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THESIS

THAI PRE-SERVICE SCIENCE TEACHER'S UNDERSTANDING AND
PRACTICE OF CLASSROOM RESEARCH



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A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
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This interpretive case study research project is concerned with 1) pre-service science teacher's understanding and practice of Classroom Research, 2) the cooperating teachers and university supervisor supervision of Classroom Research conducted by pre-service teachers, and 3) the factors that support or hinder the pre-service teacher's practice of a Classroom Research project. The research is divided into three phases: the exploratory phase, the developmental phase, and the implementation phase. The participants of this study were three pre-service science teachers, three cooperating teachers, and one university supervisor. The setting of the study was a final internship year for a five-year pre-service teacher education program in a university situated in western Thailand. The first phase explored the pre-service science teacher's understanding of Classroom Research before engaging in the initiative. In the second phase, the initiative was developed based on the collected data in the first phase accompanied with the cooperating teachers' and university supervisor's background information about the understanding of Classroom Research, and the supports that they preferred to receive for helping them to supervise Classroom Research to the pre-service science teachers. The third phase studied the effect of the initiative on pre-service teacher's practice of Classroom Research, the cooperating teachers' and university supervisor's supervision of Classroom Research to pre-service teachers, the development of pre-service teacher's understanding of Classroom Research, and the factors that supported or hindered the pre-service teacher's practice of Classroom Research. The data from this study were obtained from a questionnaire, individual interviews, observations, journal entries, and pre-service teacher's Classroom Research report. The approach to analysis involved an inductive process for generating themes of the research findings.

The results demonstrated an improvement of pre-service teacher's understanding of Classroom Research after engaging in the initiative. The cooperating teachers played a more important role in supervising Classroom Research to pre-service teachers than the university supervisor. The initiative was useful in helping the cooperating teachers and university supervisor to supervise Classroom Research to the pre-service teachers. The factors that supported pre-service teacher's practice of Classroom Research were the close supervision from the cooperating teachers, the student's responses, and the school's facilities. The factors that hindered the pre-service teacher's practice of Classroom Research were lack of time, insufficient school support, insufficient rapport between the university supervisor and the cooperating teachers, and the insufficient university support for the pre-service teachers. Further research is needed to investigate how pre-service teachers can sustain their understanding and practice of Classroom Research in the first few years when they start their career as a science teacher.

Student's signature

Thesis Advisor's signature

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Ekgapoom Jantarakantee
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CHAPTER I

INTRODUCTION

Overview of the Chapter

The first chapter of this dissertation describes the background of the study which is the basis for the research questions and research objectives. In the following section, significance of the study, research objectives, research questions, anticipated outcomes, and delimitation of the study are described. The important terms introduced in this study are operationally defined. Finally, the summary of the chapter is also presented.

Background of the Study

Challenges associate with the human resource base in Thailand has been seen as one of the major components which lead to the economic and financial crisis that has hit the country in recent years. (Office of the National Education Commission [ONEC], 2003; The National Economic and Social Development Board [NESDB], 2007). The economic crisis revealed that Thailand has deficiencies in many areas including a lack of graduates competent in higher order thinking skills, science and technology skills, and vocational skills. These deficiencies are regarded as important factors responsible for the country's economic decline, and have made the current educational reform necessary in Thailand (ONEC, 2002a; NESDB, 2007). The educational reform places emphasis on the learning process. Learners should have an opportunity to develop themselves at their own pace and to the best of their potential. The learning process should also incorporate thinking processes, application of knowledge, and problem solving. An appropriate learning environment, various instructional media, facilities, learning resources, and various authentic learning activities should be provided for learners (ONEC, 2002b).

To enhance the quality of life and standard of living, a nation must improve the productivity and potentiality of its people (Fry, 2002). The primary mean for doing this is to provide a quality education. Education is a necessary instrument to develop people, promote a knowledge-based society, and improve the nation's global competitiveness (ONEC, 2002a). This sentiment corresponds to those in The Ninth National Economic and Social Development Plan (2002 – 2006) and the 15-year National Education Plan (2002 – 2016). The Ninth National Economic and Social Development Plan (2002 – 2006) was developed by the National Economic and Social Development Board. It is a framework for developing the country in many aspects. The major emphasis of this plan is placed on the development of human, social, economic, and environmental resources. This sustainable development direction is seen in various national strategies specifically: the strategy on natural resources and environmental management, the strategy to increase national competitiveness, and the strategy on human development and social protection (NESDB, 2007).

In addition, the 15-year National Education Plan (2002 – 2016) which was prepared by the Office of the Education Council (OEC), serves as a framework for formulating the development plans pertaining to basic education, vocational education, and higher education. It also provides guidelines for formulating operational plans at the levels of educational service areas and educational institutions (ONEC, 2002a). These plans are aimed at transforming Thailand into a lifelong learning community which should lead to a knowledge-based society (ONEC, 2002a; NESDB, 2007). Lifelong learning covers the formal, non-formal, and informal (education according to one's preference) education. It is an education from birth to death. Both plans emphasized human-centered development by integrating the holistic scheme of education, religion, art, and culture (ONEC, 2002a; NESDB, 2007).

However, the evaluation of the results at the completion of the Ninth National Economic and Social Development Plan (2002 – 2006) showed that Thai students had weak knowledge in science and mathematics subjects, lacked basic working skills, and had low ability levels in critical thinking and problem solving. Furthermore, the

workers in medium and high-level professional occupations are insufficient in both quantity and quality. The investment in research and development in Thailand is currently low and is offered as one of the main reasons that currently limits the nation's global competitiveness (NESDB, 2007).

As outlined in The Tenth National Economic and Social Development Plan (2007 -2011), the goal of human development is to increase the proportion of those occupying research positions in Thailand to be one in 1000 (NESDB, 2007). Hence the government has been challenged to think about factors that would stimulate national policies for developing the country socio-economically, environmentally, and culturally. Science and technology are regarded as basic necessities for the advancement of high-technology and information-based industries and as a key catalyst in the development of the human resources of the country (ONEC, 2001a). To achieve this, the government would need to create educational opportunities that would result in the development of knowledge in all fields, especially in science and technology, for the purpose of creating new innovations and bodies of knowledge. It is argued that these innovations and the increased bodies of knowledge would serve to further develop the country. As a result, The Tenth National Economic and Social Development Plan emphasizes the promotion of science and technology to increase the nation's global competitiveness. In this development, education is the most important tool for developing scientific and technological literacy for all Thai citizens (NESDB, 2007).

To meet the requirements of The Tenth National Economic and Social Development Plan in promoting science and technology education, the National Education Act 1999 and Amendments Second National Education Act B.E. 2545 (2002) are the framework providing principles and directions for the implementation and reformation of Thai education. Among many issues in the Act, learning reform is the heart of educational reform. Learning reform emphasizes the development and promotion of a learner-centered approach. In this approach, the teaching and learning process takes into consideration an individual's interests, aptitudes, pace, and potential for learning. For science learning, it aims to encourage all learners in the

development of the processes of thinking, inquiry, problem-solving, and creativity and to inculcate in learners desirable attitudes of morality, values towards science, technology, society, and the environment. These learners will be able to adjust to world trends and events, and to develop desirable characteristics including virtue, competency, happiness, and self-reliance (ONEC, 2001a).

In order to provide students with opportunities and activities to learn science in line with these education reform guidelines, science teachers need to use teaching approaches associated with learner-centered learning. The science teachers have to shift their role away from a teacher-centered director towards a learner-centered facilitator (OEC, 2004). The teachers as facilitators provide students with activities to shift them from alternative conceptions to more broadly acknowledge and accepted scientific conceptions. The facilitators also have roles in: discovering what the students are thinking; helping students clarify and reflect on their own ideas; challenging students' ideas; helping students change their ideas; developing school-based science curriculum; planning learning centered lessons; developing instructional media; assessing and evaluating student learning, and so on. The role of the teachers as facilitators and the learner-centered approach, based on constructivist-based teaching and learning perspectives, is regarded as one vehicle which will contribute to the success of learning reformation in Thailand (OEC, 2004). The idea of learner-centered learning fosters the development of human resources quality and life-long learning, but it has proven hard for teachers to implement (Fry, 2002). Most teachers have not been able to implement these theoretical perspectives into practice because they insufficiently understand the real concepts associated with learner-centered learning. Thus, recent teaching and learning methods have not changed very much when compared with the period of time before the reformation of education in Thailand. The teaching and learning methods employed at the present time have not been enough to stimulate student's thinking and action (Pillay, 2002). To promote student's thinking and action more efficiently, teachers need to develop themselves professionally and begin using a variety of teaching techniques to enhance students' learning (Thathong and Thathong, 2002).

The success of educational reform is heavily dependent on the teachers. The teachers are the main factor for developing education because they are the most influential persons affecting the universal student success (Sagor, 2005). Competent teachers are able to bring their talents, experiences, and creative ideas into the classroom. They can implement programs and strategies that best meet the needs of their students (Johnson, 2008), and which will produce a high quality of citizenry (Department of Teacher Education [DTE], 2003). There is no question that professional development is an essential component which is needed to improve the content and pedagogical knowledge for teachers. To acquire competent teachers, teacher education institutions are significantly involved. The importance of teacher education institutions and the responsibility of the government in improving teacher education are stated in Section 52 of the National Education Act 1999 and Amendments Second National Education Act B.E. 2545 (2002) as:

The Ministry shall promote development of a system for teachers and educational personnel, including production and further education of personnel, so that teaching will be further enhanced and become a highly respected profession. The Ministry shall, in this regard, take a supervisory and coordinating role so that the institutions responsible for production and development of teachers, faculty staff, and educational personnel shall be ready and capable of preparing new staff and continually developing quality in-service programs (ONEC, 2002b).

Significance of the Study

Under the educational reform, teachers are the most important agents responsible for bringing about changes in the educational system (Thathong and Thathong, 2002). Usually, a multiplicity of difficulties in teaching and learning contexts in which they work are a challenge to them (Mertler, 2006). It is suggested that teachers should use Classroom Research as the important tool to discover which methods of teaching and learning are appropriate for their students (Thathong and Thathong, 2002; Wongwanich, 2007). Classroom Research is a systematic inquiry

that is conducted by teachers with a vested interest in the teaching and learning process for the purpose of gathering information about how they teach, and how their students learn in the context of their own classrooms. (Thathong and Thathong, 2002; Mertler, 2006). The teachers will use this information to improve their teaching practice and students' achievement (Rock and Levin, 2002; Chant, Heafuer, and Bennett, 2004).

In recent years Classroom Research has been introduced for helping teachers in Thailand to improve their classroom practices and to help identify and solve problems in the classroom (Institute for the Promotion of Teaching Science and Technology [IPST], 2002; Wongwanich, 2007). The idea of promoting Classroom Research in teacher practice also corresponds to the National Education Act 1999 and Amendments Second National Education Act B.E. 2545 (2002) in section 24, which states, "...in organizing the learning process, educational institutions and agencies concerned shall enable instructors to create the ambiance, environment, instructional media, and facilities for learners to learn and be all-round persons, able to benefit from research as part of the learning process." Furthermore, section 30 emphasizes that "...instructors should be encouraged to carry out research to develop suitable learning for learners at different levels of education." Teachers intend to perform Classroom Research not only to study and solve problems that confront them in their classrooms (Ministry of Education [MOE], 2002), but also to improve their teaching and to develop professional knowledge and skills in their careers (IPST, 2002; Wongwanich, 2007).

Using Classroom Research is one approach frequently utilized for teacher development (van Zee, Lay, and Roberts, 2003; Capobianco, 2007). Teachers are able to develop themselves by conducting Classroom Research (ONEC, 2001b; Thathong and Thathong, 2002). Classroom Research can foster skill of inquiry in teachers (Mertler, 2006; Wongwanich, 2007; Johnson, 2008). Degago, 2007 cited Noffke and Stevenson, 1995 explain that through their involvement in the research process, teachers can establish the habit and skills of reflection regarding their own practices and thereby be able to continue to learn from their own experiences and become better

at teaching throughout their careers. Engaging in Classroom Research helps teachers become more critical and analytical (Zambo and Zambo, 2006).

Classroom Research can be used to link theory and practice in education, empower teachers to become agents of change, and enhance the professional growth and development of teachers. The Classroom Research is usually used to develop or verify the theories that finally lead to consideration of best practices within one's own classroom (Johnson, 2008). These best practices are then used to help teachers develop effective learning experiences for their students. Another important aspect of Classroom Research is advancing the notion of **teacher empowerment**. Teachers become empowered when they act as a decision maker by using the gathered information in the classroom to make changes in their own practice and students' learning (Mertler, 2006). The empowered teacher can release all of his or her own experience, skills, gifts, professionalism, ideas, and creativity in their classrooms so that they can achieve the alternative instructional practice to best meet the needs of their students (Johnson, 2008). Teachers have the opportunities to take risks and determine best practice when they believe it to be appropriate for the students (Mertler, 2006; Zambo and Zambo, 2006), and enhance student achievement (Johnson, 2008). Classroom Research acts as a tool for teachers to improve their problem-solving skills and their points of view toward professional development and school change, as well as promoting their confidence and professional self-esteem (Mertler, 2006; Zambo and Zambo, 2006). Classroom Research leads the schools to become more effective learning communities (Johnson, 2008) and helps teachers to become more flexible and open minded (Zambo and Zambo, 2006).

Unfortunately, a number of teachers in Thailand have difficulties in conducting Classroom Research needed to develop suitable learning contexts for learners and to develop professional knowledge and skills in their careers (Wongwanich, 2007). Classroom Research is seen to be radical and new to the majority of Thai teachers and educators, and they are suspicious of its effectiveness (ONEC, 2001b). It is surprising that teachers lacked enthusiasm in working towards and seeking knowledge for how best to develop themselves (Chaihongkum, 2005).

