

การประเมินความต้องการของนิสิตสาขาการสอนวิทยาศาสตร์ เพื่อใช้ออกแบบรายวิชาบูรณาการความรู้วิชาชีพครู

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บทคัดย่อ

การประเมินความต้องการถือว่าเป็นกระบวนการสำคัญส่วนหนึ่งของการออกแบบรายวิชา การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาความต้องการของนิสิตสาขาการสอนวิทยาศาสตร์เพื่อใช้ในการออกแบบรายวิชาบูรณาการความรู้ในวิชาชีพครู การศึกษาประกอบด้วย 1) การวิเคราะห์หลักสูตรการผลิตครูวิทยาศาสตร์ในประเทศไทย จำนวน 2 หลักสูตร และ 2) การศึกษาความต้องการของนิสิตสาขาการสอนวิทยาศาสตร์ ชั้นปีที่ 4 จำนวน 52 คน ที่ศึกษาในหลักสูตรการผลิตครูระหว่างปีการศึกษา 2547 2548 และ 2549 ในมหาวิทยาลัยของรัฐแห่งหนึ่งในภาคกลางของ

ประเทศไทย เครื่องมือวิจัยที่ใช้ได้แก่ แบบสอบถามปลายเปิดโดยให้ประชากรวิจัยตอบในช่วงก่อนออกฝึกสอน ผู้วิจัยใช้การวิเคราะห์แบบ ไมโคร (microanalysis techniques) ผลการวิจัยพบว่า ความต้องการของนิสิตจัดกลุ่มได้ดังต่อไปนี้ ความรู้ในวิธีการสอน ความรู้ในเนื้อหาวิชา ความรู้ในเนื้อหาผนวกวิธีการสอน ความรู้ในสื่อและเทคโนโลยี, และการบูรณาการความรู้วิชาชีพครูลงสู่การเขียนแผนการจัดการเรียนรู้ นอกจากนี้ ผลจากการวิเคราะห์หลักสูตรการผลิตครู 4 ปี ผู้วิจัยพบว่า หลักสูตรยังขาดการสนับสนุนให้นิสิตครูใช้ผลจากการวิจัยในการออกแบบกิจกรรมการเรียนรู้

คำสำคัญ: การประเมินความต้องการ, ความรู้วิชาชีพครู, รายวิชาบูรณาการความรู้

Needs Assessment Used to Design a Capstone Course to Enhance Thai Pre-Service Science Teachers' Professional Knowledge

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Abstract

This study reported on a needs assessment, associated with an effort to construct a capstone pre-service teacher education course, which aimed to enhance Thai pre-service science teachers' professional knowledge. The needs assessment was an important part of the planning process for the capstone course. To explore the needs of pre-service science teachers, the assessment consisted of (1) analyzing two kinds of science teacher preparation curricula in Thailand, and (2) investigating the needs of 52 4th year pre-service science teachers from 2004 to 2006. The instrument used in the study was an open-ended questionnaire that was distributed to pre-service science teachers before their student teaching practicum in the Faculty of Education of one university in central Thailand. Their responses were analyzed by using microanalysis techniques. Pre-service science teachers from 2004 to 2006 expressed their needs, which could be categorized into general pedagogical knowledge (PK), subject matter knowledge (CK), pedagogical content knowledge (PCK), knowledge of instructional media and technology, and an integration of teacher professional knowledge in lesson plans. The results supported the idea that it was important to offer a capstone course to enhance Thai pre-service science teachers' professional knowledge. The analysis of existing 4-year teacher education programs revealed deficiencies in encouraging the use of research results in the students' learning activities.

Keywords: capstone course, needs assessment, teacher professional knowledge

Introduction

The aim of Thai education is “the full development of the Thai people in all aspects: physical and mental health; intellect; knowledge; morality; integrity; and a desirable way of life so as to be able to live happily with other people” (Office of the National Education Commission (ONEC), 1999). Teachers play an important role in this process, (Pitiyanuwat, 2004, 1; Pongsopon, 2003, 134) because teachers are the people who transform current national education policies into student knowledge.

