Enhancing Pedagogical Content Knowledge in Preservice Science Teachers

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Abstract

Preservice teachers are key element to shape students' attributes and key factor affecting to motivate students to have achievement in learning behaviors. This study aims to investigate pedagogical content knowledge of preservice teachers. Forty three preservice science teachers participated the study, inquiry-based instruction was implemented in the context of science teaching and learning for enhancing pedagogical content knowledge. A variety of qualitative methods were employed to examine the engagement of their pedagogical content knowledge. The findings can be indicated that inquiry-based instruction can enhance pedagogical content knowledge and its result can be used for teacher preparation program as well.

Keywords: Preservice science teachers, PCK, Inquiry-based teaching, Teacher preparation, Student teacher

1. Introduction

In the era of rapid change in the age of information and social learning, children need to have readiness to face with situational uncertainty and also need to adapt with flowing of globalization. Thus, there is belief to perform our children in which they should be learned based on effective in teaching and learning process. Most recent research in the educational area reveals that teachers are very crucial on students' academic achievement as well as on affective variables such as attitudes, attributes, and beliefs (Darling-Hammond, 1994; Pultorak, 1996; Kaltakci, 2011). At this point, teacher development and teacher preparation program need to emphasize on how to do with quality of teacher and in the way of growing up quality of education. Teacher preparation has been continually investigating for the best possible ways of preparing teachers to be most effective in their classroom. It is increasingly being urged to focus on developing in future teachers in which relevant to direction of social development.

Teacher must be given the skills and knowledge to develop a pedagogical content knowledge, to critique practice and challenge traditional pedagogy (Nuangchalerm, 2009; Nuangchalerm and Prachagool, 2010; Nuangchalerm, 2011). To the teacher preparation program, perspective of content or pedagogy, Shulman (1987) believed that teacher education programs should combine these two knowledge bases to more effectively prepare teachers. Pedagogical content knowledge (PCK) is defined to ability to combine knowledge of a specific discipline along with the teaching of that discipline. PCK is also like how do teachers take content and transform their understandings of it into instruction that their students can comprehend (Shulman, 1986). It can explain that the content knowledge should be blended with elements of the teaching process with the pedagogy. Teachers' subject knowledge and pedagogy need to be implemented in which teacher preparation program at all level of institutions. It is necessary to have relationship between the two of knowledge by introducing the notion of PCK into their classroom.

Attempting on understanding the nature of teachers' knowledge and teaching science are raised with the widely known as pedagogical content knowledge in which to address the importance of integrating subject matter knowledge and pedagogy in teaching. PCK illustrates how subject matter of a particular discipline is transformed for teacher and students that enhancing effective communication examines (Goodnough and Hung, 2009). The pedagogical content knowledge is different from the knowledge of what disciplinary expert and also from the general pedagogical knowledge. It involves knowledge of teaching strategies that incorporate by appropriate methods, create learning environment situation, and prior conceptions (Kane and Russell, 2005). As it change in the form of education, teacher preparation program need to support pedagogical content knowledge, and teaching strategies for preservice teachers because of the learning skills and others contextual instructions is changing as it can be shown in Figure 1.

Insert Figure 1 about here.

Shulman (1987) argued that having knowledge of subject matter and general pedagogical strategies, though necessary, were not sufficient for capturing the knowledge of good teachers. If teachers were to be successful they would have to confront both issues simultaneously (Shulman, 1986). In this paper, I try to present how PCK is important for teacher preparation program that content and pedagogy cannot be separated in the classroom. The inquiry-based learning was implemented to serve and enhance their in PCK through seminar class of preservice science teachers. The results of this study will be discussed how preservice science teachers should have PCK as well as school needs and social changes. Due to, teacher can incorporate subject matters and art of instruction in which they can do by their best. Children will be clearly learned based on happy class if teaching and learning process do not emphasizes only content.

2. Methodology

Sample: As it happens in the significant course for preservice teachers need to have professional experiences as well in teacher preparation program. The sample in this study can be described in terms of forty three of preservice science teachers who enrolled course 0506408 Seminar and Developing Teachers' Experiences, this course allowed them to register in the second semester, academic year 2011. They have to enroll this course before taking professional experiences in school science. They also were responsible for teaching science as well as they learn general science education in the university setting. The first two hours of course provide them to clarify what the course will be and how to hit the purposes. Later, four hours of school science practicum were watched together and followed by classroom discussion. Also, 14 hours of article relevant to science teaching were assigned for critical reading, classroom presentation, and discussion.