Many teachers lacked enthusiasm for this innovation, failing to conduct and utilize Classroom Research (Khotchasila, 2000). A number of studies have shown that Thai teachers faced many problems in conducting Classroom Research, such as: their lack of knowledge about how best to enact the process (ONEC, 2001b; Thathong and Thathong, 2002; Youjaiyen, 2002; Boonnak, 2005; Tarin, 2005; Wongwanich, 2007); the problems of conducting Classroom Research separately from their daily responsibilities teaching (ONEC, 2001b; Wongwanich, 2007); teachers did not have time to conduct Classroom Research due to overwork (Youjaiyen, 2002; Boonnak, 2005; Tarin, 2005; Wongwanich, 2007); a lack of support from school administration (Boonnak, 2005; Sooksanit, 2005; Tarin, 2005; Wongwanich, 2007); and a lack of data resources and supported budget (Saengsawang, 2002; Boonnak, 2005; Rachayotha, 2005; Sooksanit, 2005; Yunthongyo, 2006).

Although some teachers have attended professional development programs including workshops and seminars about conducting Classroom Research, they still could not conduct Classroom Research (Kitkanjanat, 1999), because the professional development in Thailand is mostly an authoritative top-down system of supervision and the advice usually comes from outside the schools (Pillay, 2002; Wongwanich, 2007) which has been shown mostly not to meet the needs of teachers (Cheangkool, 1999; Jurawatanaton, 2003). Further, a top-down approach to professional development is inconsistent with the principles of Classroom Research. The professional development in Thailand usually focuses on the theory instead of practice, and lacks of follow-up process after the professional development programs have been conducted (Cheangkool, 1999; Jurawatanaton, 2003). Furthermore, the former curriculum of teacher education programs placed emphasis on content and pedagogy courses. The university teachers usually teach by lecturing. Pre-service teachers were not encouraged to acquire the knowledge by themselves; rather, they experienced a transmission view of teaching and act as passive learners. Although teacher education programs have research methodology courses, emphasis is placed on academic research which has its own specific characteristics, so it is very difficult for the beginning teachers to imagine, formulate, or conduct the Classroom Research in their daily lives (ONEC, 2000a; Wongwanich, 2007).

To implement aspects of The National Education Act 1999 and Amendments Second National Education Act B.E. 2545 (2002), there has been a reformation of science teacher education program in Thailand in recent years. The five year pre-service science teacher education program, new curriculum B.E.2547 (2004), was established for training new basic science teachers at the bachelor level. The new science teachers' education programs are aimed at enhancing the status of the teaching profession and increasing the number of qualified science teachers (Silpabanlaeng *et al.*, 2006). The new curriculum requires completion of a five year bachelor's degree, with the first four years dedicated to coursework and a final year devoted to teaching practice at an approved school (Office of the Education Council [OEC], 2006). Pre-service science teachers are assigned to participate in the five field experience courses, which comprise of three practicum courses and two internship courses. The pre-service science teachers start their field experience courses in the second year and continue through the final year of their teacher education program. Throughout their studies, they will continue to observe and practice teaching at various partner schools so that they are expected to integrate their practicum experiences with the campus coursework (Office of Rajabhat Institute Council [ORIC], 2002). While the pre-service science teachers devoted their teaching practice in the final year, they are required to conduct the Classroom Research project and to write up their report in the second semester.

Teacher education institutions are now required to prepare teachers not only to meet classroom demands but also to contribute to the advancement of the society as a whole (Phetchaburi Rajabhat University [PBRU], 2007). As a result, highly theoretical subject matter courses needed to be replaced with blended theory and practice courses that develop knowledge and experiences necessary for student teachers to become effective teachers and lifelong learners upon their graduation (ONEC, 2000a; ONEC, 2000b; ORIC, 2002). To this effect, the practicum (a course designed for learning all varieties of observational and teaching experiences, both in teacher education institutions and in partner schools) is given priority and forms the core of all education courses (ONEC, 2000a; ONEC, 2000b; Degago, 2007). The assumption behind this policy document is that pre-service teachers will be effective

if they are given sufficient time and opportunity to explore teaching methods and practices for themselves through peer teaching and the direct experience of teaching at schools before they become qualified teachers (Degago, 2007).

Classroom Research is an effective way of preparing teachers for the demands of today's classroom, such as caring for all students, teaching heterogeneous classes, fostering learner-centered approaches, and so on (Dedago, 2007). Classroom Research has the potential to develop pre-service teachers' thinking skills because it narrows the gap between theory and practice. Student teaching experiences during the first years in the field are critical to building self-efficacy. New teachers need to be successful; to believe that they can reach and teach their students (Rock and Levin, 2002; Degago, 2007). Zambo and Zambo (2006) studied the beliefs of student teachers at two levels of their education regarding the benefits of Classroom Research and found that it encourages reflection and provides evidence that change has occurred in student teachers. The involvement in Classroom Research helped student teachers understand the complexities of teaching and learning through the process of inquiry (Zambo and Zambo, 2006; Dedago, 2007). Other studies have indicated that if student teachers are involved in Classroom Research during their teacher education programs, they will not only become professionals in the short term but also be likely to continue in this direction throughout their careers (Dedago, 2007).

Involving the pre-service teachers in Classroom Research is a new component in the revised Thai teacher education curriculum (A five-year Bachelor of Education). There are few research projects in Thailand that study about the practice of Classroom Research of the pre-service teachers in a five - year Bachelor of Education. One example was conducted by Srisuantang, Traimongkolgul, Tunpichai, and Yingyuad (2009). They studied the development of Classroom Research potential of the five-year pre-service teachers through the supervision process of cooperating teachers and university supervisors. The pre-service teachers worked collaboratively with the cooperating teachers and university supervisors in developing learning units, learning management strategies, learning assessment task, and the final Classroom Research report. Reflective journals were used to elicit the pre-service teachers' development of

Classroom Research potential and the obstacles they faced in conducting the Classroom Research projects. The research results revealed that the pre-service teachers achieved better understanding in developing learning units, learning management strategies, learning assessment task, and the Classroom Research report. They also achieved worthwhile experience in the practice of critical thinking, planning, and problem-solving skill. The obstacles the pre-service teachers faced were finding time to conduct the Classroom Research project, the lack of collaboration between the cooperating teachers and the university supervisors in supervising the pre-service teachers, and some confusion in conducting the Classroom Research project.

Classroom Research is a current input in Thai teacher education curriculum, but there is little research conducted on pre-service science teachers' practice of Classroom Research. Hence, the researcher is interested to develop the initiative for studying the pre-service science teachers' understanding and practice of Classroom Research during the internship period, the cooperating teachers' and university supervisors' supervision of Classroom Research to the pre-service science teachers, and the factors that support or hinder the pre-service science teachers' practice of Classroom Research.

Research Objectives

This study is designed to study about pre-service science teachers' understanding and practice of Classroom Research, the cooperating teachers and university supervisor supervision of Classroom Research to pre-service teachers, and the factors that support or hinder the pre-service teachers' practice of Classroom Research project during the implementation of the initiative that was developed by the researcher.

Research Questions

The research questions of this study are:

1. What are the pre-service science teachers' understandings of Classroom Research before engaging in the initiative?
2. How do the pre-service science teachers' understanding and practice of Classroom Research evolve over the implementation of the initiative?
3. What supports about Classroom Research do pre-service science teachers receive from the cooperating teachers and university supervisor over the implementation of the initiative?
4. What factors support or hinder the pre-service science teachers' practice of Classroom Research?

Anticipated Outcomes

The anticipated outcomes of this study are as follows: (i) to provide the information to the teacher education institutions about the support that they should give to the pre-service science teachers for conducting Classroom Research; (ii) to engage pre-service science teachers to teach intellectually and practically while exercising the judgment from their own teaching experiences through the process of Classroom Research; and (iii) to encourage teacher education institutions to use Classroom Research as a powerful method of professional development for the pre-service science teachers.

Delimitation of the Study

Research site:

The research was coordinated by a university situated in western Thailand and the participating schools, which signed the contact with the university to serve as the professional development school for the pre-service teachers to practice their teaching during the internship period, in the 2009 academic year.

Participants:

The pre-service science teachers

Three pre-service science teachers who have been studying in the final year of the five year pre-service science teacher education program, the new curriculum B.E.2547 (2004), for preparing Physics, Chemistry, Biology, and General Science for the Bachelor of Education (Teaching Science) degree in the 2009 academic year.

The cooperating teachers

The three cooperating teachers are in-service science teachers who are officially assigned from lower-secondary schools to supervise the pre-service science teachers during their internship courses in the 2009 academic year in the aforementioned schools. The schools are in a province in western Thailand.

The university supervisor

One university supervisor who is officially assigned from the Westernthani University (pseudonyms), to supervise the three pre-service science teachers during their internship period in the schools in the 2009 academic year.

Definition of Terms

Important terms introduced in this study are operationally defined as follows.

The initiative for enhancing the pre-service science teachers'

understanding and practice of Classroom Research means the researcher's plan to help the cooperating teachers and university supervisor in supervising the pre-service science teachers to conduct the Classroom Research project. The researcher develops the Supervision Handbook of Classroom Research (SHCR) and organizes the workshop for enhancing the cooperating teachers' and university supervisor's understanding of Classroom Research and for guiding them to use the SHCR to supervise the pre-service science teachers how to conduct a Classroom Research project. The SHCR comprises of seven topics: general concept of Classroom Research, generating research question, reviewing literature, developing the research plan and research instruments, collecting data, analyzing data, and writing a Classroom Research report. The researcher follows through the plan to study the impact of the initiative on pre-service teachers' practice of Classroom Research, the cooperating teachers' and university supervisor's supervision of Classroom Research to pre-service teachers, the development of pre-service teachers' understanding of Classroom Research, and the factors supporting or hindering the pre-service science teachers' practice of Classroom Research.

Understanding of Classroom Research means the ability to explain the concept of Classroom Research, and to explain how to conduct a Classroom Research project in each stage. The stages for conducting Classroom Research in this study is clarified into six stages: generating research question; reviewing literature; developing the research instrument; collecting data; analyzing data; and writing a Classroom Research report. Understanding of Classroom Research is reflected through the responses of the pre-service science teachers in the journal entries, Classroom Research report, and questions in the questionnaire and individual interviews.

Practice of Classroom Research means the performance of pre-service science teachers in generating research question, reviewing literature, developing the research plan and research instruments, collecting data, analyzing data, and writing a Classroom Research report. Practice of Classroom Research is revealed through journal entries, interview, observation, and the pre-service teachers' Classroom Research report.

Supports from the cooperating teachers and university supervisor means the supervision from the cooperating teachers and university supervisor to help the pre-service science teachers generate research question, review literature, develop the research plan and research instruments, collect data, analyze data, and write a Classroom Research report. Supports from the cooperating teachers and university supervisor are revealed through their journal entries and interview.

The factors that support or hinder the pre-service science teachers' practice of Classroom Research means the factors that promote or obstruct the pre-service science teachers' practice of Classroom Research include those things that influence the pre-service science teachers to conduct Classroom Research during the internship settings. These factors are revealed through semi-structured interviews with the pre-service science teachers, cooperating teachers, and university supervisor and their journal entries.

Summary

This introductory chapter discusses the statement of the problem in this study noting that Thailand's current educational reform came from the shock of the Asian economic crisis in 1997. The National Education Act 1999 and Amendments Second National Education Act B.E. 2545 (2002) are the frameworks providing principles and guidelines for the provision and development of Thai education. According to the education reform, Thai teachers need to emphasize a learner-centered approach to learning. In this approach, the teaching and learning process takes into consideration the students' interests, aptitudes, pace, and potential for learning. Science teachers

have to shift their role away from a teacher-centered director towards a learner-centered facilitator. Classroom Research is seen as an important tool to discover which methods of teaching and learning are appropriate for their students. Classroom Research can be used to link theory and practice in education, empower teachers to become agents of change, and enhance professional growth. Unfortunately, a number of teachers in Thailand have difficulties in conducting Classroom Research needed to develop suitable learning contexts for learners and to develop professional knowledge and skills in their careers. This reason has led to the reformation of teacher education in Thailand in recent years.

The five year pre-service science teacher education program was established for preparing new basic science teachers at the bachelor level. While pre-service science teachers have devoted their teaching practice to the final year, Classroom Research is included as the component of their second internship course. Involving pre-service teachers in Classroom Research is a new component in Thai teacher education program, and not much research has been conducted to learn about the pre-service science teachers' understanding and practice of Classroom Research. Hence, the researcher is interested to develop the initiative for studying the pre-service science teachers' understanding and practice of Classroom Research during the internship period, the cooperating teachers' and university supervisor's supervision of Classroom Research to the pre-service science teachers, and the factors that support or hinder the pre-service science teachers' practice of Classroom Research. The findings of this study are beneficial not only in suggesting theoretical and practical guidelines for pre-service science teachers, cooperating teachers, and university supervisor who are related to the professional development, but the characteristics of an effective initiative for enhancing the pre-service science teachers' understanding and practice of Classroom Research are also available for consideration by others in similar teacher education contexts.

This study also expects to provide a productive learning environment for the pre-service science teachers. This hopefully results in the preparation of effective

science teachers that can use Classroom Research as a strategy to improve their teaching practice and to enhance the students' learning.



CHAPTER II

LITERATURE REVIEW

Overview of the Chapter

The first two sections of this chapter comprise a literature review of science education in Thailand, and pre-service science teacher education programs in Thailand. These sections conclude with a discussion of the problems in the former pre-service science teacher education program and the aims of the new pre-service science teacher education program in Thailand. The third section is a review of using Classroom Research in pre-service teacher education. It begins with the conceptualization of Classroom Research, the characteristics of Classroom Research and is followed by a discussion of the literature review regarding Classroom Research process and the significance of Classroom Research in pre-service teacher education. The objective here is to discuss the purposes, the benefits, and the impact of Classroom Research on pre-service science teacher education. In the fourth section, the role of university supervisor and cooperating teacher for supervising pre-service teacher are discussed and used to guide the researcher towards a definition and design for the initiative to enhance pre-service science teachers' ability to conduct Classroom Research. In the last section, the relevance research on engaging pre-service teacher in Classroom Research Project is provided.