To cultivate professional teachers, all teacher education institutes need to improve their curriculum to include professional knowledge which includes knowledge of educational context (Elbaz, 1981; Education Review Office of New Zealand (ERO), 1998; Nazri, 1990), general pedagogical knowledge (PK) (Elbaz, 1981; ERO, 1998; Nazri, 1990; Vonk, 1995), subject matter knowledge (CK) (Elbaz, 1981; ERO, 1998; Nazri, 1990; Vonk, 1995), pedagogical content knowledge (PCK) (Elbaz, 1981; ERO, 1998; Nazri, 1990; Vonk, 1995), knowledge of instructional media and technology (ERO, 1998; Nazri, 1990), knowledge of educational philosophy (Nazri, 1990), and knowledge of research on best practices (ERO, 1998).

Nevertheless, data from other studies indicated that there were many beginning teachers who felt minimally qualified because they did not experience a high quality pre-service program (Pillay, 2002). One potential way to improve pre-service teacher education is to offer a capstone experience at the end of the program. Capstone courses help students to tie together and make sense of the various discrete program components. This can enhance students self-efficacy by improving student perceptions of their

abilities and their professional identities (Dunlap, 2005), and also can provide students with professional world experiences to blend their knowledge from methods courses into application (Catalano, 2004).

An essential first step in revising the content and strategies of a teacher education curriculum is to assess participants' perception of the program's strengths and weaknesses. Needs assessment has been increasingly recognized as an essential tool for both curriculum and course revision (Pratt, 1980). This process has been diversely used in assessing the status of components of professional development or teacher preparation programs in both developed countries such as the United States (Greene, 2000; Halim, Osman & Meerah, 2004) and developing countries such as Malaysia (Halim et al., 2004) and the Philippines (Pontiveros, Jr., 2004). Most needs assessments use various methods including questionnaires (most commonly used), interviews, focus group discussions, and document analysis.

Objective of the Study

The purpose of this study was to assess the needs of teacher education students regarding the capstone course that blended knowledge from the methods course into application.

Research Methods

This study used a mixed method. The following describes the various data sources and data collection instruments, and data analysis.

Participants

The participants consisted of fifty-two 4th year pre-service science teachers. There were 17, 17, and 18

pre-service science teachers in the 2004-2006 academic years, respectively.

Instruments

1. Documents

Documents that were analyzed in this study came from the four-year science teacher preparation curricula provided by the University Faculties of Education and Rajabhat University in Thailand.

2. Questionnaires

The researcher used an open-ended questionnaire to investigate the needs of pre-service science teachers. The questionnaire was divided into two parts. The first part aimed to acquire fundamental demographic information from the participants including their gender and science major emphasis. The second part aimed to identify the needs of pre-service science teachers in terms of further professional preparation. To acquire this in-depth information and to promote free and open responses from the students, the researcher used a single open-ended item. The question was "In which areas of teacher education do you feel you need more preparation before you begin teaching?"

To validate the construct and the content of the questionnaire, the researcher used the following procedures:

1. The researcher studied the existing literature, including research papers from Thai and international journals, and used sample instruments from qualitative handbooks to design the questions and the construction of the questionnaire.

2. The questionnaire was sent to two Thai-professors in the Faculty of Education to correct the content, construction and language.

3. The researcher then corrected the questionnaire and submitted it to the same professors for re-correction.

4. The questionnaire was finalized by the researcher and was distributed to pre-service science teacher students during the 2004-2006 academic years.

Data Collection and Analysis

From Extant Programs

Data from extant teacher education programs in Thailand were gathered from documents published by the four-year science teacher preparation institutions throughout the country. To obtain a description of the national four-year science teacher preparation curricula, syllabi and course descriptions were analyzed by using a content analysis technique to identify goals and the content of the courses. The goals and content of the courses were categorized into each domain of teacher professional knowledge.