Procedure: In this study, conduct learning activities to study pedagogical content knowledge in which preservice science teachers should have during teacher preparation program. The study provides them to understand what teaching science is. During the study, a variety of qualitative methods and sources were used, including:

1) Videos relevant to school practicum and science teaching sessions (6 hours for video watching and discussion), this videos were done by former preservice science teachers when school practicum were examined. Researcher embodied preservice science teachers with two knowledge by orientation pedagogical content knowledge of what and how significant for teacher preparation program. Classroom-based discussion is allowed and conducted as well. Later, they showed and discussed in the frame of what preservice science teachers should have and should be, especially teaching strategies, instructional management, and teachers' knowledge in which to extent inquiry-based learning.
2) Journal entries, they have to search, consider, read, and present through classroom participation and reflective entries. This study assigned them to represent 10-15 minutes of each by choosing international and peer reviewed journals, and then they have to translate and make understanding in terms of Thai. Class discussion will be made for 5-10 minutes by engaging inquiry-based learning and pedagogical content knowledge as much as a chance of classroom allowed. The discussion and giving some examples of teaching strategies were implemented as it be. Journal reading and critical reading provide them much more knowledge and understanding of what science education research says.
3) Classroom discussion and interview, the study gather data of what preservice science teachers understand about PCK and teaching strategies that science teachers should be and should have. This method try to get of how they perceive PCK, also some teaching strategies based on pre-school practicum are emerged and realized during this session.
4) Journal reflection, they have to reflect of what they think and perceive about video and journal entries by writing some observation through the inquiry process. The method let them think and express what should be aware about teacher profession, pedagogy, and subject matter knowledge. Writing can show their framework of short communication based on nature of science teacher and philosophy of science teachers as it of their learning background.
5) School visit, they have a good chance to visit school science where incorporated inquiry-based science learning and also ICT-based teaching. The study can provide them with perspective of teaching and learning management. The innovative teaching and learning strategies employ 5E learning cycle model, questioning method, group-based thinking, and hands-on experiences.

Researcher analyzed data by checking knowledge about PCK and teaching strategies after regarding some article related to teaching science and what research says about science teaching. Findings were shown in the qualitative information and theoretical efforts.

3. Results

This study emphasizes the importance of pedagogical content knowledge that teacher preparation implements for preservice science teachers. It can be written and be shown in terms of qualitative explanation, learning learned through the process in which they were examined.

3.1 PCK and Teaching Profession

Classroom-based discussion was employed to generate preservice science teachers about what they had learned through inquiry-based learning and the implication for teaching strategies in science. Most of they found that English is an important problem for communication and seems to them like a big wall. They are very difficult to understand knowledge about teaching science and learning innovations as well. This study prepares them with small start with English to face ASEAN economic community. They can adjust their mind and adapt to live with the difference of language through academic journal. Also, information seeking competence them to inquire new information and balance it with prior knowledge, they have to change their learning behavior from passive learner to active learner. The concept of what they had learned were transformed to others by using knowledge management, representation and classroom-based discussion help them as much to revised concept of pedagogical content knowledge. They have learned too much with self-assessment and reflection through democratic method.

Pedagogical content knowledge is not only importance for classroom, but also it helps teachers' attributes to be a professional best. The videotape watching activity is an engagement phase to adjust their mind with school science and learning environment that they have to meet in school practicum or professional experiences. Watching behavior is observed and recorded during the study, most of them eager to see and feel in with the teaching video. Later, they communicate with others and solve the problem with their own ideas through inquiry such as information seeking, asking peers, and looking for way of problem-solving by getting more reading. It is not surprise to the inquiry-based learning, can help them access anytime and anywhere by internet. Now, subject matters knowledge are easily found by just only clicking through online databases and free internet resources. While teaching strategies and instructional practices need to perform preservice teachers reach the goal of professional best and attributes as well.