Science Education in Thailand

Science Education Reform

Science education reform in Thailand has been occurring since 1997, according to the national education reform. The reason for having the national education reform comes from the economic and financial crisis that has hit Thailand in recent years. The economic crisis revealed that Thailand has deficiencies in many

areas including a lack of graduates competent in higher order thinking skills, science and technology skills, and vocational skills (ONEC, 2002a; NESDB, 2007). These deficiencies encouraged a reformation in the Thai educational system. In developing the Thai educational system, the Constitution of the Kingdom of Thailand 1997 (Office of the Council of State [OCS], 2002), and the National Education Act B.E. 2542 (1999) and Amendments Second National Education Act B.E. 2545 (2002) (ONEC, 2002b) played a vital role in education reform. In the 1997 Constitution, education is seen as a major tool for developing the quality of life for Thai people. Section 81, specifically referring to education reform, requires the state to:

Provide education to attain knowledge and morality; issue a national education law for national education development; improve education in harmony with economic and social change; create and strengthen knowledge and inculcate sound awareness of politics and a democratic system of government under a constitutional monarchy; promote research in various disciplines; accelerate the application of science and technology for national development; promote the development of quality of teachers and educational personnel to meet the current changing in the present day world; and encourage the revival of local wisdom, art and culture of the nation. (OCS, 2002: 29)

To follow the Constitution, the National Education Act B.E. 2542 (1999) and Amendments Second National Education Act B.E. 2545 (2002) were established in law and provide frameworks and guidelines for the provision and development of Thai education. The National Education Act includes nine chapters prescribing: the objectives and principles; educational rights and duties; the educational system; national education guidelines; educational administration and management; educational standards and quality assurance; teachers, faculty staff and educational personnel; resources and investment for education; and technologies for education.

The National Education Act emphasizes lifelong learning with a balanced orientation of knowledge, skills and attitudes. The aim is for encouraging all learners

to be able to: adjust to world trends and events; to develop desirable characteristics of the human capability including virtue, competency, intellect, knowledge, happiness, and self-reliance; to enhance the living experience and to fulfill vocational and social aspirations which are intended for certain goals at certain ages (ONEC, 2002a; ONEC, 2002b).

Expected characteristics of science learners

The Institute for the Promotion of Teaching Science and Technology [IPST] (2002a) expects the science learners to be the scientifically literate persons who: understand principles and theories of basic science; understand the boundaries, nature and limitations of science; use skills to inquire and explore science and technology knowledge; develop thinking processes and imagination, ability to solve problems, data management, communicative and decision-making skills; realize the influence and effects of the relationships between science, technology, people and environment; use knowledge of science and technology to advance society and everyday life; and have scientific minds, morality, and values for using science and technology creatively.

The science curriculum framework

The IPST developed the new science curriculum framework which is aimed to help the students achieve scientific literacy. The science curriculum is one subject area out of eight subject areas (Thai Language; Mathematics; Science; Social Studies, Religion, and Culture; Hygienic Education and Physical Education; Arts; Home Economic and Technology; Foreign Languages) in the Basic Education Curriculum (MOE, 2001). The Basic Education Curriculum is the broad framework that provides objectives, curricular strands, standards for curricular content and learning outcomes, and assessment and evaluation methods of teaching and learning in science subject. The science curriculum framework comprises eight curricular strands, covering 12 years of basic education (Grades 1-12). The curricular strands consist of: Living Things and Living Processes; Life and the Environment; Substances and their

Properties; Force and Motion; Energy; Changing Process of the Earth; Astronomy and Space; and the Nature of Science (IPST, 2002a).

The science curriculum framework expects the science teachers to: understand the nature of science and technology; use science and technology with morality and ethically; organize learning experiences which respond to the aptitude, developmental and various interests of the learners; promote inquiry learning to the learners; use diverse learning strategies to respond to the needs of the learners; and be enthusiasts to enhance their professional practice for enhancing teaching skills and learner's learning (IPST, 2002b).

Ways for organizing science learning

There are many issues in Thai science education outlined in the new science curriculum framework. The key issues include: approaches to learning science, the use of instructional media and technology, the assessment and evaluation of student learning, and the encouragement of instructors to carry out research for developing suitable learning for learners. Science learning needs to take into consideration of learners' interests, aptitudes, paces, and potentials (Fry, 2002; IPST, 2002a; ONEC, 2002b; Pillay, 2002). This means a learner-centered learning approach should be emphasized in science classrooms. This learning approach is based on constructivist views of learning which believes that students actively and purposefully construct their own knowledge and teachers do not simply transfer knowledge to students (Brooks and Brooks, 1999; Harcombe, 2001; Fosnot, 2005; Gagnon and Collay, 2006). Individual students connect new information that they encounter in schools with their own existing experiences and consciously participate in the cultural contexts for the construction of knowledge. The students make personal meaning for themselves, discuss and share social meaning with other students and then reflect on their thinking and learning with a teacher.

Based on this constructivist view of learning, the use of a variety of teaching strategies, instructional media, technology and learning resources seem to

significantly enhance students learning of science (Fry, 2002; Pillay, 2002). Assessment and evaluation methods also are the relevant factors that can promote student learning development. To assess student performance, a variety of assessment and evaluation methods are required, such as observation of student development, learning behaviors, participation in activities, self-evaluation, peer-evaluation, and using the results of tests. Furthermore, teachers should use Classroom Research as an important tool to discover which methods of teaching and learning are appropriate for their students in the classroom (IPST, 2002b; Thathong and Thathong, 2002; Wongwanich, 2007; Li, 2008).

The problems in Thai science education reform

The evaluation after the science education reform a few years ago shows that there have been some obstacles which have hindered the success of Thai science education curriculum reform. One is that schools and teachers are not familiar with the new teaching methods used in a learner-centered learning approach. In the results of the Project on Learning Reform Schools for Developing Quality of Learners, Amornvivat (2002) argues that the learning process reform cannot meet with success, unless administrators show academic leadership and are able to provide a management system to support the various activities organized by teachers. The teachers still lack a good understanding of the concepts, principles and processes involved in the new approaches of teaching and learning (Fry, 2002; Pillay, 2002). For example, some teachers understand that activity-based learning is only one method that can be used for teaching in a learner-centred learning approach, and assume that learner-centered learning rejects all memorization (Fry, 2002). Another reason is that the curriculum and teaching provided in the teacher education institutions have not been attuned to actual practice and learning process reforms in the school; the emphasis was mostly on theory rather than practice that was not able to prepare the future teachers in any way for the teaching methods they would be expected to use in the schools (ONEC, 2000a; Amornvivat, 2002). Many research (ONEC, 2000a; ONEC, 2000b; Amornvivat, 2002; Fry, 2002; Pillay, 2002;) suggest that Thai teacher education institutions should revise and reform their curricula and

teaching methods to prepare effective science teachers in coherence with the current education reform movement.

Summary

Science education in Thailand is a part of current educational reform which is aligned with the 1997 Constitution of the Kingdom of Thailand and the National Education Act B.E. 2542 (1999) and Amendments Second National Education Act B.E. 2545 (2002). According to this framework, Thai students are intended to learn science as part of lifelong learning with a balanced orientation of knowledge, skills and attitudes, in order to achieve scientific literacy. To achieve scientific literacy, a new science curriculum has been formulated based on a learner-centered learning approach. All approaches in learning science, for example, the use of instructional media and technology, the assessment and evaluation of student learning, and the teachers' teaching practice should follow the constructivist views of learning and teaching. However, some teachers are not familiar with, and lack an understanding of these new teaching and learning perspectives and activities. Therefore, it is necessary to have a reformation of science teacher education program in Thailand for preparing a new generation of science teachers for quality of science teaching following the current educational reform mandates.

In the next section, the pre-service science teacher education programs in Thailand is discussed including the former pre-service science teacher education programs and the new pre-service science teacher education programs. This discussion provides the framework of pre-service science teacher education programs in Thailand from the former time until today. The new pre-service science teacher education programs in Thailand expects pre-service science teachers to link the theory they learn in methods courses with the practice they gain in the field experience courses from the beginning of their studies and throughout their pre-service teacher education program.

Pre-Service Science Teacher Education Programs in Thailand

The Former Pre-Service Science Teacher Education Program

The organization of the pre-service science teacher education program

The former pre-service science teacher education program was based on a four-year pre-service teacher education curriculum which had been used up until the 2004 academic year. The purpose of this pre-service science teacher education program was to enhance pre-service science teachers' professional knowledge and it typically required between 120 to 150 credit hours for graduation (Rochanasamita, 2006). The curriculum consisted of three main types of core courses including general education courses, specialized courses, and free elective courses. The general education courses were in the areas of social science, humanities, languages, mathematics and science with total credit not less than 30 hours. The specialized courses were in the areas of science content, teacher profession, and professional training. The total credit hours were not less than 84 hours. Science content was a major part of this course category. In term of specialized courses, pre-service science teachers also study general issues in curriculum and instruction, codes of ethics for the teacher, basic concepts of education, principles of education evaluation and assessment, educational psychology, introduction to educational technology, a seminar in science teaching, and field experiences. The elective courses were chosen by the pre-service teachers based on their own interests that required at least 7 credit hours (Roadrangka, 2004).

After finishing their methods courses, the pre-service science teachers had one semester, 18 weeks, for the student teaching practicum in a professional development school. They were expected to teach science 8-12 hours per week. This experience offered pre-service science teachers the opportunity to link the theory into practice by blending their knowledge of content, curriculum, pedagogy, student psychology, instructional media, and assessment strategies to help students understand the concept of science to the best of their abilities (Roadrangka, 2004).

Problems in the former pre-service science teacher education program

Many research have shown that there are problems with the four-year pre-service science teacher education program in Thailand (ONEC, 2000a; ONEC, 2000b; Rochanasmita and Roadrangka, 2006; Roadrangka and Srisukvattananan, 2002). The problems include:

- Failure to support cooperating teachers with their supervision role;
- Pre-service science teachers were not encouraged to contribute to their own learning; rather, they experienced a transmission view of teaching and were expected to listen passively;
- Pre-service science teachers accumulate factual information to pass an examination at the end of the semester with little thought as to what might be required after the examination;
- Insufficient science content understanding;
- An inability to write lesson plans based on learner-centered learning approach;
- The problem of constructing and selecting appropriate instructional media in each content area;
- The challenge of teaching science by emphasizing science process skills and the nature of science and;
- The limitation of number of professional development schools.

The incoherence between campus courses and practicum experiences

Research indicates that campus courses were treated separately from practicum experiences which reinforced the gap between theory and practice. For instance, the pre-service teachers were asked to put into practice of the theoretical knowledge that they gained from the campus courses only one time when they carried out student teaching in the schools at the final semester of their education program. Thus, overall there was no room to integrate school experiences with campus courses, nor was there the opportunity to address issues from school in campus courses (ONEC, 2000a). Research in foreign countries support these findings in that most pre-

service teachers develop a utilitarian perspective about teaching as they progress through their pre-service teacher education program. That is, while their attitudes may become more progressive as they take coursework in education (Goodman, 1986; Zeichner, 1980) their experiences in public schools during internships encourage them to focus on learning "what works" with little consideration of broader educational objectives and principles (Ward and McCotter, 2004). Consequently, as Ross (1987: 131) argues, "when most of pre-service teachers complete their final field experiences they have become '*passive technicians*' who merely learn to execute prepackaged instructional programs. Rather than becoming more reflective, they learn to accept uncritically the practices of their cooperating teachers."

Work by Faikhamta and Roadrangka (2005) shows that the professional experience training program failed to promote pre-service science teachers' self confidence in the aspects of teaching preparation, preparing instructional media, understanding students learning, and being familiar with the school atmosphere. They also had problems in designing the learning activities to fit the science content and student abilities; creating instructional materials to suit the science content; using questioning techniques to elicit student prior knowledge; and concluding lessons by showing the interrelationships of science concepts. The most salient complaint from pre-service teachers about their teacher education program is that it does not prepare them for the complex reality they face in their first years of teaching. Correspondingly Brock (1996) found that the old traditional approach to pre-service teacher education was not able to prepare the young future teachers in any way for the teaching methods they would encounter in the schools.

These results encourage a consideration of the reformation of Thai pre-service science teacher education programs following the National Education Act B.E. 2542 (1999) and Amendments Second National Education Act B.E. 2545 (2002). The new teacher education program has been in effect since 2004. The key changes include switching from a four-year to a five-year pre-service teacher education program which includes four years of course work and one additional year in the school for

student teaching. This has increased the total credit hours from 120 – 150 required pre-2004 to not less than 160 credit hours.

Summary

The former pre-service science teacher education program in Thailand was a four-year pre-service teacher education program which was used up until the 2004 academic year. The purpose of this pre-service teacher education program was to enhance pre-service science teachers' professional knowledge. This pre-service teacher education program emphasized the transmission of knowledge to pre-service science teachers and paid attention to theory more than practice. Campus courses were treated separately from practicum experiences. Significant research has shown the ineffectiveness of this program, specifically that it did not prepare the pre-service science teachers to have self-confidence in designing the learning activities, in preparing instructional media, and so on. These studies lead to the development of a new pre-service science teacher education program in Thailand post-2004. The most significant change is the extension from a four-year to a five-year pre-service science teacher education program. The following section will discuss the new pre-service science teacher education program.