From Questionnaires

The researcher collected data at the end of the first semester of the 2004 and 2005 academic years, and before the first semester of the 2006 academic year. Each academic year, pre-service science teachers were asked to come together in a classroom and complete the questionnaire. They were given about in 30 minutes to do so. All questionnaires were completed and returned to the researcher. There were 52 answers returned, 17, 17, and 18 in the years 2004-2006 respectively.

Answers were analyzed using the microanalysis technique of Strauss and Corbin (1998). The main strategy used in this technique was coding. In this process, the researcher first read all of the pre-service

science teachers' answers and tried to understand the underlying needs of participants as expressed in their writing. Then, their answers were analyzed line-by-line to generate pre-categories. The data supporting each pre-category in each year were analyzed to confirm that each data source contributed to the shared characteristics within a category. Using this process, the final categories of needs were determined and the frequencies of answers within each category were calculated and compared using Microsoft Excel. The results were then presented in percentages and averages. These final categories of needs were classified according to the domains of professional knowledge, as cited in available literature, and compared with results from extant data that emerged from analysis of the four-year science teacher preparation curricula.

Results

Components of the Programs in Two Types of Institutes

The analysis of data from extant programs revealed that program content covered most of the major domains of teacher professional knowledge including knowledge of: educational context, general

pedagogical knowledge (PK), subject matter knowledge (CK), pedagogical content knowledge (PCK), knowledge of instructional media and technology, and knowledge of educational philosophy. The Rajaphat University mainly emphasized the domain of general pedagogical knowledge (PK), whereas the University Faculties of Education emphasize the domain of pedagogical content knowledge (PCK), including specific science curricula and the purpose of teaching science. However, there was not a course in either program that emphasized knowledge of research on best practices.

There were many activities provided within both curricula that focus on enhancing teacher's professional knowledge. During their methods courses, pre-service science teachers experience writing lesson plans, classroom observation, and microteaching. After finishing their methods courses, pre-service science teachers have a full-time field experience where they practice blending their professional knowledge into teaching practice.

Needs Assessed from Questionnaire Survey

Results from the demographic portion of questionnaire are presented in Table 1.

Table 1 The Distribution of Pre-Service Science Teacher Demographic Data during the 2004 to 2006 Academic Years.

Academic year	Response (%)					
	Science Majors				Sex	
	Chemistry	Biology	Physics	General Science	Female	Male
2004 (n=17)	47.06	17.65	29.41	5.88	64.71	35.29
2005 (n=17)	23.53	29.41	47.06	0.00	70.59	29.41
2006 (n=18)	50.00	38.89	11.00	0.00	77.77	22.22

There were more female pre-service science teachers than male in every year. The proportion of females to males in 2004, 2005, and 2006 academic year varied from 65:35 in 2004, to 78:22 in 2006. In the 2004 and 2006 academic years, the highest percentage of pre-service science teachers majored in Chemistry, 47 and 50 percent respectively. In the 2005 academic year, the highest percentage of pre-service science teachers majored in Physics (47%). The second highest percentage of pre-service science teachers majored in Physics (29%) in 2004, Biology (29%) in 2005 and Biology (39%) in 2006.

Answers of pre-service science teachers on the open-ended part of the questionnaire were analyzed

and categorized into 18 categories. The categories that emerged from their answers are the following: curriculum, teaching methods, questioning techniques, classroom management, assessment, cognitive development of students, language for teaching, topic-specific instructional strategies, conducting interesting science activities, content knowledge, instructional media, lesson plans, bringing knowledge into practice, teacher awareness, special projects, being informed of grade level in advance, teacher duties at school, building rapport with students and school staff, and confidence and good personality. Percentages associated with each category are presented in table 2 and represented graphically in Figure 1.