"supervisor in school practicum during professional experiences might want to supports us, especially knowledge and attributes of what good teachers be because they are our role model and supporter in school science"

The translated above sentence indicated that preservice science teachers confident with supervisor in school, factor affecting to shape their pedagogical knowledge. Schools maybe different in context of professional experiences, especially science curriculum structure and instructional materials, but preservice teachers can enhance pedagogical knowledge by implying ways of supervisor did as well as situation allowed. As it accordance, some of them recommended with pedagogy in terms of intrinsic factor, motivation can be implant by role model and best practice in teaching science. The data can be shown by translated sentence as follows.

"motivation should be incorporated in the classroom to all students, they need to motivate in different level. If teacher had only direction lab or sheet, teacher might want to help students set more conception and other learning behaviors through motivating skills in which learners created and managed in his/her classroom"

They almost emphasized that motivation is important for teachers' teaching and also students' learning, intrinsic factors will leads all them to a positive attitude towards instructional contexts in science. The pedagogical knowledge of what they have also learned, instructional model, and teaching strategies to prepare them for school practicum are emerged in the classroom-based discussion. This activity can help them to fulfill democratic science classroom and prepare them with process of knowledge management.

3.2 PCK and Inquiry-Based Learning

Science teaching is widely contributed in the framework of teaching science trough inquiry-based learning, teachers are familiar with terms "inquiry" but they do not really know how to serve inquiry in their classroom. The discussion about inquiry is raised during the period of study preservice science teachers and PCK, they eliminated confusion about methods of inquiry by surface clarification.

"inquiry-based learning needs students to have explanation, reasoning, questioning, and experimenting in the ways of understanding in science and hands-on experiences determined"

"inquiry is a methods of teaching science to extent of what students should understand subject matters under different context such as classroom, instructional media, and facilities. It will help students to have more knowledge by employing prior knowledge to bridge science conception"

The study found that most of them express their habit with educational research articles by challenge them to answering and discussing that related to inquiry-based learning. The notion of reflective writing and journal reading

with critiques needs preservice science teachers understand nature of teaching science in the context of both national and international differences. Inquiry is not only methods of teaching, but it is also ways to practice preservice teachers to be a professional teachers.

"mobile learning is now important for science classroom because the nature of student had been changed. They can learn new things through the process of scientific inquiry, but it should be started in the younger students"

As we known, the ICT skills is importance for teaching and learning process, some preservice science teachers translate their perception to educational policy. The information technology age is very difficult to reject, but we need to seek what is the appropriate choice. Personal computer tablet is raised and talk of the town how it influence to classroom, due to Thailand will launch project to serve first grade students with personal tablet computer in the short time. However, some preservice teachers believed that some contents of science and no needs it, but some content plays it important role to enrich students achievement.

The 21st century skills, is raised the criteria to change paradigm in education. The ICT, assessment, subject matter, and pedagogical kills are priorities to support our students. Teacher preparation program might want to collaborate with professional development program, as it, teacher as a key element to engage students learn new experiences. Knowledge can be changed, nature of learning learners is also transformed, knowledge can be easily accessible through a variety of online resources. Teacher preparation might want to rethink how to perform new teachers' attributes in which accordance with the changing world.

"The teaching and learning in school science, the present is very different and difficult than those before because there are too many factors i.e. parent participation, ICT reform, educational policy, students' learning behavior"

Today, we have to teach science based on the nature of teaching and philosophy of science teaching, constructivist theory is referred for science and mathematics education, but it needs to understand co-evolution of teaching and learning in each generation. Inquiry-based learning is so good for theoretical recommendation, instructional strategies and practices should be adapted that relevant to inquiring mind in both preservice and in-service teachers.

4. Discussion

The study indicated that pedagogical content knowledge as important things to integrate in teacher preparation program. Teachers' content knowledge or pedagogical knowledge alone does not contribute much to their professional development. It should combine these two knowledge bases to more effectively prepare teachers. This link, preservice teachers have to understand that teaching and learning based on national science education and key performance index of science education need appropriately content and pedagogical knowledge such as questioning method, ICT-based classroom, and innovative learning activities (Nuangchalerm, 2011). This study is also rethinks about the process of teacher and teaching approaches to fit the content and how elements of the content can be arranged for an effective teaching. According to Shulman (1987) stated that the capacity of a good teacher lies in the ability to transform the content knowledge he or she possesses into forms that are pedagogically powerful and adaptive to the variations in ability by the students.

