachers had low subject matter knowledge and pedagogical knowledge. Student teachers could not transfer abstract idea to concrete idea. Furthermore, they could not work collaboratively. The instructors claimed that these problems came from student teachers 'lack of teaching

experience. The data were analyzed and used as a mean to develop lesson study as a learning process.

Phase II: Development of lesson study guideline
After finishing analyzing data from phase one, the result indicated that practice-based form of teacher learning where student teachers works together to plan, practice teaching, observe and analyze taught lessons would help student teacher gain their teaching experience and develop their teacher knowledge more quickly. For this reason, lesson study which is both collaborative and practice based has a high potential. However, due to many limitations; the implementation of the lesson study differed from the original model. First, student teachers receive feedback from the peers in their team, as well as their course instructors. Second, the student teachers taught each lesson once due to time constraints and the fact they only being at school one day a week. However, they discussed the taught lesson in group meeting and designed and modified their next lesson with this feedback. The modified lesson study was integrated into curriculum and instruction in general science 2 course.

Phase III: Implementation of the lesson study guideline
During the beginning of the course, the fourth year science student teachers were given the detail about lesson study. These student teachers were asked to work in pair. Then they were assigned to do classroom observation and practice teaching in the school they chose. After classroom observation, 2 pairs were grouped together; therefore every team had 4 members based on their concerned problems. Each pair then analyze teaching unit received from their school teachers they worked with and made a lesson plan. However, they had to discuss with their group members about their lesson plan and revise before meeting with the course instructor to receive guidance and revise the lesson plan again if necessary before teaching in the actual classroom. While the lesson was being taught by each pair, the other members observed their peer classrooms. After the class, they organized a group discussion about their teaching and then used feedbacks from their peer to modify the next lesson plan then repeated the cycle again. When they finished all lesson, all student teachers were asked to write the concept on the topic of “teaching science” and reflected on their teaching experience.

Data gathering methods and data analysis

Data for this study came from a range of data-gathering methods in order to enhance trustworthiness.These included lesson plan analysis, group discussions, semi-structured interviews, concept maps, and documentations. Data were collected from a group of 42 fourth year science student teachers a period of 4 months. The data were analyzed by using Shulman’s (1987) seven forms of teacher knowledge as an analytical framework.

Preliminary findings and discussion

All these science student teachers developed teacher knowledge in different respects and to different extents during the course period indicating that teaching experience played an important role in developing their teacher knowledge. The student teachers began to moved from thinking like a learner based on their own experiences as students in schools to thinking like a teacher. These changes tended to occur as a

result of the practicum, as the preservice teachers had to play the teacher role as well (Ineke et al., 1999; Hoban, 2005). The findings from this study are similar to Wickramasinghe (2004) who investigated the change of Sri Lankan preservice teachers' knowledge. That study showed that preservice teachers mainly developed their teacher knowledge during their practice teaching periods. However, lesson study helped facilitate these changes. The expressions of their views about teaching and learning shifted from themselves as science learners to being science teachers concerned about students' learning. Their understanding about teaching became broader and more complex. This is consistent with the study of Erick and Dias (2005), which indicated that during field placement, student teachers initially relied on teaching knowledge from university courses, and their past experiences as a student then began to integrate these experiences with knowledge they gained from their teaching practice. However, their teacher knowledge did not show explicitly in their practice because they had limited teaching experience. The same finding was also found in Da-Silve, Mellado, Ruiz, and Porlan's (2006) work that showed that beginning teachers used a teacher-centred approach in their first years of teaching.

However, science student teachers developed similar views about *content knowledge*, probably because their university subjects preceded their teaching experiences. They believed that the university science subjects provided them with the knowledge necessary for teaching.

Although the university science subjects were one of the influences on preservice teachers' content knowledge, there were some problems in the course itself. The science course consisted of lecture sections where the science concepts are taught to student via a teacher-centred approach. The laboratory activities are conducted by strictly following experimental procedure. Student teachers have to learn too much information in too brief a time, so it is impossible for them to understand science concepts, principle, and theories (Arons, 1989 cited in Cobb &Koballa, 1996). This learning experience also impacted on the student teachers' own teaching style. The finding we consistent with Adams and Krockover's (1997) study on preservice secondary teachers which indicated that the preservice teachers used the instructional approach demonstrated in subject matter courses as a model for teaching. Lesson study made them aware of their misconception in science concepts. One student teacher stated that comments about his lesson the lesson study meeting help him improve his science content knowledge.

The student teachers showed development of *curriculum knowledge*. They were aware of the necessity of understanding the curriculum before planning a lesson. In lesson plan analysis they showed their curriculum knowledge through their ability to indicate the relevant between teaching standards, indicators and content.

There was no evidence indicated the development of *pedagogical content knowledge*. Even through, they showed their effort to find the more effective way to transfer science knowledge to their students. It would seem that this was due to their limited teaching experiences.