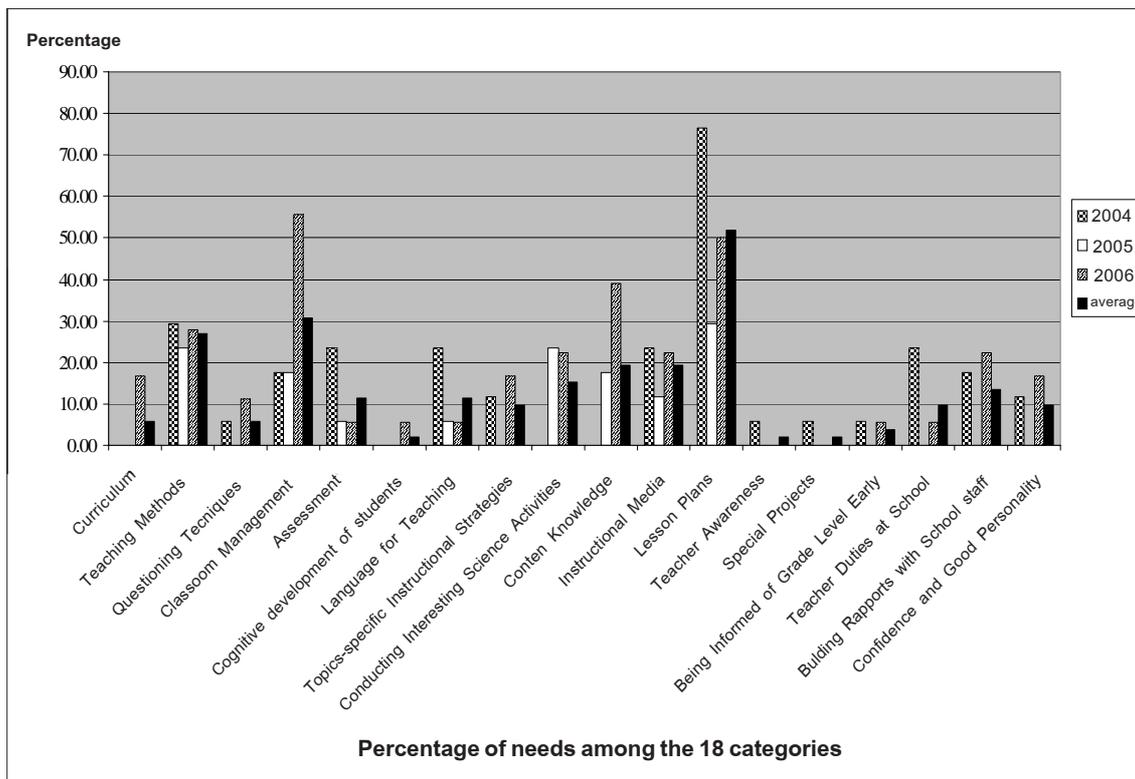


Figure 1: Needs for program revision as viewed by pre-Service science teachers during the 2004 to 2006 academic years.

Table 2 Needs for Program Revision as Viewed by Pre-Service Science Teachers during the 2004 to 2006 Academic Years.

Categories of the needs	Response (%)			
	2004	2005	2006	Average
Curriculum	0	0	16.67	5.77
Teaching Methods	29.41**	23.53**	27.78	26.92*
Questioning Techniques	5.88	0	11.11	5.77
Classroom Management	17.65	17.65*	55.56***	30.77**
Assessment	23.53*	5.88	5.56	11.54
Cognitive Development of Students	0	0	5.56	1.92
Language for Teaching	23.53*	5.88	5.56	11.54
Topics-specific Instructional Strategies	11.76	0.00	16.67	9.62
Conducting Interesting Science Activities	0	23.53**	22.22	15.38
Content Knowledge	0	17.65*	38.89*	19.23
Instructional Media	23.53*	11.76	22.22	19.23
Lesson Plans	76.47***	29.41***	50.00**	51.92***
Teacher Awareness	5.88	0	0	1.92
Special Projects	5.88	0	0	1.92
Being Informed of Grade Level Early	5.88	0	5.56	3.85
Teacher Duties at School	23.53*	0	5.56	9.62
Building Rapport with School Staff	17.65	0	22.22	13.46
Confidence and Good Personality	2 (11.76)	0 (0.00)	3 (16.67)	5 (9.62)

*** represents the highest percentage of responses

** represents the second highest percentage of responses

* represents the third highest percentage of responses

Results as reported in Table 1 and Figure 1 revealed that during the 2004 to 2006 academic years, the top three needs of pre-service science teachers were related to lesson plans (52%), classroom management (31%), and teaching methods (27%).