The New Pre-Service Science Teacher Education Program

Numerous teacher educators have documented the need for teacher education programs which focuses on helping pre-service teachers become more reflective about teaching (ONEC, 2000a; Price, 2001; Chant *et. al.*, 2004; Smith and Sela, 2005; Moore, 2006; Singh, 2008). Developing this ability to reflect about their practice requires pre-service teachers to learn to question their own practices, consider alternatives, and view teaching as a problem-solving process that involves the consideration of multiple variables and multiple solutions. Although there are many interests and concerns from teacher educators, little is known about how to help pre-service teachers develop this habit of reflection (Carboni, Wynn, and McGuire, 2007). Under the educational reform movements in recent years in Thailand, there have been

several claims to change the ways of educating young future teachers, with a belief that teachers play a significant role the betterment of society. As stated in the policy document for pre-service teacher education issued in 2000 by Office of the National Education Commission (ONEC), "Teachers are essentially agents for positive societal change. They are expected to be a community leader who have up to date knowledge and try to develop their knowledge and teaching practice all the time for the most successful of educational reform" (ONEC, 2000a: 9).

The development of a new pre-service science teacher education program

The problem that the former pre-service science teacher education program could not prepare the pre-service science teachers to teach in way that corresponded to the science education reform led to the development of a new pre-service science teacher education program. The new pre-service science teacher education program, a five-year pre-service science teacher education program, was used in 2004. The new pre-service science teacher education program is derived from a former four-year pre-service science teacher education program. The new pre-service science teacher education program is aimed at enhancing the status of the teaching profession and increasing the number of qualified science teachers (Silpabanlaeng *et al.*, 2006). The pre-service teachers in the five-year pre-service teacher education program study coursework for four years and spend a further year in a partner school for their student teaching in the internship courses (OEC, 2006). The field experiences courses provide to pre-service science teachers are the culminating experience based on a gradual immersion in the field throughout the previous four years. This idea corresponds to Brock (1999) who argues that locating pre-service teacher education in schools is valuable since schools are uniquely qualified to show how teaching is done. The pre-service teachers should be provided with adequate practice and time for reflection in the real classroom atmosphere. Involvement in real classroom circumstances encourages pre-service teachers' own professional development and bridges the gap between theory and practice. This means that the pre-service teachers' education

program should be structured along a more competency based approach by increasing time in the practicum setting.

The new pre-service teacher education programs introduce a big challenge to all teacher education institutions in Thailand. Specifically, it requires them to redefine their education programs. The teacher education institutions are now required to prepare future teachers not only to meet classroom demands but also to develop new skills, knowledge, and the ability to reflect on their own practice. The policy requires the education system to make a shift from the transmission of knowledge to a focus on individuals' constructing of knowledge and facilitating the development of higher order thinking (ONEC, 2000a). To this effect, the field experience courses (the courses designed for learning all varieties of observational and teaching practice experiences, both in teacher education institutions and in partner schools) are given priority and form the core of the pre-service teachers' education program. The assumption behind this policy is that pre-service teachers will be effective if they are given sufficient time and opportunity to explore teaching methods and practices for themselves through the direct experience of teaching at schools before they become the qualified teachers in the future (ORIC, 2002). To ensure the most benefit, they also need support from cooperating teachers and university supervisors to track their progress and suggest strengths and weaknesses of their teaching practice (Degago, 2007).

The organization of the new pre-service science teacher education program

The pre-service science teachers in the new pre-service teacher education program require at least 160 credit hours for graduation in the bachelor degree of Education (Teaching Science). The curriculum consists of three main types of core courses including general education courses, specialized courses, and free elective courses. The general education courses are in the areas of social science, humanities, languages, mathematics and science with total credit not less than 30 hours. The specialized courses are in the areas of specialized science content, teacher profession,

and professional training. The total credit hours are not less than 136 hours. The specialized science content means the content for Physics, Chemistry, and Biology depending on each pre-service science teachers' major. The term teacher profession is associated with the study about curriculum and instruction, codes of ethics for the teacher, basic concepts of education, principle of education evaluation and assessment, educational psychology, introduction to educational technology, a seminar in science teaching, and field experiences. The elective courses are chosen by the pre-service teachers based on their own interests that required at least 6 credit hours (PBRU, 2007).

The professional training represents to field experience courses which consist of five courses as outlined in the following table 1.

Table 1 The field experience courses for pre-service science teachers in a five year pre-service science teacher education program

Code	Course	Unit
PROF 101	Practicum 1	3
PROF 102	Practicum 2	3
PROF 103	Practicum 3	3
PROF 104	Internship 1	8
PROF 105	Internship 2	8
	Total	25

As outlined in the table, pre-service science teachers are expected to complete three consecutive practicum courses followed by two internship courses from the beginning of the pre-service teacher education program. The practicum courses require the pre-service teachers to observe and participate in the school atmosphere. The time spent varies from a few hours to half or a whole day. The internship courses require the pre-service teachers to devote full time to their student teaching in the schools. Throughout their studies and work, they are carefully guided in their reflections which aim to develop the competencies necessary for teaching in a bottom-up rather than top-down manner. Pre-service science teachers will be informed about

their learning activities when they go to observe in the partner schools. They will continue to observe and practice teaching at partner school so that they will be able to integrate their practicum experiences with the campus coursework (ORIC, 2002).

Classroom Research is included as a component of the internship courses. Pre-service science teachers are required to conduct a Classroom Research project and to write up a report during the internship course in the second term of the final year of their education program (PBRU, 2007). Classroom Research is a new component of Thailand's new pre-service science teacher education program with the purpose of studying and solving problems during pre-service science teachers' student teaching. Furthermore, by involving pre-service science teachers in Classroom Research, it is expected to improve their teaching and to develop professional knowledge and skills in their life long careers (IPST, 2002b; MOE, 2002; Wongwanich, 2007). Classroom Research can foster skills of inquiry and reflection in pre-service teachers (Mertler, 2006; Wongwanich, 2007; Johnson, 2008). Price (2001) explains that through the involvement in the research process, pre-service teachers can establish the habit and skills of reflection regarding their own practices and thereby be able to continue to learn from their own experiences (and others) and become better at teaching throughout their careers. Engagement with research becomes a process of individual and collective reflection and inquiry that helps pre-service teachers become more critical and analytical (Zambo and Zambo, 2006). Through their inquiries, pre-service teachers begin to explore simultaneously the intellectual and cultural dimensions of their students' experiences in classrooms, pedagogical content knowledge, and the larger political and social issues of teaching and schooling (Price, 2001). University supervisors and cooperative teachers use the pre-service teachers' reflections about their practical experiences as a basis for successful attainment of teaching competences (Smith and Sela, 2005).

Summary

The new pre-service science teacher education program in Thailand is aimed at enhancing the status of the teaching profession and increasing the number of

qualified science teachers. It emphasizes more of a competency based approach by increasing time in the internship setting from one semester to two semesters. The new pre-service science teacher education program increases the credit hours in the specialized courses which include the course about specialized science content, the teaching profession, and professional training from 84 credit hours to be 136 credit hours. Conducting Classroom Research is a new component that has been introduced into the new pre-service science teacher education program for the intention of promoting pre-service science teachers' critical and analytical thinking, reflecting on their own practices, collegial discussion, and problem solving skills. The author will clarify more details about Classroom Research in the next section.

Classroom Research

Common Ideas of Classroom Research

The general meaning of Classroom Research is research that is conducted by the teachers for improving their own teaching practices and to enhance the students learning (Tabachnick and Zeichner, 1998). There are numerous educators defined the meaning of Classroom Research in terms similar to the followings set of descriptions:

Classroom Research is a research undertaken by teachers in order to increase the understanding of their own teaching practice and/or to increase the capability in solving problems and making decisions. The essential characteristic of Classroom Research is that it is conducted by the teachers in their classroom context. The problems studied emerge from the classroom situation in daily life teaching (Noffke and Zeichner, 1987: 1).

Classroom Research can be framed from two points of view. The first is ownership - Classroom Research is more often initiated and implemented by the teachers themselves, than by outside persons, to solve the problems in real classroom settings. The second point of view is focus – Classroom Research has the limitation of

specific application only in the context that the teachers are undertaking it (Wallace, 1996: 291).

Classroom Research is a collaborative process between teachers and their peers in terms of discussing, exchanging ideas, and reflecting on each teacher's practice. Classroom Research intends to learn about how to improve one's teaching practice by collecting and analyzing the data of daily life in classroom (Cochran-Smith and Lytle, 1999: 17).

Classroom Research is research that is conducted by teachers to find the solution of a local problem in the classroom and immediately apply the research results to develop the teachers' teaching practices for the most benefit of their students. Classroom Research helps teachers clarify their implicit assumptions about teaching and learning (Wongwanich, 2007: 21).

Classroom Research is conceived as a small scale intervention conducted by the teacher for investigating alternative strategies or innovations to solve the problem in the classroom and for developing student's learning. A close examination of the effects of such an intervention enables teachers to constantly improve their action in a systematic manner (Ritjaroon, 2001: 24). Classroom Research can be seen as the research and development approach due to its trying to build new knowledge or new innovations to solve the problems in the field of education (Tanya, 2004: 12).

Classroom Research is unique because it involves teachers in a systematic procedure for improving their classroom; it views teachers as researchers, evaluators and change agents of their own situations who are enabled to find an appropriate solution that is immediately applied and put into action. Teachers who conduct Classroom Research will gain more understanding about their students and improve the quality of their teaching practice. There are four basic themes in conducting Classroom Research: empowerment of teachers; collaboration; acquisition of knowledge; and producing change (Mills, 2006: 42-43).

In this study, Classroom Research means the research that is conducted by pre-service teachers to solve the problems in their classroom and/or to improve the quality of their teaching practice. The insights they gain from conducting Classroom Research project will lead them to analyze and improve their teaching practice and to understand how their students learn.

The characteristics of Classroom Research

Educators agree that there are many aspects of Classroom Research which characterize its uniqueness from the other types of educational research. The following list, compiled from several sources (Cohen, Manion, and Morrison, 2003; Tanya, 2004; Mertler, 2006; Carboni *et. al*, 2007; Mills, 2006; Wongwanich, 2007; Johnson, 2008), is an attempt to describe what Classroom Research *is*.

- Classroom Research often involves solving practical problems and exploring classroom issues. Teachers do not need to prepare specific research questions that they want to study, but the research question typically emerges from problems that occur in the classroom while they are teaching.
- Classroom Research is persuasive and authoritative in local contexts, since it is done by teachers for teachers. Teachers try to investigate the appropriate solutions or test their own ideas to solve their classroom problems and directly use the research results in their own situations. The teachers deliberately monitor the actions and circumstances in real situation for retrospectively reconstructing an interpretation of the action as a basis for future action.
- Classroom Research is participative, since teachers are integral members of the research process and they usually conduct the research parallel with their daily teaching. In this sense, teachers are engaging in a participatory self-reflective process in which they focus on their own classrooms, schools, or practices.

- Classroom Research is a collaborative process; that is, it is composed of teachers talking, working, and sharing the construction of knowledge together to empower relationships and to improve their own practices. Discussion among peers can provide a greater understanding of research techniques, the development of communities of practice, and the goals of the Classroom Research. During this collaboration process, roles may vary and be negotiated, but the concept of interacting is central to understanding one's practices.

- Classroom Research is systematically inquiry for producing acceptable research results. It requires teachers undertake critical reflection at each step in the inquiry process. Teachers are encouraged to reflect on what they can do to improve their own educational practices.

- Classroom Research is dynamic; change is an inherent part of the Classroom Research process.

- Sharing Research - Unlike traditional researchers that usually report their finding in journals or book publications, Classroom Researchers often share findings with teachers, local schools, communities, and other educational personals in face-to-face meeting. Classroom Researchers are typically more interested in sharing information locally with individuals who can promote change or enact plans within their classroom or local school. In addition, online journals (both with and without standards for inclusion), websites, and list-serves are other sources that provide great opportunities for Classroom Researchers to share their studies with other people.

Of equal importance that educators also clarify is what Classroom Research *is not* (Mertler, 2006; Mills, 2006; Johnson, 2008):

- Classroom Research *is not* a common task that teachers do while they are teaching; it is more systematic and more collaborative.

- Classroom Research *is not* done by other people; it is research done by teachers on their own classroom context.

- Classroom Research *is not* the simple execution of predetermined answers to educational questions; it explores, discovers, and attempts to find creative solutions to educational problems.

- Classroom Research *is not* certain; the results of Classroom Research are neither right nor wrong but rather tentative solutions in the specific context which based on observations and other data collection methods. It requires further monitoring and evaluation in order to identify strengths and limitations.

- Classroom Research *is not* something that occurs in a short period of time; it is an iterative process that involved the long term systemic examination of the instructional process which effects student learning. Teachers are usually looking for ways to improve their instructional practice.

In summary, Classroom Research is a form of inquiry undertaken by teachers in order to (a) improve their own educational practices, and (b) gain their understanding of these practices and the situations in which the practices are carried out. The Classroom Research framework is most appropriate in contexts and for teachers who identify and recognize the existence of shortcomings in their educational practices and who would like to adopt some initial ideas to formulate a plan and carry out an intervention and to evaluate the outcomes of an intervention.

The Stage for Conducting Classroom Research

In the previous sections, I have defined the meaning of Classroom Research and its components, and described the characteristics of Classroom Research. Now I will explore the stages for conducting Classroom Research. Many educators defined the stages for conducting Classroom Research with the following examples.

Wallace (1996) clarified four stages of conducting Classroom Research project: planning, acting, observing, and reflecting. Planning includes problem analysis and setting a strategic plan. Acting refers to the implementation of the strategy planned. Observing includes an evaluation of the action by using appropriate methods and techniques. Reflecting is done on the results of the evaluation and on the whole Classroom Research process.

Sagor (2005) presented a four-stage of Classroom Research that includes clarifying vision and targets, articulating theories, implementation and collecting data, and reflecting on data. Stage one comprises of three components: identify a focus, select achievement targets, and establish assessment criteria. Stage two engages the teachers in the literature for articulating a theory of action that can approach the greatest potential for the achievement of targets. Stage three is about taking action and collecting data. Lastly, stage four is the data analysis regarding the impact of action on the achievement targets.

