CHAPTER 5

CONCLUSION, DISCUSSION AND RECOMMENDATION

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.

Research participants

The participants in each phase of study were as follows:

1. Participating teachers in the development of research tools phase are 127 teachers who teach science in secondary school level in Thailand.

2. Participating teachers in the quantitative strand are 264 science teachers from Thailand and 167 science teachers from Malaysia. Those participants are in-service teachers from all over the countries who intently volunteer to give their information for this research. They responded to the Teacher's Orientation to Teaching Science questionnaire (TOTS).

3. Participating teachers in the qualitative strand are selected from the result of the previous phase of study. The main objective of this part is to examine how teacher's orientation to teaching science is related to teaching practice. 2 science teachers from Thailand and 2 science teachers from Malaysia allowed the researchers to observed their classrooms and conduct an interview.

Research tools

- Teacher's Orientation to Teaching Science (TOTS) questionnaire

The TOTS questionnaire is the Likert scale questionnaire composed of items which assess teachers' beliefs about goal of science teaching and the characteristics of teaching that support the goal.

- Classroom Observation Form

The Classroom Observation Form is used to collect data about learning activities, classroom environment, and classroom management of participating teachers that reflect the teacher's orientation to teaching science

Research method

The research methodology in this study was consisted of three main stages including research tool development, quantitative strand and qualitative strand. In research tool development stage, the TOTS questionaires was developed and examined by the experts. After the questionnaire was tried out, the reliability of each items was analyse by using Rarsch analysis. The quantitative strand of this study was conducted by distributing questionnaires to

science teachers form Thailand and Malaysia, then the data was analyse the highest agreement. In qualitative strands of this study, some teachers from both countries volunteered to give their information and be observed their teaching.

Conclusion of research results

The objectives of this study were to construct the Teacher's Orientation to Teaching Science (TOTS) questionnaire, examine the orientation to teaching science of science teachers from Malaysia and Thailand and observe the science classrooms of the participating teachers to collect data about their Orientation to Teaching Science. The results of each phase were presented as followed:

1. The result of development TOTS questionnaire

Three raters were invited to review the suitability of the items that captured the conceptual meaning of orientation to teaching science scale. The purpose is to ensure the content validity and comprehensibility. The first rater was a lecturer from the well known university; and the latter two raters were science educators who expertise in pedagogical content knowledge. Several items were found inappropriate in terms of the problems of item structure, grammatical, and its generalisability to the broader context based on the comments from the raters. The problematic items according to the comments given by the raters were refined and no items were excluded.

The Rarsch analysis result of Thai data indicated that a total of 11 misfit item were found with the logit units beyond the acceptable range of mean squares standardized z-scores. The misfit items included Item 17 and 20 (Academic Rigor), Item 30 (Didactic), Item 15 (Conceptual), Item 10 and 41 (Activity-driven), Item 43 (Project-based science), Item 26, 53 (Inquiry) as well as Item 36 and Item 40 (Guided Inquiry). These misfit items were suggested to be excluded from further analysis. Overall, a total of 43 out of 54 items were found reliable and valid based on the Thai data.

The Rarsch analysis result of Malaysia data indicated that the misfit items included Item 12 (Process), Item 1 and 30 (Didactic), Item 49 (Activity-driven), Item 48 (Discovery), Item 37 (Project-based science) and Item 54 (Inquiry). The seven misfit items were suggested to be

excluded from further analysis. Overall, a total of 41 out of 54 items were found reliable and valid based on the Malaysian data.

2. The result of quantitative strand

The results indicated that the highest agreement of orientation of teaching science of Malaysian teachers was discovery learning followed by guided inquiry, project-based inquiry and inquiry. After the orientations were categorised , the result showed that contemporary student-center was the highest agreement following by 1960s student-center, and teacher-center. For thai teachers, the highest agreement of orientation of teaching science of Thai teachers was inquiry followed by project-based science, guided inquiry and discovery learning. After the orientations were categorised, the result showed that contemporary student-center was the highest agreement following by 1960s student-center, and teacher-center.

3. The result of qualitative strand

The result from qualitative part supported the notion of the relationship between teacher's orientation to teaching science and classroom practice. The participating teachers design classroom activity based on their orientations.

Discussion

In conclusion, The highest agreement of orientation of teaching science of Malaysian teachers was discovery learning followed by guided inquiry, project-based inquiry and inquiry. The highest agreement of orientation of teaching science of Thai teachers was inquiry followed by project-based science, guided inquiry and discovery learning. Contemporary-Students-Centered orientation was the highest agreement that is an ultimate goal of science teaching for both Malaysia and Thailand teacher participants.