When analyzing each academic year separately the highest need for 2004 fell into the category of lesson plans (76%), with the second highest in teaching methods (29%). Four categories tied for third (24%): assessment, language for teaching, instructional media, and teacher duties at school. The

following quotes represent typical examples of pre-service science teacher's answers that made up the top two categories.

lesson plans: *"I would like to revise and practice writing long range lesson and also a period lesson plan."*

teaching methods: *"I have learned a lot of teaching methods, but now I already forgot them. I would like to review all teaching*

methods, strategies, and techniques before the teaching practicum."

In 2005, the need with the highest percentage was related to lesson plans (29%). Two categories tied for the second highest (24%): teaching methods and conducting interesting science activities. Similarly, two other categories tied for the third highest needs (18%): classroom management and content knowledge. The following quotes represent typical examples of pre-service science teacher's answers that made up the top two categories.

conducting interesting science activities "*I am sure about science content knowledge, but I would like the Department to train me more how to conduct interesting science activities*"

content knowledge: "*I am ready to manage with misbehaved students, I feel I don't have enough content knowledge to teach students. I need more preparation.*"

In 2006, the most needed was classroom management (56%), the second one was lesson plans (50%), and the third one was content knowledge (39%). The following quotes represent typical examples.

classroom management: "*I would like to know classroom management strategies, and appropriate punishment for students who misbehave.*"

lesson plans: "*Writing lesson plans and defining expected learning outcomes are what I would like to prepare for before the teaching practicum.*"

In addition, they included the following: instructional media (19%), conducting interesting science activities (15%), building rapport with school staff (13%), assessment, and language for teaching (12%), topics-specific instructional strategies, teacher duties at school and confidence and good personality (10%), curriculum, questioning techniques (6%), being informed of grade level in advance (4%), cognitive development of students (2%), teacher awareness and special projects (2%).

Discussion and Conclusion

The results of this study showed that pre-service students did not feel fully prepared before beginning their teaching practicum. They also showed the importance of needs assessment in the process of program planning.

On average, the first three aspects that needed to be strengthened were related to lesson planning, classroom management, and teaching methods. The content knowledge and instructional media were tied for the fourth highest needs. This result differs from the former literature that found content knowledge is the aspect most needed by pre-service science students (Ellis, 2001; Gess-Newsome & Leaderman, 1993; Rice & Roychoudhury, 2003). For example, in the study of Rice and Roychoudhury (2003), they found that about 60 percent of pre-service students felt that their subject matter was weak, and that they needed more preparation. Some former studies found classroom management (Butts, Koballa & Elliott, 1997; Eiriksson, 1997) and teaching methods (Ellis, 2001) were also needed by pre-service students.

The results from this study also indicated that most domains of teacher professional knowledge were

well covered, except knowledge of research on best practices. The difference between the curricula of the two types of Thai teacher education institutions was that The Rajabhat University mainly emphasized the domain of general pedagogical knowledge (PK), while University Faculties of Education emphasize the domain of pedagogical content knowledge (PCK). Both curricula provided experiences for pre-service science teachers to develop their professional knowledge and have full-time experiences in schools to help students integrate their professional knowledge into teaching practice after finishing their method courses.

The results from the questionnaire indicated that there were more females than male pre-service science teachers during the 2004 to 2006 academic years, and most of them were majoring in Chemistry and Physics. The major categories of the pre-service science teachers' needs in the 2004 to 2006 academic years were the following: curriculum, teaching methods, questioning techniques, classroom management, assessment, cognitive development of students, language for teaching, topic-specific instructional strategies, conducting interesting science activities, content knowledge, instructional media, lesson plans, bringing knowledge into practice, teacher awareness, special projects, being informed of grade level, teacher duties in school, building rapport with students and school staff, and confidence and good personality.