Johnson (2008) mentioned six stages in conducting Classroom Research which includes: exploring the problem and generating research question, reviewing the related literature, developing the research plan and research instrument, collecting data; analyzing data; and writing research report.

My purpose in presenting this topic is to clarify the stages in conducting a Classroom Research project. I would like to demonstrate that despite there being many stages in conducting a Classroom Research project are presented by various educators above; in fact they share more similarities than differences. The common elements of these stages are: a sense of purpose based on a problem or area of focus (identifying an area of focus), observation or monitoring of practice (data collection), synthesis of information gathered (data analysis and interpretation), and sharing the results with other.

These shared elements are the basis for the researcher to elaborate the stage of conducting a Classroom Research project that will be introduced to the pre-service

teachers in the current study. In this study, the researcher employs the stages of conducting Classroom Research project which are proposed by Johnson (2008) for developing the Supervision Handbook of Classroom Research (SHCR) because Johnson has obviously clarified each stage of a Classroom Research project that is easy to understand. These stages can help the cooperating teachers and the university supervisor supervise the pre-service science teachers to conduct a Classroom Research projects step by step. The details of each stage are described below.

1) Generating the research question

Generating the research question is the first step for conducting a Classroom Research project. This stage is the initial point for developing the plan to address a problem or enhance the quality of instruction. Pre-service teachers should decide what to study by identifying a problem or defining an area of interest for further exploration. They should find something that they are curious about or they would like to examine in depth. In order to investigate a topic for Classroom Research, the research topic must be manageable. The pre-service teachers should take into consideration the restriction of time and their skill levels of data collection and data analysis.

2) Reviewing literature

These means setting the problem or research topic in a theoretical framework by looking in research journals, books, dissertations, school or district documents, and web sources to see what others have found out or have to say about the research topic. Relating research topics to current theories gives pre-service teachers more information and provides a theoretical framework for their findings. It also enables them to link theory and practice by connecting what they find in the literature to what is happening in their classroom. The purpose of reviewing this information is to help pre-service teachers make informed decisions about the research focus and plan. It provides guidance for defining or limiting the problem, for

selecting instruments for collecting data, and for determining techniques to analyze the data.

3) Developing the research plan and research instruments

In this step, pre-service teachers develop the research plan and research instruments for implementing their study. Specifically, it is the determination of the research design, the specific data to be collected and how to actually collect it. In other words, decisions must be made about the research instruments that will be used in the study. Questions pre-service teachers should consider are: What research question(s) are they going to study? What data need to answer the research question(s) How can data be collected? How to develop the research instruments? Classroom Research is systematic; therefore, data collection must be focused, and decisions about data collection methods must be determined before implementing the actual plan.

4) Collecting data

The pre-service teachers can use many kinds of data collection methods to collect the data for their Classroom Research project such as observations, interviews, questionnaires, the analysis of existing documents or records, tests, and other forms of evaluation. One important thing that should be remembered is that the collected data must relate directly to the research question(s) that can provide the answer to the research question(s).

5) Analyzing data

Data analysis in the Classroom Research process typically begins during data collection, and continues throughout the remainder of the process of collecting data and beyond. While pre-service teachers are collecting their data, they should analyze the data at the same time by looking for themes, categories, or patterns that emerge. Decisions about which type of data analysis to use are based on whether the

data are qualitative or quantitative. It is imperative for pre-service teachers to remember that the analysis of data must match the research question(s) being addressed, and hopefully answered, by the study.

6) Writing a research report

This step is about presenting the facts or findings of the research. The research report should include an overview with detailed descriptions and illustrative samples of important events, activities, and responses. The pre-service teachers should provide answers for their research question and also report the themes that emerge from their study. They should describe what they saw and providing examples that demonstrate their perceptions, what the conclusion are, and the recommendations for further study.

Classroom Research in Pre-Service Teacher Education

Current thought on pre-service teacher education is based on the premise that learning to teach is an ongoing process of lifelong professional learning. It is time to find ways to move beyond the top-down training models of teacher education to models that support learner-centered views of teaching (Smith and Sela, 2005). The pre-service teacher education programs should not only enable teacher candidates to start teaching with competence and confidence but also provide them with the tools and understanding for further development. This position is argued on the basis that teaching is overwhelmingly complex and requires practitioners to exercise their professional judgment in deciding how to act in contemporary classroom situations on an ongoing basis (Degago, 2007). The goal of a learner-centered approach is intended to help pre-service teachers develop their habits of teaching by looking retrospectively on the teaching that has occurred; reconstructing, re-enacting and recapturing events, and critically analyzing their students' and their own performances, with explanations supported by evidence (Price, 2001). This approach to teaching is consistent with a Classroom Research approach to studying one's own practice.

It is impossible to prepare young future teachers to be ready for every situation and problem they might encounter. Instead of a ‘cookbook’ approach to teacher education, pre-service teachers need to be empowered and provided with tools through which they are able to diagnose the challenge and know where and how to look for solutions. In the past thirty years, Classroom Research has been introduced as a tool which teacher educators can use to provide help and support to pre-service teachers during the beginning period of their teaching practice (Smith and Sela, 2005).

Classroom Research Empowers the Potential of Pre-Service Teachers

Classroom Research has been defined as the attempt by pre-service teachers to improve their practices as a result of classroom experiences. Classroom Research lays the foundation for long-term practices of observation, reflective thinking, and helping pre-service teachers to make the teacher-researcher role more flexible and accessible (Price, 2001). Numerous studies have indicated that teacher candidates who conduct Classroom Research as part of their education programs can improve teaching dramatically (Valli, 2000; Price, 2001; Levin and Rock, 2003; Price and Valli, 2005; Smith and Sela, 2005; Degago, 2007). Classroom Research assists pre-service teachers in systematically documenting practical experiences with the aim of improving practice, thus bringing pre-service teachers’ tacit expertise to a level of awareness that enables them to develop and make explicit their personal practical theory of teaching throughout their careers (Smith and Sela, 2005). Furthermore, Classroom Research also helps pre-service teachers become better decision makers, and helps pre-service teachers view teaching as a form of experimentation or inquiry (Ross, 1987).

Engaging in Classroom Research has the potential to broaden and transform pre-service teachers’ conceptions of research. The challenge for pre-service teachers is not only one of learning about the research process and raising research questions, but simultaneously one of helping them forge agendas that serve their needs, goals, and commitments. This means providing experiences and orientation towards research and teaching that are rooted in their lives as teachers, as learners of teaching and

research, and as intellectual and emotional nurturers of children. In essence, Classroom Research becomes a study of their relationship with students in schools, with curriculum, and their emerging pedagogies.

Another important goal for pre-service teachers is to examine critically the kinds of communities they develop with their students in the classroom, and their colleagues in the school, the broader community, and beyond. This involves exploring issues of representation in curriculum and pedagogy and power relations in knowledge production (Price, 2001; Rock and Levin, 2002). The transition from student to teacher can be eased and supported by doing Classroom Research. Classroom Research sharpens pre-service teachers' reasoning capabilities and facilitates the development of dispositions to self-monitor. It provides pre-service teachers with an opportunity to become more flexible and open minded and to become aware of their own practices, of the gaps between their beliefs and practices and of what their pupils are thinking, feeling, and learning (Price, 2001; Smith and Sela, 2005; Zambo and Zambo, 2006).

Studies reporting the use of Classroom Research with pre-service teachers present a number of interesting findings. New teachers have been found to undergo observable professional development through doing Classroom Research (Levin and Rock, 2003). They came to understand the importance of research in the classroom and to recognize themselves as the researchers (Ginns, Heirdsfield, Atweh, and Watters, 2001). In addition, pre-service teachers also report their learning in the area of curriculum content, collaboration, and the Classroom Research process (Levin and Rock, 2003; Smith and Sela, 2005). They show real change that is taking place in their classrooms which makes them feel they have succeeded in fulfilling the goals they had set themselves as the effective teachers (Valli, 2000; Price, 2001).

Clearly, the benefits of Classroom Research are becoming well recognized and have prompted the call to include Classroom Research as part of pre-service teacher education in many countries around the world. Classroom Research is an effective way of preparing teachers for the demands of today's world. Having Classroom

Research as a component of pre-service teacher education is an effective way to promote pre-service teachers integration of theory into practice because, while reflecting on their experiences, pre-service teachers can bridge the gap between the realities of school and their campus courses. Voluminous studies have indicated that if pre-service teachers are involved in Classroom Research during their internship period, they will not only become professionals during their early years as teachers but will also be likely to continue in this direction throughout their careers. Engaging pre-service teachers in Classroom Research projects encourage them to focus on observations of students, and observations of their own practice (MacIntyre, 2000; Spilkova, 2001; Levin and Rock, 2003; Smith and Sela, 2005; Zambo and Zambo, 2006).

Classroom Research Promotes the Collaboration Between School and University Personnel

Classroom Research can serve as a vehicle through which pre-service teachers, in-service teachers, and university faculty can work together. On the one hand, schools and cooperating teachers can provide real-world experiences for pre-service teachers and university faculty. On the other hand, pre-service teachers and university faculty provide schools and cooperating teachers with the access to current best practices. Through a collaborative Classroom Research process, pre-service teachers, cooperating teachers, and university faculty can collaboratively work towards a common goal for enhancing student learning. Strategies for introducing Classroom Research into a pre-service teacher education program must be based on sensitivity to the student's interest, the concerns of public school systems, and the demands on faculty time. At the same time, strategies should provide the opportunity for pre-service teachers to engage in worthwhile projects and to develop needed skills so that the research activities will foster their professional knowledge growth, and collaboration between all partners.

The Benefits of Classroom Research in Pre-Service Teacher Education

A growing body of research suggests that one way to improve pre-service teachers' learning to teach is to involve them in doing Classroom Research during their internship period. (Price, 2001; Levin and Rock, 2003; Smith and Sela, 2005; Zambo and Zambo, 2006; Degago, 2007). The premise for introducing Classroom Research to pre-service teachers is the idea of integrating the art of teaching and the science of research together (Zambo and Zambo, 2006). This notion is reflected in the growing trend of worldwide for teacher education programs to use Classroom Research as a professional development tool to develop the ability of young future teachers. Some educational researchers have found the benefits of Classroom Research in pre-service teachers' education in five areas including its ability to: promote inquiry; promote reflective, critical and analytical thinking; increase understanding of the role and responsibility of teachers; gain greater awareness of the students; and integrate the theory and practice of teaching (Price, 2001; Levin and Rock, 2003; Chant *et al.*, 2004; Smith and Sela, 2005; Zambo and Zambo, 2006; Carboni *et al.*, 2007; Degago, 2007).

Promote inquiry

Classroom Research is a form of problem solving characterized by inquiry. Classroom Research inquiry employs the scientific thinking process to question and improve the researcher's practice (Ross, 1987). Incorporating Classroom Research into the pre-service teachers' experience situates them in an intentional, systematic problem-solving activity that raises problems and questions about existing practice and potentially leads to increased understanding of their actions in the classrooms in which they function (Carboni *et al.*, 2007). While pre-service teachers are involved in the Classroom Research process such as developing a research question, developing a research design, and analyzing, synthesizing and interpreting the data, it means they are trying to test their ideas, to understand their teaching practice, and to understand their students at the same time. The primary procedure in the Classroom Research processes is to use inquiry cycles that move several times between reflection and

action. Through their inquiries, the pre-service teachers begin to explore simultaneously the intellectual and cultural dimensions of their students' experiences in classrooms, pedagogical content knowledge, and the larger political and social issues about teaching and learning (Price, 2001). Ross (1987) noted that pre-service teachers must begin to see teaching as a form of inquiry before they can develop the predisposition for self-evaluation that is the foundation of Classroom Research and the basis of lifelong professional learning.

Promote reflective, critical and analytical thinking

Reflection is perhaps one of the most critical components of Classroom Research because it lays the foundation for the growth of a long-term reflective practitioner. The reflection occurs parallel with all of the Classroom Research processes which includes the underlying assumptions of a plan; the development of a plan of action; the implementation of the plan; and, the observation of the effects and the nature of the social context which pre-service teachers are embedding (Ross, 1987; Rock and Levin, 2002; Carboni *et. al.*, 2007). Reflection also includes sharing pre-service teacher's own ideas, listening and reacting to someone else's ideas, listening to colleagues' reactions toward their ideas, and trying to integrate these ideas into their thinking for changing their performance in the classroom (Tabachnick and Zeichner, 1998). The skill of reflection can promote deep and meaningful understanding for pre-service teachers such as helping them improve their instructional effectiveness, helping them become better decision makers, and helping them view teaching as a form of experimentation or inquiry (Zambo and Zambo, 2006). Pre-service teachers can develop their 'habits of mind' by looking retrospectively on the teaching that has occurred, reconstructing, re-enacting and recapturing events, and critically analyzing their students' and their own actions with explanations supported by the evidence (Price, 2001).

Li (2008) has noted that pre-service teachers who learn to reflect on their practice through the Classroom Research process will develop a personal theory of teaching and will become more critical and analytical and implement an alternative

pedagogy for solving problems in their classrooms. Change in pre-service teachers will occur when they learn to solve their own problems by using the skills of inquiry and reflection. Teacher education programs should focus on helping pre-service teachers to become more reflective about their practice. Classroom Research provides one strategy useful for encouraging pre-service teachers to approach their teaching practice as reflective inquiry.

Understand the roles and responsibilities of teacher

Classroom Research is a strategy to enhance pre-service teachers' capacities to understand teaching, curriculum, teachers' roles, and teachers' responsibilities (Tabachnick and Zeichner, 1998; Price, 2001; Rock and Levin, 2002). Through their own experience of undertaking Classroom Research projects, pre-service teachers can explore and experiment with alternative ways of teaching in their classroom to discover their challenges and values (Degago, 2007). It turns the pre-service teachers' potential feelings of desperation and disappointment about their work into a productive space, causes change, and facilitates professional growth; it encourages them to develop their voices and perspectives about teaching (Price, 2001); and it helps them to consider what they are learning about themselves as teachers during their shared inquiry with other colleagues (Rock and Levin, 2002). They learn to recognize the important role of teachers-researcher as the main factor for making change in students' learning (Ginns *et al.*, 2001). Other studies indicate that Classroom Research also promotes continuous learning, revitalizes pre-service teachers' practice, and motivates pre-service teachers by improving their self-confidence as professionals (Price and Valli, 2005; Smith and Sela, 2005; Moore, 2006; Ax, Ponte, and Brouwer, 2008).