Conceptual change, project-based science, inquiry, and guided inquiry are student-centered orientations that represent contemporary reform efforts and curriculum projects (Friedrichsen et al, 2011). Not surprisingly, those orientations have been presented many times in professional development programs currently in both countries. In Thailand, the Institute for the Promotion of Teaching Science and Technology (IPST) is the independent authority under the Ministry of Education, responsible for the development of national curriculum, educational media and tools, standard and quality assessment on science, mathematics and technology education from elementary to upper secondary schools. IPST is also tasked with re-training teachers and students, promoting science talents and advising science education policy. Many of professional development programs have organized by IPST related with inquiry teaching

approach and project-based learning. In fact, scientific inquiry was included in science curriculum as a national standard in which Thai students should understand and be able to do. In Malaysia, Southeast Asian Ministers of Education Organisation- Regional Centre for Education in Science and Mathematics is committed to promote the quality of science and mathematics education in the SEAMEO Member Countries which included Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor Leste and Vietnam. Inquiry approach have also influent how professional development were conducted for Malaysian teachers. Both Thai and Malaysian teachers, therefore, perceive the idea of inquiry teaching as the effective method to teach science rather than teacher-centered orientation. This result is consistent with Bahcivan (2014) in which the research was conducted in Turkey. The result indicated that professional development in science teacher education in Turkey may contribute to teacher's conception of teaching which was constructivist conceptions of teaching and learning. Bahcivan (2014) also explained that professional development in Turkey conducted for a past decade devoted to increase participants' conception related to constructivist approach in education. Moreover, science teacher educators tried to convince science teachers that implementing constructivist approach in classroom would have advantages related to individual qualification.

Hancock and Gallard (2004) also suggested that professional development programs play an important role in how teachers develop their belief about teaching and learning. In addition, teachers' belief about teaching and learning can be developed through the observations and classroom practices that begins from the pre-service teacher educational program to in-service training. (Harwood et al., 2006).

Teacher-centered also gain high agreement for Thai teachers. This result indicated that Thai teachers also aware of didactic teaching as an important science instruction. Even scientific inquiry skills is necessary for Thai students, the teachers still need to use lecturing to teach science content because they believe that it will help students to get high scores on the examination.

The results of this study also suggest that, for both Malaysian and Thai teachers, contemporary science teaching orientations such as inquiry guided-inquiry and project-based learning are recognized as the most effective way to teach science. However, the classroom practice might be influent from other factors including school policy, parent's expectation, or social norm and value. Those factors also play an important role in teacher's decisions for planning and organizing the classroom. This research suggested that the teachers tend to design their classroom related to their orientations if other factors are also supported.

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For Thai teachers, they use laboratory activity to verify science concept. Before the activity, both teacher explained the definition of terms and illustrated the concepts, then lab directions were distributed to the students. The students followed the direction steps by steps to verify scientific concepts. After the experiment, some groups of the students presented their finding. The teacher tried to guide the classroom discussion in the way that lead to science content. The teachers did not spend time discussing about the results from some groups that were not support science content. Instead of helping students understand how scientific knowledge could be constructed from analysing evidence, the teachers use science experiment to demonstrate scientific phenomena.

For Malaysian teachers, it happened in the same way as Thai teachers. One teacher used lab experiment as the activity to verify scientific concept. The other teacher use classroom activity to engage students to learn science. Both case support the notion of the relationship between the orientation to teaching science and the classroom practice.

The result of this study was consistent with Boesdorfer and Lorsbach (2014) study. Using observations, interviews, and class documents, the study concluded that the teacher's orientation toward science teaching was an appropriate way of understanding her teaching practice.

There is a consensus among science educators that this knowledge is important for teachers. It determines what learning activities the teachers are going to use, teaching methods that the teachers are going to implement, and the assessment tools that the teachers are going to administer. As Bahcivan (2014) suggested, teachers' beliefs are widely accepted as predictors of their practice. Today, educators approve that teachers' beliefs, as implicit theories, filter how they know and teach their subject matters.

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social norm and value. Those factors also play an important role in teacher's decisions for planning and organizing the classroom. This research suggested that the teachers tend to design their classroom related to their orientations if other factors are also supported. Professional development programs should not only focus on knowledge of science teaching but also practical examples of how to implement science teaching in various contexts.

Recommendation

The main finding of this study indicated that most Thai and Malaysia teachers who participated in this study believe in contemporary student center which included inquiry and guided inquiry, conceptual change and also project-based learning. In addition, teachers from both countries tend to teach science based on their orientation when they were asked to choose the best approach to design their classroom activities. The implementation of this findings are as followed:

1. Professional development program should focus on how to implement contemporary teaching orientation to various contexts. That means it needs a lot of examples that illustrated how teaching approach can be applied in the real classroom context. Not only what the theory is, but also how the theory can connect to practice.

2. It is the importance to know what teachers already know and believe before they participate in professional development workshop. In this study, the teachers already believe in student-center orientation. Therefore, providing the knowledge about the teaching method may be not enough. The professional developer should consider the activities that promote teacher's application of their knowledge of teaching.

3. The future study should focus on other aspects of pedagogical content knowledge including knowledge about curriculum, student's learning, assessment and so on to develop a holistic profile of teacher pedagogical content knowledge.