These categories could be classified into domains of teacher professional knowledge includes pedagogical knowledge, content knowledge, pedagogical content knowledge, and knowledge of instructional media and technology. Some categories

of the needs in the study didn't match any standard category with these domains, and the category of lesson plans represented an integration of domains of all of teacher professional knowledge. From the results of this study, it can be concluded that there were needs of pre-service teacher education students regarding their preparation and readiness for teaching

Implications and Recommendations

The results of this study indicated that there was a type of integrating experience near the end of a teacher education program which the researcher calls a capstone course. The purpose of this capstone course would be to enhance pre-service science teachers' professional knowledge and to help them connect and assimilate information and strategies learned in separate courses and experiences. Types of integrated knowledge that would be emphasized in such a course would be the following.

1. Even though the four-year science teacher preparation curricula covered almost all domains of teacher professional knowledge, the domain of knowledge of research on best practices was neglected. A system of teacher education should encourage pre-service science teachers to use processes and results of current research to improve their professional lives. This recommendation is supported by the work of Goodnough (2002) who suggested the addition of this topic in order to develop teacher professional knowledge in the context of primary science education. To improve teachers' professional knowledge, the program should impart research based strategies to help teachers in curriculum development and implementation, selecting effective instruction and assessment

strategies, and utilizing knowledge in using educational research.

2. Even though pre-service science teachers had fulltime field experiences after finishing their methods courses, most pre-service science teachers continued to have problems. On potential solution to this would be a capstone course before field experiences that provides opportunities for pre-service science teachers to review and integrate each domain of professional knowledge into practice. This recommendation was similarly suggested by Vonk (1995) and Bryan and Abell (1999). Vonk (1995) said it is impossible to prepare pre-service teachers adequately by learning only from coursework. The program should provide opportunities for teachers to develop their professional knowledge earlier and extend them in school experiences (Bryan and Abell, 1999). Other recommendations from this study relate to designing or revising courses that aim to enhance teacher professional knowledge. These include:

3. Needs assessment to design or revise a preparation course is an important process that should be investigated before planning objectives or activities for a course or for a program. The results from this study identified various needs of pre-service science teachers across three academic years at one institution. The program designer or curriculum developer can use this information to improve courses and make them better correspond to participants needs. This suggestion is similar to Flowers (2001) that needs assessment should be used to gain information on the changing needs of the changing population.

4. Typically, needs assessments have been conducted on a large scale and the instruments used

were often questionnaires, but to eliminate the weaknesses suggested by United Nations Office on Drugs and Crime (UNODC) (2006); this study used open-ended questionnaires, which provided an opportunity for participants to express their own needs. This study also used curriculum analysis to compliment the needs assessment process and to search for any deficiencies in current teacher preparation programs. The recommendation of the researcher is that when trying to acquire in-depth information with small numbers of participants, open-ended questionnaires and curriculum analysis can be very useful. However, to investigate information with a large number of participants, a rating scale questionnaire might be selected. This is similar to the method used by Zhang and et.al (2003), which used a rating scale questionnaire to conduct a national needs assessment in an online survey.

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References

- Alam, S. (2005). **Need Assessment and Designing a Model for Professional Development of Educational Administrators in Pakistan**. Rawalpindi: Ph.D. Dissertation, University Institute of Education and Research, Pakistan.
- Bryan, L. A. & Abell, S. K. (1999). Development of professional knowledge in learning to teach elementary science. **Journal of Research in Science Teaching**, 36(2), 121-139.