Gain awareness of the students

The pre-service teachers begin to focus more on their students when they engaged in a Classroom Research project. By engaging in discourse with students and by conducting individual student interviews as part of their data collection pre-service

teachers gain much useful knowledge from their students which often challenges their own assumptions and prior beliefs (Rock and Levin, 2002). Classroom Research provides a framework of systematic inquiry to heighten awareness about the diverse needs of the students in the classroom and to increase understanding of the way that students manifest their inward needs in their outward behavior (Levin and Rock, 2003). In the pre-service experience, Classroom Research can encourage the pursuit of understanding about students' behavior rather than merely managing it and so presents the opportunity to examine the roots and motives of student performance and behavior. Increasing awareness of student needs can stimulate pre-service teachers to organize the learning environment that will fit their students' preferences. This is a good strategy to promote students' learning in their classroom (Carboni *et. al.*, 2007).

Integrate the theory and practice of teaching

Classroom Research is an effective way for pre-service teachers to integrate the theory and practice of teaching. While pre-service teachers are undertaking Classroom Research project, there is the potential to bridge the gap between the realities of school and the theory which they learn from their campus courses (Tabachnick and Zeichner, 1998; Price, 2001; Degago, 2007). Pre-service teachers clarify their personal teaching theories in a supportive and collaborative environment while they are engaging in Classroom Research projects (Rock and Levin, 2002). Carboni *et. al.* (2007) asserts that Classroom Research provides the occasion for transforming both the external context and the internal self of pre-service teachers. The translation of theoretical ideas into practice is shaped not only by pre-service teacher's interests, passions and understandings, but also by the context of the Classroom Research is undertaken (Ax *et al.*, 2008; Price, 2001).

Clearly, the advantages of Classroom Research are becoming well recognized and have prompted the call for Classroom Research to be included as part of pre-service teacher education program around the world. Engagement in Classroom Research embeds pre-service teachers into the inquiry process, promotes reflective, critical and analytical thinking, and provides a good chance for pre-service teachers to

explore their images of themselves as teachers. Classroom Research often requires pre-service teachers to interact more with students and therefore increases their awareness of student needs within the classroom. Classroom Research also can be used to link theory and practice in pre-service teachers, empowering them to become the agents of change, and enhance professional growth.

The Roles and Responsibilities of University Supervisors and Cooperating Teachers in Supervising Pre-Service Teachers

The roles and responsibilities of university supervisors

The university supervisor is the liaison between the schools and the university. If something goes wrong with the pre-service teachers during their teaching practice in the school, the university supervisor would still be available to help them (Boydell, 1986). Hopkins and Moore (1993) mention three important responsibilities of university supervisors for pre-service teachers. The first job is to orient pre-service teachers about the university requirements while they are practicing their teaching such as writing lesson plans, conducting Classroom Research projects, attending practicum conferences, and writing weekly journals. The pre-service teacher should be aware of the course objectives, the type of activities that are needed to attain those objectives, and the general procedures to work with their cooperating teachers and university supervisors.

The second job of the university supervisors is to provide assistance throughout the pre-service teachers' internship period. The strengths and weaknesses should be identified while the university supervisors are observing pre-service teachers' practice in the school. After an observation, the university supervisors should give the written feedback to the pre-service teachers. A conference should then be scheduled for analyzing the university supervisor's feedback. Some university supervisors require pre-service teachers to write daily logs of their internship

experiences. This record enables university supervisors to keep up-to-date with the pre-service teachers' activities and areas of need.

In most contexts, the university supervisors' third job is to evaluate pre-service teachers' practice by assigning grades at the end of the internship period. Assigned grades should be based on data gleaned by both cooperating teachers and university supervisors throughout the internship period in the school.

To follow all of the above responsibilities is very difficult for the university supervisors. The research that were conducted by Boydell, (1986) and Beck and Kosnik (2002) found that, the lack of time and the remoteness from pre-service teachers created a significance conflict between the assessment and supportive roles of university supervisors. The university supervisors seem unable to help the pre-service teachers make theory-practice connections or to bring the productivity of college work into the pre-service teacher's practice. All teacher education programs should ensure that university supervisors work closely with cooperating teachers and pre-service teachers to support the pre-service teachers in all aspects, and they should visit the school sites often.

The role and responsibility of the cooperating teachers

The focal point for providing successful pre-service teacher internship experiences is the cooperating teachers, whom the pre-service teachers will be working with. The cooperating teachers are the most crucial factor in developing competent teachers and are the models in pre-service teachers' attitudes toward teaching and towards the students (Rodgers and Keil, 2007). The cooperating teachers who have critical knowledge, skills, and dispositions can support pre-service teachers by being involved in the supervision process. One reason that cooperating teachers can play a critical role in supervising pre-service teachers is because they can build trusting relationships with the pre-service teachers based on reflection on pre-service teachers' practice and collaborative work through the involvement in such tasks as planning the lessons, selecting methods and materials, and helping them to solve the

problems in the classroom (Hopkins and Moore, 1993). Cooperating teachers are a source of implicit, contextualized, expert, and professional knowledge and help pre-service teachers to develop their own teaching style (Chalies, Bertone, Trohel, and Durand, 2004). The cooperating teachers should be willing to assume the following responsibilities:

1. To share knowledge, materials, and experiences with pre-service teachers such as allowing pre-service teachers to see the example of classroom activities and the pre-service teachers also share the activities they have developed during their method courses to the cooperating teachers (Hopkins and Moore, 1993; Beck and Kosnik, 2002).

2. To provide ideas, options and suggestions for improvement. They should support the pre-service teachers by giving a considerable amount of feedback to pre-service teachers. The information that cooperating teacher write about regarding what is happening in the pre-service teachers' practice could be a very precise approach for leading the discussion with pre-service teachers. The pre-service teachers will know what action is important based on what cooperating teachers have recorded (Rodgers and Keil, 2007). They should talk with the pre-service teachers about strengths as well as weaknesses and help pre-service teachers to develop their practices. Assisted in the reflection by the cooperating teachers, the pre-service teachers will gradually construct their own professional knowledge. Pre-service teachers learn more effectively when their interaction with the cooperating teachers is based upon dialogue and reflection (Beck and Kosnik, 2002; Chalies *et al.*, 2004). The more insights that cooperating teachers provide about pre-service teachers' performance the smoother the transition will be from college students to classroom teachers (Rodgers and Keil, 2007).

3. To encourage pre-service teachers to try new ideas in the classroom. The pre-service teachers should be provided the freedom to accept or reject the ideas that they will implement in the classroom by themselves (Hopkins and Moore, 1993).

4. To provide the emotional support for pre-service teachers. Friendliness or an emotional kindness were seen as key components of good teaching practice placement. This helps pre-service teachers do a better job and grow as a teacher. Emotional support makes pre-service teachers feel comfortable during their internship experiences. A climate of care and trust will encourage pre-service teachers to entertain uncertainty, express confusion, and articulate doubt (Beck and Kosnik, 2002).

In conclusion, there are many supervising tasks for cooperating teachers to do with pre-service teachers. For example, they must be able to raise confidence, to develop the level of teaching experiences gradually, to coach the preparation of lessons, to observe in a goal-oriented ways, to model teaching methods, to provide support during internship experiences, to encourage reflection balanced with giving proper feedback, to evaluate the practices of pre-service teachers, and so forth. The quality of the coaching relationship while preceding these tasks will be an important reconciling factor in encouraging pre-service teachers to act as a teacher in a powerful way. The cooperating teacher has to be informed about the characteristics of each individual pre-service teacher, and should be given adequate preparation for supervising the pre-service teacher before the pre-service teachers begin their internship in the school.

The Relevance Research on Engaging Pre-service Teacher in Classroom Research Project

There are several studies that have focused on engaging pre-service teachers in the Classroom Research project during the internship period. The majority of these studies are descriptive in nature, providing narrative accounts of attempts to develop the ability of pre-service teachers in conducting a Classroom Research project. For example, in a study conducted by Rock and Levin (2002) which investigated the pre-service teachers professional development during the engagement in a collaborative Classroom Research with their cooperating teachers in the internship period. The pre-service teachers and cooperating teachers were involved in five-steps of conducting

the Classroom Research including, (a) identification of a question to be researched, (b) formation of a strategic plan of action in which to answer the question, (c) collection of data in various forms to study the effects of the strategic action plan, (d) reflection upon the results of the strategic action plan, and (e) creation of new action steps to be taken based on what was learned. The results indicated that Classroom Research experiences provided opportunities for pre-service teachers to gain valuable insights about their students, the curriculum, and their roles and responsibilities as teachers. The cooperating teachers played an important role to the pre-service teachers' practice of Classroom Research. The cooperating teachers' suggestion impacted the pre-service teachers' understanding of teaching, curriculum, reflection, and the practice in each step of Classroom Research.

Smith and Sela (2005) examined the student teachers' understanding of Classroom Research, the process student teachers went through when doing the Classroom Research project, and the implications of Classroom Research to the process of teaching and professional development. The student teachers were engaged in the Classroom Research projects as a compulsory assignment in the course 'Teacher as Researcher'. The objective of the course was to provide student teachers with reflective tools for improving their teaching. The documentation of meetings, the student teachers' personal diaries, the questionnaire, and the Classroom Research report were used to collect the data. The research finding showed that at the beginning, the student teachers did not understand what Classroom Research meant. They not succeed to identify one specific problem in the classroom for generating the research question. But when the Classroom Research progressed and they got the recommendation from the cooperating teachers, they gain more understanding of conducting the Classroom Research project. They know how to generate the research question, to develop the research instrument, and to reflect on their teaching practice. They saw Classroom Research as a way of examining their own work and improving it. Classroom Research taught them about the research topic that they conducted, about the teacher role, and about their pupils' learning. The student teachers raised the problem of the limitation of time to reflect on their Classroom Research project and the confusion of multiple roles they had during the internship period.

In another study, Price (2001) conducted research which was aimed at understanding how the student teachers learn the process of Classroom Research, and how they see the connections among pedagogy, research, and change. The student teachers were introduced to the Classroom Research projects while enrolled in a year-long full-time master's certification program. The researcher assigned the student teachers to conduct the Classroom Research project step by step which was classified into five steps: generating a research question, developing a research design, collecting data, analyzing data, and writing a research report. The researcher designed the assignments and gave recommendations to the student teachers from the first step to the last step for helping them conducted the Classroom Research project. The transcripts of audiotapes of classroom conversations; questionnaires; Classroom Research journals; informal interviews; videotapes of classroom work; and documents such as school, district and state policies were part of the data collection. The findings revealed that conducting a Classroom Research project promoted the student teachers' growth and development as teachers. Conducting a Classroom Research project was an effective way for the student teachers to evaluate their teaching practice, and to evaluate the students' learning. The student teachers faced the challenge of finding time to reflect on their Classroom Research project and felt that they had insufficient support from the cooperating teachers in implementing new idea in the classroom. The student teachers had very few resources for conducting their Classroom Research projects.

Halim, Buang, and Meerah (2010) studied the effect of Classroom Research on the professional development of supervisors and student teachers in internship setting. In this study, both the supervisors and student teachers identified the problems in teaching physics, planned an action to overcome the problems, and evaluated the effectiveness of the plan. Data was collected through the reflective journals written by the student teachers, interviews between the student teachers and the supervisors, supervisors' observation notes on the classroom teaching of the student teachers, and the supervisors' own reflective notes. Findings showed that the student teachers improved their own subject matter knowledge, developed pedagogical content knowledge and enhanced research skills. For the supervisors, the collaborative

Classroom Research enabled them to reflect on the effectiveness of their supervision and of the methods course in helping student teachers to teach and to research.

Zambo and Zambo (2006) studied the beliefs of 296 pre-service teachers about the benefits of Classroom Research when they took part in the Classroom Research projects during the internship period. A questionnaire was used to elicit the pre-service teachers' beliefs about Classroom Research. He found that the pre-service teachers showed positive attitude about Classroom Research regarding their professional growth and teaching improvement. Classroom Research encourages reflection and provides evidence that change has occurred in pre-service teachers. The involvement in Classroom Research helped pre-service teachers understand the complexities of teaching and learning through the process of inquiry. There were some obstacles for the pre-service teachers in conducting the Classroom Research projects. The pre-service teachers thought that the cooperating teachers were not supportive and they had insufficient resources they need for conducting the Classroom Research project.

Thathong (2002) introduced the pre-service teachers in the four-year pre-service teacher education program in Thailand to the practice of Classroom Research during the one semester internship period. The researcher organized two-day seminar for explaining the concept and the steps in conducting the Classroom Research project to the pre-service teachers. The pre-service teachers regularly consulted with the university supervisors about conducting the Classroom Research project throughout the semester. The pre-service teachers were asked to write the reflective journals to express their opinions while they were conducting Classroom Research projects. The study revealed that the pre-service teachers thought Classroom Research interrupted their practical teaching process and were very difficult to conduct. The important constraints that need to be solved were related to the acquisition of research knowledge for the pre-service teachers and the research proposal presentation pattern. The process of two-day seminars before going to the internship period in the professional development school was not appropriate because there was an overload of information, too many presenters, and insufficient time. These difficulties made

pre-service teachers feel more confused rather than better prepared for conducting Classroom Research. The pre-service teachers claimed that they were confused, discouraged, and worried about conducting the Classroom Research projects.