The dimension of subject matters knowledge and pedagogical knowledge can help preservice teachers to make positive attitudes in science teaching. PCK can be impacted with teacher profession in the future by shaping their concept of instructional design and inquiry-based learning implication for science classroom. As it should be, pedagogical content knowledge will be enhanced, if preservice teachers engage nature of science, scientific contents, national science curriculum, and pedagogy that meet the requirement of national science curriculum standards (Eilks and Markic, 2011). PCK help teachers to incorporate nature of science relevant to teaching-learning actions by various kinds of wisdom and practices in term of transformation of subject matter knowledge that can be used effectively in professional development (Botha and Reddy, 2011). So, the preparation should integrate inquiry and pedagogical content knowledge to science teachers at all level. The implication can be used for enhancing their competency to love of teaching and ability to manage teaching and learning in science by various art and science of teaching.

The results of this study supported the notion of PCK and inquiry-based learning that framework for designing and reflecting in teacher preparation program as science classroom should be. The conception of teaching strategies and pedagogical knowledge are suitable for content. Teacher preparation program needs mentoring for preservice teachers by supervisor in both school and university (Appleton, 2008). The process of study program of teacher education included theoretical course in university and professional experiences in school. The subject matters knowledge will be fulfilled as university courses decided and pedagogical knowledge will be designed in school practicum. However, pedagogical content knowledge in each preservice teachers will be varied by different experiences, background, communicative skills, and inquiry-based learning. Teacher preparation program needs to

imply and discuss PCK as well as context of learning and teaching science changes (Abell *et.al.*, 2009).

6. Conclusion

Pedagogical content knowledge is important factor that shape preservice teachers' attributes in terms of teaching by their best. However, it will be enhanced if they understand nature of teaching science, inquiry-based learning, innovative lesson design, and also 21st century skills. The results of this study indicated that enhancing PCK in preservice teachers through inquiry-based instruction is an auxiliary teaching strategy, it can be discussed and implied to the teacher preparation program as well as professional development needs for educational changes.

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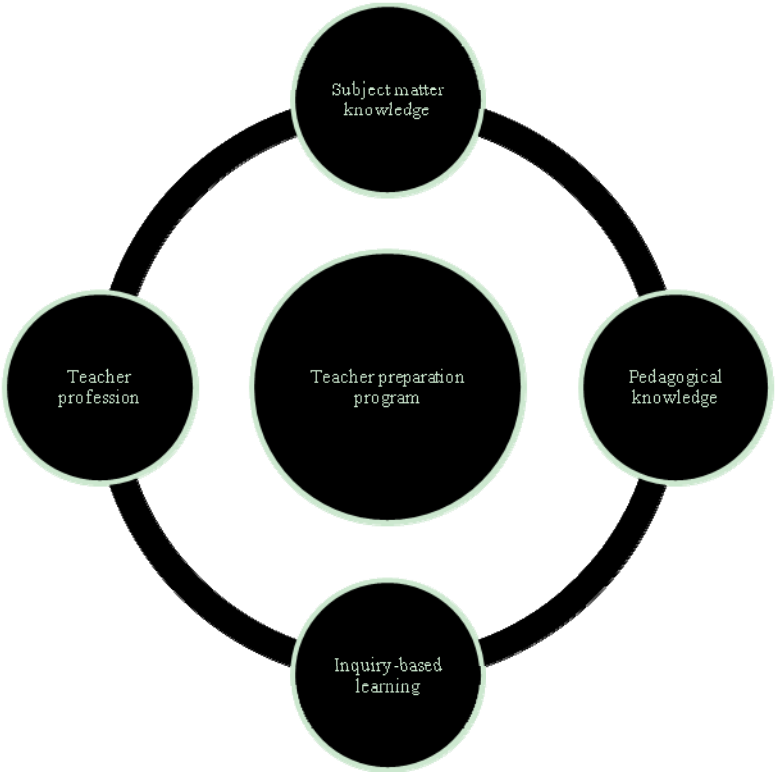

Figure 1. Teacher preparation program in the context of learning changes