- Butts, D.P., Koballa, T. R. & Elliott, T. D. (1997). Does participating in an undergraduate elementary science methods course make a difference? **Journal of Elementary Science Education**, 9(2), 1-17.
- Catalano, D.G. (2004). Senior capstone design and ethics: a bridge to the professional world. **Science and Engineering Ethics**, 10(2), 409-415.
- Dunlap, C.J. (2005). Problem-based learning and self-efficacy: how a capstone course prepares students for a profession. **Educational Technology Research and Development**, 53(1), 65-83.
- Education Review Office (ERO). (1998). **The Capable Teacher**. Available: <http://www.ero.govt.nz/Publications/eers1998/98no2hl.htm>
- Eiriksson, S. (1997). Preservice teachers' perceived constraints of teaching science in the elementary classroom. **Journal of Elementary Science Education**, 9(2), 18-27.
- Elbaz, F. (1981). The teacher's 'practical knowledge': report of a case study. **Curriculum Inquiry**, 11(1), 43-71.
- Ellis, J.D. (2001). A dilemma in reforming science teacher education: responding to students' concerns or striving for high standards. **Journal of Science Teacher Education**, 12(4), 295-310.
- Flower, J. (2001). Online learning needs in technology education. **Journal of Technology Education**, 13(1), 17-28.
- Gess-Newsome, J. & Leaderman, N. G. (1993). Preservice biology teachers' knowledge structures as a function of professional teacher education: a year-long assessment. **Science Education**, 77(1), 25-45.
- Goodnough, K. (2001). Enhancing professional knowledge: a case study of an elementary teacher. **Canadian Journal of Education**, 26(2), 218-236.
- Greene, J.S. (2000). A biology laboratory internship program: improving preservice teacher education. **The American Biology Teacher**, 62(2), 108-112.
- Halim, L., Osman, K. & Meerah, T.M. (2004). **Trends and Issues of Research on In-Service Needs Assessment of Science Teachers: Global vs the Malaysian Context. Proceedings of an international conference to review research on science, technology and mathematics education. December 13-17, 2004. Dona Paula: International Center.**
- Nazri, M.I. & Barrick, R.K. (1990). Professional knowledge competency achievement of agricultural teachers with and without preservice teacher preparation in peninsular Malaysia. **Journal of Agricultural Education**, 31(2), 49-54.
- Office of the National Education Commission (ONEC). (1999). **National Education Act B. E. 2542 (1999)**. Bangkok: Office of the Education Council.
- Pillay, H. (2002). **Teacher Development for Quality Learning: The Thailand Education Reform Project**. Brisbane: Queensland University of Technology.
- Pitiyanuwat, S. (2004). Policy Recommendations on Production and Development of Teachers. Available: <http://www.edthai.com/publication/0001/3.htm>.

- Pongsophon, P., Jantrarotai, P. & Roadrangka, V. (2003). Perspectives of Thai students in grade 9-12 on evolutionary concepts. **Kasetsart Journal (Social Science)**, 24, 1-14.
- Pontiveros, Jr. F. (2004). **Pre-Service and In-Service Teacher Education in the Philippines**. Available: <http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN011545.pdf>.
- Pratt, D. (1980). **Curriculum Design and Development**. New York: Harcourt Brace Jovanovich.
- Rice, D. C. & Roychoudhury, A. (2003). Preparing more confident preservice elementary science teachers: one elementary science methods teacher's self-study. **Journal of Science Teacher Education**, 14(2), 97-126.
- Strauss, A.&Corbin, J. (1998). **Basics of Qualitative Research: Techniques, and Procedures for Developing Grounded Theory**. 2nd ed. Thousand Oaks, CA: Sage.
- United Nations Office on Drugs and Crime (UNODC). (2006). **UNODC Training on Needs Assessment and Programme Planning**. Available: http://www.unodc.org/pdf/youthnet/tools_message_escap_needs.pdf.
- Vonk, J. H. C. (1995). **Conceptualizing Novice Teachers' Professional development: A Base for Supervisory Interventions**. Proceedings of the annual meeting of the american educational research association. April 18-22, 1995, San Francisco, CA.
- Zhang, Q., J.Reisslein, Klein, J. & Reisslein, M. (2003). **A Need Assessment for a Graduate Level Course in Optical Networking**. Available: http://www.eas.asu.edu/~mre/etop03_need_assess.pdf.