In summary, a number of studies investigated the outcomes of engaging the pre-service teachers in the Classroom Research project. The results showed that pre-service teachers gain more insight about the students, the curriculum, and the roles and responsibilities of teachers. Classroom Research helped pre-service teachers improved their teaching practices. The research findings also revealed some obstacles for pre-service teachers in conducting the Classroom Research project such as the limitation of time, the confusion of multiple roles during internship period, and the insufficient resources for conducting the Classroom Research project.

CHAPTER III

METHODOLOGY

Overview of Chapter

The purposes of this study were to assess any changes of pre-service science teachers' understanding of Classroom Research and to study the pre-service science teachers' practice of Classroom Research, the supports about Classroom Research that the cooperating teachers and university supervisors give to pre-service science teachers, and the factors that support or hinder pre-service science teachers practice of Classroom Research. Therefore, qualitative methods for gathering and analyzing data were employed. In this chapter, there are four sections. The first section describes qualitative research, interpretive methodology, and case study research design. Subsequently, the second section provides descriptions of the data collection methods and data analysis used in this study. The third section describes the criteria for assessing the quality of qualitative research. Finally, the last section addresses the procedures of the study which comprises of three phases including the exploratory phase, the developmental phase, and the implementation phase.

The Qualitative Research Approach and Interpretive Methodology

All research is framed by fundamental beliefs of what researchers perceive as reality, knowledge, and way for studying the world (Patton, 2002). These beliefs guide researchers about methods and strategies that are appropriate for studying social phenomena (e.g., a group, event, program, community, or interaction) (Merriam, 1998). For the current study, the methodology is qualitative research which is a form of inquiry that help people to explain and gain insights into the meaning of a particular phenomenon in the natural setting (Mertens, 1998). Under these circumstances the phenomenon are viewed holistically. That complex phenomena cannot be reduced into the independent parts is an underlying assumption for

qualitative research. Qualitative researchers argue that all meaning is situated in a particular perspective or research context; it is not imposed by the researcher. The meanings derived from research are specific to that context and its conditions which is not controlled or manipulated by the researcher (Wiersma, 2000; Gay, Mills, and Airasian, 2006). Qualitative research emphasizes the detailed descriptions and explanations in an attempt to understand how the participants experience and make sense of their own world, how they define their situation, and how individuals interact with the others (Jackson, 1995). Therefore, research design, assumptions, and conclusions are tentative and subject to change throughout the research process (Wiersma, 2000).

Understanding, actions, thoughts, feelings, and beliefs are all a part of interpreting meaning and thus qualitative research typically focuses on a small number of participants (Maxwell, 1998) such as the three pre-service science teachers in this study. The researchers need to put themselves into the specific contexts or settings that they are studying (Stake, 1995; Maxwell, 1998). The researcher is the primary instrument for collecting and analyzing data that can maximize the opportunities for interpreting and producing meaningful information. Qualitative research is thus a fundamentally interpretive process, in which a researcher makes an interpretation of the gathered data (Creswell, 2008).

Interpretive Methodology

Qualitative research covers various methodologies (Merriam, 1998; Marshall and Rossman, 2006). The current study is framed by a methodology aligned with qualitative inquiry which is known as interpretive research (Marshall and Rossman, 2006). Interpretive methodology is based on the assumption that reality is broad and subjective. It is individually and socially constructed (McMillan and Schumacher, 1997). The meaning is derived from one's experience and his/her context. Therefore, to access the reality, interpretivist researchers must study people in their contexts (Lincoln and Guba, 1985). The researchers must immerse themselves in the field where the participants are involved and attempt to understand how they construct

meanings of the social phenomena. In short, the researchers must view the world through the lens of their participants. The aim of interpretive methodology in general is to understand how people interpret the social world, construct meanings, and interact within a particular context. Interpretivist researchers are likely to utilize qualitative methods to deal with multiple realities. The researchers must prepare themselves in the field in which the participants are involved. With this regard, the researchers themselves are data-gathering instruments (Lincoln and Guba, 1985). They conduct interviews, observe people's actions, and gather available documents. Qualitative methods enable interpretivist researchers to broaden their views into the way participants perceive the world and reveal its meaning. To make for better understanding, the researcher needs to enter into long term relationships with the research participants for the purpose of learning about the manner and contexts in which they do their work, how they think about it, what "forces" influence their thoughts and actions, and their personal and professional commitments (Hargreaves, 1994).

In this research, the researcher begins the study with an assumption that the participating pre-service science teachers do have prior understanding of Classroom Research. The challenge is to track and learn how the pre-service science teachers practice of Classroom Research, how they develop their understandings of Classroom Research before and after engaging in the initiative, what supports the pre-service science teachers receive from cooperating teachers and university supervisor over the implementation of the initiative, and what factors support or hinder the pre-service science teachers' practice of Classroom Research. In this study, the researcher neither controls nor manipulates the participants and their environments. Rather, the researcher studies the pre-service science teachers in a natural setting. The data are gathered from questionnaire, interviews, journal writing, observations, and documents. They are then analyzed by seeking patterns or themes.

The Case Study Research Design

There are different research designs under the qualitative research approach. Merriam (1998) identifies five research designs: ethnography, historical research, phenomenology, grounded theory, and case study. With the exception of historical research all seem to share common characteristics in that the researchers must immerse themselves into the natural setting in which the participant is involved. The researchers try to understand how participants construct social meaning and act in that setting by collecting thick descriptive data in the real context (Gay, *et al.*, 2006). The research design employed in this research is qualitative case study. Qualitative case study research is a research approach widely utilized in education (Merriam, 1998). The purpose for implementing a qualitative case study is to gather comprehensive, systematic, and in-depth information about individual cases (Patton, 2002). According to Stake (1995), case study is the study of the individuality and complexity of a single case (or cases) in which researchers come to understand the activity of a case (or cases) within its circumstances. He argues anything can be defined as a case, particularly, if it (the object of study) is a specific, unique, and bounded system. Bounded means the case is separated out for conducting research in terms of time, place, or other physical boundaries. Merriam (1998) and Creswell (2008) mention that the bounded system should have a limited number of people involved in the study or a finite amount of time for collecting the data. According to Yin (1994), the case study relies on multiple sources of data (e.g., interviews, observations, documents, or artifacts) and these data need to be converged in a process of triangulation. Once the case data is analyzed, the findings are reported via “thick description” (Merriam, 1998). Thick description helps the readers to understand results of a case more clearly than presenting the findings with abstract theories or principles.

As mention previously, this study focuses on a particular group of people, at a particular time and place which aims to describe the pre-service teachers’ practice of Classroom Research, the development of pre-service teachers’ understanding about Classroom Research, the supports about conducting Classroom Research project that pre-service teachers receive from cooperating teachers and the university supervisor,

and the factors that support or hinder the pre-service teachers' practice of Classroom Research. Therefore, the qualitative case study design is in agreement with the aim of the study because it enables the researcher to gather comprehensive and in-depth information of individual pre-service teacher experiences of Classroom Research. Furthermore, the characteristics of qualitative case study design are compliant with the researcher's philosophical beliefs on reality, knowledge, and methods for reaching knowledge. Multiple data sources were used to provide a holistic and in-depth collection of data. From the data gathered, inductive analysis was used to develop themes. The details of data collection method and data analysis are discussed in the next section.

Data Collection Methods

Qualitative researchers usually employ various forms of data collection in their studies (Merriam, 1998). This section will briefly describe major data collecting methods that are employed in this research study: questionnaire, interview, observation, journal writing, and documents.

1. Questionnaire

Questionnaires are used for collecting data from a large number of people to represent a broad range of ideas (Merriam, 1998). A good questionnaire should be attractive and easy to read for eliciting respondents' information and motivating the respondents to complete all of the items. The items should be in a logical sequence to hold the interest of the respondent. Instructions for completing the questionnaire should be concise and clear, with examples for any complex items (Wiersma, 2000). Cohen *et al.* (2000: 248, 257) suggest that:

Initial questions should be simple, have high interest, value, and encourage participation. This technique will build up the confidence and motivation of the respondent. The middle section of the questionnaire should contain the difficult questions, and the last few questions should be

of high interest in order to encourage respondents to return the completed questionnaire. [In addition,] some kinds of questions should be avoided in questionnaires such as leading questions, complex questions, irritating questions, and questions that use negatives or double-negatives.

In this research, the researcher used the questionnaire to find out pre-service science teachers' understanding of Classroom Research before engaging in the initiative.

2. Interview

The interview tends to have more unstructured items than a questionnaire, so it leaves much more freedom for the respondent to answer the questions (Wiersma, 2000). Basically, interviews are used to understand a social phenomenon from perspective of research participants; it unfolds meanings that the research participants make from their experiences of the phenomenon. It is very appropriate to use interviews when conducting intensive case studies of a few selected participants to probe the feelings and perceptions of each individual. The researcher often audiotapes the conversations and transcribes the information from the interview for later analysis (Merriam, 1998). There are many advantages of the interview such as the format of two-ways communication and open-ended questions can eliminate the problems of non-response or the omission of items. Furthermore, the interview provides opportunity to the researcher for in-depth probing, elaborating, and clarifying the ambiguity of the respondents' ideas (Wiersma, 2000).

In this research, interviews are used to (i) clarify the pre-service teachers' understanding and practice of Classroom Research, (ii) clarify the cooperating teachers' and university supervisors' supervision of Classroom Research that they give to the pre-service teachers, and (iii) allow the pre-service teachers, cooperating teachers, and university supervisor to express their opinions about the factors that support or hinder the pre-service teachers' practice of Classroom Research.

3. Observation

One of the main data collection procedures in qualitative case study research is the observation (Wiersma, 2000). Observation can be distinguished from interviews in two ways. First, observation takes place in the natural field setting. Second, observational data represent a firsthand encounter with the phenomenon of interest (Merriam, 1998). Observation is a continuing process of gathering open-ended information from the primary source which is not limited to one or two sessions. The observer might engage in the situation within a day, a week, a month, a year or many years depending on the research design (Creswell, 2008). The observer should record all relevant information in an unobtrusive way. An important part of observation relates to the ideas of contextualization in trying to understand the context in which individuals are thinking and reacting. The participant-observer attempts to generate the data from the perspective of the individuals who are being studied. Observing in a field setting requires good listening skills and careful attention to the visual details (Wiersma, 2000).

The observers usually use “*field notes*” to record the information while they are conducting the observations (Wiersma, 2000). Because it is difficult to take complete notes while observing in the natural field setting, the content of field notes may be somewhat unorganized, rough, and contain abbreviations or some form of shorthand (Creswell, 2008). If the movements of subjects in the context of study are important, the field notes may contain diagrams with arrows to show the direction of those movements. The field notes should be vivid, clear, and carefully identified in terms of when, where, and under what conditions the phenomenon was observed (Wiersma, 2000; Bryman, 2001). The observer should synthesize and summarize the field notes into broad ideas or themes, include any interpretations and insights that come to mind, and record any questions that may be asked of the participants immediately after the observation or at the end of the day (Bryman, 2001). Creswell (2008) called these processes ‘*Reflective field notes*’.

In this research, the researcher observed the pre-service teachers' teaching practice of the lesson plans that they developed for using in the Classroom Research project to see how they performed their teaching according to the lessons plan that they developed.

4. Journal Writing

Journal writing is an increasingly common technique in education as a strategy for promoting professional development in the fieldwork experience. It allows the persons to stop and think in order to express their thinking and beliefs toward their experiences (Moon, 2006). Journals provide a researcher with a rich and reliable source of information concerning a person's view of the world (Creswell, 2008). Journals are fantastic teaching and learning tool because they are the way of developing a reflective ongoing relationship with oneself and one's work. A journal is a place where the individual and their activities can be described. Journal writing is not only words but it can also be mixed with drawing. It is a tool for individuals to connect the knowledge, concepts and ideas which they acquire from the past and present experiences, thoughts, work, self-reflections, books or articles read (Moon, 2006). If pre-service teachers are introduced to journal writing, it provides an important means to gather the information about actions and reactions with the students, cooperating teachers, and university supervisors. Pre-service teachers can use a written record in journal entries to gain insight about their self-as-a-teacher and to evaluate their practices over a period of time (Burnaford, Fischer, and Hobson, 1996). The writing in a journal can lead a person to look at an event more carefully, more discriminatingly, and more thoroughly (Merriam, 1998).

Journal writing is a good way to scrutinize things that occur in the past and present phenomena, to explore the perceptions of events, and to search for connections, associations, significances, and possible meanings that have not been noticed before (Burnaford, *et al.*, 1996). A journal can be viewed as a place for an individual to record his or her observations, stories, insights, and wonderings. It is widely accepted that writing a journal leads to better action of the individual because

it addresses the importance of past and present experiences as a foundation to guide the future practice (Burnaford, *et al.*, 1996; Moon, 2006).

In this research, the pre-service teachers were asked to write journals to describe how they conducted the Classroom Research project in each stage, and to express their opinion about the factors that support or hinder them to conduct the Classroom Research project. On the other hand, the cooperating teachers and university supervisor were also asked to write journals for describing what they supervised the pre-service teachers to conduct the Classroom Research project.

5. Documents

Documents are a valuable source of research information in helping researchers understand the interested phenomena occurring in their study. Documents are a ready-made source of data and easy to access (Merriam, 1998). Documentary data are particularly good to employ in qualitative case study research because they ground an investigation in the context of the problem being investigated. This grounding in real-world issues and day-to-day concerns is ultimately what the qualitative researchers are working toward (Creswell, 2008). Documents consist of both public and private records including research reports, newspapers, meeting reports, and letters that are relevant to the research site or participants in a study (Merriam, 1998; Creswell, 2008). The positive side of documentary data are that they are relatively objective sources of data that are quite different from other forms of data collecting methods; these kinds of data have also been called “*unobtrusive data*” (Merriam, 1998). Documents represent a good source for text data which provide the language and words of the participants that are needed for the analysis without the necessity of transcription as is required with observation and interview methods (Creswell, 2008). On the negative side, documents are sometimes difficult to locate and obtain. Information may not be available to the public or may be located at a distance that requires the researcher to travel which takes time and can be expensive. Further, the documents may be incomplete, inauthentic, or inaccurate. In some cases,

the handwriting in the documents may be hard to read that makes it difficult to decipher the information (Merriam, 1998; Bryman, 2001; Creswell, 2008).