Most student teachers developed *knowledge of learners and their characteristics*. They exhibited a concern with students' problems in their classes. In group discussion, they came to identify their students' characteristics and problems and their

solutions from a teacher's perspective. This major development was influenced by his teaching experiences. They discussed and gave each other advice about how to gain students' attention and classroom management.

However, the students did not show knowledge of educational contexts and knowledge *of educational ends, purposes, and values, and their philosophical and historical grounds*.

The presentation of the findings in this study may suggest that the forms of teacher knowledge act independently. As stated by Shulman (1987), all seven types of teacher knowledge are interrelated. In order to teach effectively, teachers have to possess all types of knowledge, which work collectively with other knowledge to influence pedagogy. None of the particular types of knowledge alone can make good teaching. Therefore, to make teaching successful, all forms of teacher knowledge must be woven together into the expression of practices. This claim was support by Exley (2005) who pointed out that teachers must have all type of teacher knowledge in order to teach successfully. However, teaching experience play a major role in their developing of their teacher knowledge. Lesson study can be a promising practice for beginning teacher use to examine their teaching practice as well as their peers practice in order to develop their knowledge (Marble, 2007).

Acknowledgement

This research was financially supported by faculty of Education Mahasarakham University and Mahasarakham University Development Fund.

References

Adams, P. E., & Krockover G. H. (1997). Beginning science teacher cognition and its origins in the preservice secondary science teacher program. *Journal of Research in Science Teaching*, 34 (6), 633-653.

Baba, T.(2007). Japanese education and lesson study : an overview. In Isoda, M., Stephens, M., Ohara, Y., & Miyakawa, T. (Eds.), *Japanese lesson study in Mathematics: its impact, diversity and potential for educational improvement* (pp.2-7). Toh Tuck Link:World Scientific Publishing.

Barnett, J., & Hodson, D., (2001). Pedagogical content knowledge: toward a fuller understanding of what good science teachers know. *Science Education*, 85(4), 426-453.

Bishop, K., & Denley, P. (2007). *Learning science teaching*. Berkshire, UK: Open University Press.

Burgess, T. A. (2006). A framework for examining teacher knowledge as used in action while teaching statistics. In Rossman, A. & Chance, B. (Eds.), *Proceedings of the 7th International Conference on Teaching Statistics*, July 2-7, Salvador, Bahia, Brazil. International Association for Statistical Education and International Statistical Institute.

Cobb, C.R., & Koballa, T.R. (1996). Science education. In Sikula, J. (Ed.), *Handbook of research on teacher education* (pp. 459-484) (2nd ed). New York, NY: Simon & Schuster Macmillan.

Da-Silva, C., Mellado, V., Ruiz, C., & Porlan, R. (2006). Evolution of the conceptions of secondary education biology teacher: longitudinal analysis using cognitive maps. *Science Education*, 91, 461-491.

Erick, C., & Dias, M. (2005). Building the authority of experience in communities of practice: the development of preservice teachers' practical knowledge through coteaching in inquiry classroom. *Science Education*, 89 (3), 470-491.

Grossman, P. L. (1990). *The making of a teacher: teacher knowledge and teacher education.* New York: Teachers College Press.

Hiebert, J., Gallimore, R., & Stigler, J. W. (2003). A knowledge base for the teaching profession: what would it look like and how can we get one. *Educational Researcher*, 31(5), 3-15.

Ho, B. T., & Toh, K. A. (2000). *Case studies of their beginning teachers: their struggles, knowledge and beliefs*. Paper presented at AARE conference on "Educational Research: Towards an optimistic Future", December 2000, Sydney, Australia, Retrieved June 13, 2007, from http://www.aare.edu.au/00pap/ho00213.htm

Hoban, G. F. (2005). Theory-practice links between school and university settings. In Hoban, G. F. (Ed). *The missing link in teacher education design: developing a*

multi-linked conceptual framework (pp. 113-115). The Netherlands: Springer.
Ineke, F., Ton, V., Laurinda, L., & Ingvar, T. (1999). Preservice physics teachers and conceptual difficulties on temperature and heat. *European Journal of Teacher Education*, 22 (1), 61-74.

Office of the National Education Commission (ONEC) n.d., National Education Act of B.E. 2542 (1999), Retrieved April 26, 2016, from http://www.ONEC.go.th/Act/acteng/acteng.pdf

Shulman, L. S. (1987). Knowledge and teaching: foundation of the new reform. *Harvard Educational Review*, 57(1), 1-22.

Shulman[a], L.S. (1986). Those who understand: a conception of teacher knowledge. *American Educator*. 10(1), 9-15, 43-44.

Shulman[b], L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, 15, 4-14.
Stepanek, J., Appel, G., Leong, M.,Mangan, M.T., & Mitchell. M.(2007).*Leading lesson study: a practical guide for teachers and facilitators.*Thousand Oaks: Corwin Press.

Wickramasinghe, N. (2004). *A study of the changes to Sri Lankan pre-service teachers' knowledge about teaching during their student teaching period*. EdD thesis, University of Wollongong.

Contact email: kanyarat.s@msu.ac.th