CHAPTER 1
INTRODUCTION

Background

It is accepted among educators that science teachers must have the ability to manage the classroom in a way that improve students' achievement. This includes student's understanding on scientific concepts and their ability to apply that knowledge to real world situations. Most scientific concepts are abstract in nature because they can be used to explain various phenomena that cannot be observed such as atomic model, natural selection and energy . Shulman (1986 : 9) defined pedagogical content knowledge (PCK) as the ways to present subject content that make it accessible to others. It can be illustrations, examples, demonstrations or analogies. In other words, it is knowledge of how to teach specific content in specific context- a form of knowledge in action. This definition infers that teachers who possess a high level of PCK can design or organize the science classroom effectively in specific context.

Grossman (1990 : 8-9) identified four major components of PCK as: (a) knowledge and beliefs about the purposes of teaching a subject at different grade levels, (b) knowledge of students' understanding, conceptions and misconceptions of particular topics in a subject matter, (c) knowledge of curriculum materials available for teaching particular subject matter as well as knowledge about both the horizontal and vertical curricula for a subject and (d) knowledge of instructional strategies and representations for teaching particular topics. The first component, conceptions of purposes for teaching subject matter, influences the other PCK components. Magnusson et al. (1999) named this component later as orientations to science teaching.

Magnusson et.al. (1999 : 97) conceptualized pedagogical content knowledge for science teaching as consisting of five components: (a) orientations toward science teaching, (b) knowledge and beliefs about science curriculum, (c) knowledge and beliefs about students' understanding of specific science topics, (d) knowledge and beliefs about assessment in science, and (e) knowledge and beliefs about instructional strategies for teaching science. According to Magnusson' model, the five components were presented in a linear way that emphasized the interaction only between orientation toward science teaching and each of the other four components (Park and Chen, 2012:925)

Park and Chen (2012),however, reconceptualise model of PCK by focusing the interrelationships among these components, they finally derived the pentagonal model of PCK

that equates all components to the same plane. They affect each others and are influenced by each other which means increasing knowledge of one component will result in improve the other knowledge. Given the importance of the orientations toward science teaching as the salient knowledge of science teachers, the orientations are teachers' knowledge and beliefs about the purposes and goals for teaching science at a particular grade level. They are organized according to the objectives and the nature of the instruction from only process or content to the instructions that focus on inquiry-based learning.

Magnusson et.al. (1999 : 97) described nine orientations with respect to two elements that are useful in defining and differentiating them: the goals of teaching science, and the typical characteristics of the instruction, which are 1)process 2) academic rigor 3) didactic 4) conceptual change 5) activity-driven 6)discovery 7)project-based science 8) inquiry 9) guided inquiry.

Using the orientation to teaching science as the research frameworks, many researchers explored teacher's orientations in classroom practices. Friedrichsen, Van Driel and Abell (2010) deep tracked a number of research articles citing the science teaching orientation component of the pedagogical content knowledge (PCK) science teaching done by Magnusson, Frajcik and Borko (1999). The study founded that several published articles still provide the definition of the orientation to teaching science in different, unclear or absent relationship between orientations and the other model components, and simply judging teachers into one of nine categories of orientations. Friedrichsen et. al. defined the science teaching orientations as “a set of beliefs with the includes these dimensions: goals and purpose of science teaching, views of science, and beliefs about science teaching and learning (p.358)” and they recommended further of the need for new instruments to elicit these dimensions.

Even the literature provide evidence of the relationship among components of PCK, however, the components of the orientations of teaching science themselves have rarely been investigated. Moreover, from analysing critically on the orientation to teaching science research, Friedrichsen and her colleagues (2010) concerned that "many of the orientations to teaching science were based on curriculum orientations instead of empirical studies of the goals of teachers". They also questioned the list of nine orientations " how do we sort through complex belief sets and distill these beliefs, for practical reasons and ease of comparison, to report only critical differences among groups of teachers?" Given that most studies on PCK utilized qualitative method to study specific cases of classroom practice, there are rarely studies that focus on the comparison of PCK between groups of teachers, let alone the comparison of PCK of science teachers in different countries.

From the literature above, the psychometric scales should be constructed to explore teachers' orientation to teaching science. Once developed, it will provide information regarding teachers' beliefs about the goals for teaching science in general with a large scale. It allows the researchers to compare teachers' orientation between groups. Moreover, it fills research gaps regarding the categories of orientations based on empirical evidence and the relationship among the categories.

The purposes of this study are to assess science teachers' PCK and to compare Teachers' PCK between Malaysia and Thailand. The Embedded Design is used as research methodology for this study. The purpose of this design is to combine the collection and analysis of both quantitative and qualitative data within a traditional quantitative research design (Creswell & Clark, 2011: 90). In the quantitative data collection, Teacher's Orientation to Teaching Science (TOTS) questionnaire will be developed to assess parts of teachers' PCK considering the goal and characteristics of teaching. The qualitative part of the study will be used to explore the relationship between teacher's orientation to science teaching with classroom practices. Participating teachers will be selected purposefully for collecting qualitative data. Classroom observation and teachers' interviews will be conducted and triangulated with the data from the teacher's response of the questionnaire to create the teacher's profile of PCK. The embedded design was appropriate because this study had different questions that required different types of data in order to address the objective of the study. The Regional Centre for Education in Science and Mathematics (RECSAM) is going to collaborate with Thaksin University in terms of collecting data in Malaysia.

Objectives of the study

This study aims to:

1. Construct the Teacher's Orientation to Teaching Science (TOTS) questionnaire to measure parts of teacher's Pedagogical Content Knowledge (PCK) considering the goal and characteristics of teaching.

2. Examine the orientation to teaching science of science teachers from Malaysia and Thailand.

3. Observe the science classrooms of the participating teachers to collect data about their orientation to science teaching and examine the relationship between the orientation to science teaching and the classroom practices.

Significance of the study

Research findings can provides information regarding teachers' beliefs about the goals for teaching science in general with a large scale comparing between Malaysia and Thailand. The results also fill research gaps regarding the categories of orientations based on empirical evidence and the relationship among the categories. Moreover, research findings can provide information and methods to improve teaching quality and enhance professional development of Malaysian and Thai science teachers.

Scope and limitation of the study

The participants of this study are science teachers around Thailand and Malaysia. In Thailand, they have been participated in many professional development programs with the Institute for the Promotion of Teaching Science and Technology (IPST), Thailand. In Malaysia, they have some connections with RECSAM. The participants volunteer to give their information and allow the researchers to observe their classroom.

Definition of terms

1. Pedagogical Content Knowledge: Knowledge and belief of teachers about the ways to present subject content that make it accessible to others. It can be illustrations, examples, demonstrations or analogies. In other words, it is knowledge of how to teach specific content in specific context. It consists of five components: (a) orientations toward science teaching, (b) knowledge and beliefs about science curriculum, (c) knowledge and beliefs about students' understanding of specific science topics, (d) knowledge and beliefs about assessment in science, and (e) knowledge and beliefs about instructional strategies for teaching science.

2. Teachers' orientations to teaching science: The orientation to teaching science is one of five components of pedagogical content knowledge which is teachers' beliefs on the goals of teaching science and characteristics of instruction that should be used which are 1) process 2) academic rigor 3) didactic 4) conceptual change 5) activity-driven 6) discovery 7) project-based science 8) inquiry 9) guided inquiry. The data of orientation to teaching science of Malaysian and Thai teachers is collected by using Teacher's Orientation to Teaching Science (TOTS) questionnaire.