In this research, the researcher used the document in term of the pre-service teachers' Classroom Research report and the lesson plans that the pre-service teachers developed for conducting their Classroom Research project to triangulate with the data that was collected from interviewing and journaling about why the pre-service teachers conducted the Classroom Research project with the students in the class that they selected, what were the topics that they wrote in the literature review, how they analyzed data, how they performed their teaching according to the lesson plans that they developed for conducting in the Classroom Research project, and so on.

Data Analysis

Because raw data have no inherent meaning, data analysis is a process of bringing meaning to raw, inexpressive data for the reader or other researchers (Marshall and Rossman, 2006). The qualitative analysis lies in making sense of massive amounts of data which are transformed into findings (Patton, 2002). This involves reducing the volume of raw information, sifting the trivia from significant, identifying significant patterns or themes, and constructing a framework for communicating the essence of findings (Patton, 2002; Marshall and Rossman, 2006). Most common data analysis used in qualitative studies is the inductive approach. Inductive approach allows findings to emerge from data rather than setting up abstractions, concepts, hypotheses, or theories beforehand (Merriam, 1998).

The inductive approach tries to seek the multiple interrelationships among dimensions that emerge from themes found in the cases under study, without presupposing in advance what the important dimensions will be. In case study research, an inductive approach begins by constructing individual cases by bringing all the information about the case together and categorizing those cases (Merriam, 1998; Patton, 2002). A case study is an intensive, holistic description and analysis of a single, bounded unit aimed at conveying an understanding of the case (Merriam,

1998). Multiple or comparative case studies involve collecting and analyzing data from several cases. In a multiple case study, there are two stages of analysis: the within-case analysis and the cross-case analysis. For the within-case analysis, a single case is first treated and data are gathered so that the researcher can gain as comprehensive a view of the contextual variables as possible that might have a bearing on the case. Once the analysis of each case is finished, cross-case analysis can begin. A qualitative, inductive, multi-case study seeks to build themes or a general explanation of processes and outcomes that occur across cases that fit each of the individual cases, even though the cases will vary in their details (Yin, 1994; Patton, 2002). The researchers then attempt to develop more sophisticated descriptions and more powerful explanations covering all cases (Miles and Huberman, 1994).

In this research, the researcher used the inductive analysis to organize and interpret data from the questionnaires, interviews, observations, journal entries, and pre-service teachers' Classroom Research reports to identify themes about the pre-service teachers' understanding of Classroom Research before and after engaging in the initiative, the pre-service teachers' practice of Classroom Research, the supports about Classroom Research that cooperating teachers and university supervisors give to pre-service teachers, and the factors that support or hinder the pre-service teachers' practice of Classroom Research.

Criteria for Assessing the Quality of Qualitative Research

Reliable knowledge refers to knowledge that we can count on, knowledge which allows us to predict outcomes more accurately. Reliable knowledge comes from the quality of the research process (Jackson, 1995). Criteria for judging the quality of qualitative research that is congruent with the criteria for judging quantitative research have been outlined by a number of writers (Mertens, 1998; Cohen *et al.*, 2000; Bryman, 2001; Guba and Lincoln, 2005). Guba and Lincoln (2005) propose the term 'trustworthiness' for assessing the quality of qualitative research which is made up of four criteria: credibility, transferability, dependability, and confirmability. Each of the criteria has an equivalent with the criterion used in the

quantitative research. The following section will describe each criterion in more detail.

1. Credibility

Credibility is parallel to internal validity in quantitative research. Credibility involves a correspondence between the way the research participants actually perceive social constructs and the way the researcher portrays their viewpoints (Bryman, 2001). The researcher should provide evidence from multiple sources for stating the credibility of the research (Mertens, 1998). Mertens (1998) suggests three basic strategies to enhance credibility: long-term engagement, member checks, and triangulation.

1) Long-term engagement: the researchers should have sufficient time in the field to understand daily events in the way that participants understand them.

2) Member checks: the researcher takes the data and tentative interpretations back to the research participant and ask them whether the findings are acceptable.

3) Triangulation: this is the process of using multiple investigators, multiple sources of data, or multiple data collecting methods to confirm the emerging findings. It is qualitative cross-validation to determine whether or not there is corroboration. It is a search for convergence of the information for a common finding.

2. Transferability

Transferability is parallel to external validity in quantitative research. Transferability means the degree to which the researcher can generalize the results to other situations (Bryman, 2001). The researcher's responsibility is to provide sufficient detail to enable the reader to make judgments about the possible transferability of findings to other contexts. Rich details of the time, place, context, and culture is known as "*thick description*" (Mertens, 1998). Multi-case study is

another technique used to enhance transferability within single case study research (Merriam, 1998).

3. Dependability

Dependability is parallel to reliability in quantitative research which refers to the stability of the findings if the study is repeated, coupled with the ability to explain any variations (Lincoln and Guba, 1985). To enhance dependability, the researcher should explain the assumption and theory behind the study, by triangulating data, leaving an audit trail, and describing in detail how the study was conducted and how the findings were derived throughout the inquiry (Merriam, 1998).

4. Confirmability

Confirmability is parallel to objectivity which means that the influence of the researcher's judgment is minimized. The data and the interpretation are not overwhelmed by the researcher's values. The aim of confirmability is to ensure that the findings are not influenced by the researcher's bias, when they attempt to immerse themselves in a field of a study (Mertens, 1998). To increase confirmability, the researcher can employ an audit trail (Lincoln and Guba, 1985). The audit process involves an internal audit regarding the researcher's explanation of the methods of data collection and analysis and theory behind the research study, and an external audit which allows an external person to assess both process and product of the research study (Merriam, 1998).

Context of the Study

Selection of Case

In conducting case study research, the selection of a case is important because a case study focuses on a few instances of a particular phenomenon with a view to providing an in-depth understanding and a holistic view of events, relationships,

programs or processes taking place in those instances. Purposive sampling is recommended in choosing what case to study, so as to gain rich information (Stake, 1995; Merriam, 1998). In this study, three pre-service science teachers were selected by using purposive sampling. All eight fifth-year pre-service science teachers in Westernthani University showed their willingness to engage in this research. The researcher selected three pre-service teachers based on “convenience sampling” (Patton, 2002: 241-242) because their nearby location allowed easy transportation and could make collaboration among the research participants and the researcher. The researcher visited the three pre-service teachers in the professional development schools and discussed with a university supervisor and the cooperating teachers who were responsible for supervising these three pre-service teachers about the purposes and expectations of the research study. A university supervisor and the cooperating teachers accepted to participate in the study. The research participants in this study were three pre-service science teachers, three cooperating teachers, and one university supervisor who were responsible to supervise the selected three pre-service science teachers in the internship period in 2009 academic year. One pre-service teacher and cooperating teacher was at the St. Paul School. Two pre-service teachers and cooperating teachers were at the St. Mary School.

Background Information of the Professional Development Schools

This study was conducted in two professional development schools, St. Paul School¹ and St. Mary School¹, located in a province in western Thailand. These two professional development schools maintained partnerships with the Westernthani University¹, serving as sites for preparation pre-service teachers in all subject fields. These schools were considered by the university to be the professional development school sites because they provided pre-service teachers with rich experiences working with a diverse group of students who had a wide variety of needs. The context of each school is presented with the following details.

¹Pseudonyms are being used for the university, the professional development schools, and the participants in this study to protect their privacy

1. St. Paul School

St. Paul School is a private school. This school is the first girl private school in Thailand which was founded in 1865. Nowadays St. Paul School has both male and female students. The school operates from kindergarten to grade twelve. The school comprises of both day students and boarding students.

St. Paul School focuses on developing individualized learning where students' progress through a curriculum of concepts and skills at their own pace. The school's official vision statement is to produce students to grow up strongly and progress steadily. The aim of the school is to enhance students' quality of life while providing an adequate potential and capability to live happily in today's world by utilizing an integrated education through a Christian perspective. The school's official mission statements are: (a) to enable the students to grow physically and mentally who possess a wide range of academic knowledge and have morality in accordance with the teachings of Christianity; (b) to produce the students with leadership abilities, a way of life based on Thai culture, and an awareness to protect the environment; (c) to have a system of academic administration which enables the students to fulfill their individual potential; and (d) to encourage staffs and students to acquire the skills needed for using modern technology effectively.

St. Paul School is a large school in size. Based on the school year book reports in 2009, there are totally 3,105 students; 1,450 males and 1,655 females, in kindergarten to grade twelve. The total classrooms are 84 classrooms. The school has 160 teachers. There are 19 teachers in science department which Pattama is the member. The distribution of teachers according to gender, age, and academic qualification as follows: 79.4% (127 teachers) are females and 20.6% of teachers (33 teachers) are males. Regarding their age, 65% of the teachers are 30-40 years old. With reference to academic qualification, most teachers (90.0% or 144 teachers) have a bachelor degree.

In lower secondary level (grade 7-9), the school organizes the curriculum follows the Basic Education Curriculum. The subjects taught are grouped into eight subject areas including: Thai Language; Mathematics; Sciences; Religion and Culture; Health and Physical Education; Arts; Career and Technology; and Foreign Languages (MOE, 2002). The school constitutes an eight-period schedule a day. One period is 50 minutes. There are morning announcements and attendance at the beginning of the day. School class time starts at 8.30 in the morning and ends at 3.10 in the afternoon. The fourth and fifth periods are lunch time, depending on students' grade level. General science is credited for 1.5 instructional units which is taught in three periods a week or 60 periods a semester. Three periods a week of teaching science can be separated into two continuous period classes in one day and another one period class on another day.

The school year is divided into two semesters. School generally begins on or around May, 15 and ends in March, 15. It has a three-week break between the first and the second semesters in October. The long summer break is from April to the middle of May. The School enjoys all public, Buddhist, and Christian holidays. In lower secondary level, the number of classroom at grade seven to grade nine are seven, six, and seven classrooms, respectively. Each classroom has approximately 44 students with mixed ability and gender. There are special rooms set apart for special activities; for examples, nursing room, counseling room, music room for Thai and international musical instruments, computer room, science laboratory, library, and cooperative store. The school has a safe and spacious ground (courtyard setting) for physical activities such as football, basketball, volleyball, badminton, and a swimming pool. Bulletin boards of different sizes are placed strategically inside and outside of the classrooms. These bulletin boards are used for operational announcements, display the organization directives, and other matters that relate to the school's vision and mission including reports the school events or school's activities, etc.

St. Paul School is located in the center of a district near the municipal hall. The environment near the school is surrounded by the government buildings, stores,

temples, and a residential area. The majority of students are Buddhist, and remainders are Christian and Muslim. The student parents' occupations are merchants, government officials, and employees. The majority of parents are of middle and high socio-economic status range. The average number of family members are about 3-4 persons. The pre-service science teacher, Pattra, and her cooperating teacher, Pattama, are teaching in this school.

2 St. Mary School

St. Mary School is a private school. This school was founded in 1988. The School has both male and female students. The school operates from kindergarten to grade nine, and has only day students.

St. Mary School focuses on offering quality education according to the potential of the students in an atmosphere of love and compassion towards building a happy society. The school's official vision statements are to pursue administration based on international standards, and develop personnel and students to be the quality persons. The aim of the school is to be the leader in education by continuously developing academic quality in order to produce students who perform well in both morality and academics and maintain their quality of life. The school's official mission statements are: (a) to educate every person in the school to realize that quality is the heart of academic administration in the school; (b) to teach the students to be religious and virtuous; (c) to provide a learning environment in the school which includes equipment, materials, and teaching media which truly facilitate the students' knowledge acquisition; and (d) to create life-long learners who enjoy learning while helping them develop the skills they need to meet the demands of their future, whether in Thailand or abroad.

St. Mary School is a medium school in size. Based on the school year book reports in 2009, there are totally 1,189 students; 572 males and 617 females, in kindergarten to grade nine. The total classrooms are 41 classrooms. The school has 66 teachers. There are eight teachers in science department which Jakchai and Dara are

the member. The distribution of teachers according to gender, age, and academic qualification as follows: 15.2% of teachers (10 teachers) are males and 84.8% (56 teachers) are females. Regarding their age, 50% of the teachers are 30-40 years old. With reference to academic qualification, most teachers (92.4% or 61 teachers) have a bachelor degree.

In lower secondary level (grade 7-9), the school organizes the curriculum following the Basic Education Curriculum. The subjects taught are grouped into eight subject areas including: Thai Language; Mathematics; Sciences; Religion and Culture; Health and Physical Education; Arts; Career and Technology; and Foreign Languages (MOE, 2002). There are eight periods per day including four periods in the morning and four periods in the afternoon. One period is 50 minutes. There are 20 minutes breaks between periods 2 and period 3, and 10 minutes break between periods 6 and period 7. In addition, the school also has 50 minute break between 12.10 p.m. to 1.00 p.m., set as a lunch time. At the start of the school day, there are morning announcements and attendance. School class time starts at 8.30 in the morning and ends at 4.30 in the afternoon. General science is credited for 1.5 instructional units which taught for three periods a week or 60 periods a semester. Three periods a week of teaching science can be separated into two continuous period classes in one day and another one period class on another day.

The school year is divided into two semesters. School generally begins on or around May, 15 and ends in March, 15. It has a two weeks break between the two semesters in October. The long summer break is from April to the middle of May. The School enjoys all public, Buddhist, and Christian holidays. In lower secondary level, the number of classroom at grade seven to grade nine are 2, 2, and 2 classrooms respectively. Each classroom has approximately 33 students with mixed ability and gender. There are special rooms set apart for special activities for examples: music room for Thai and international musical instruments, computer room, science laboratory, English-sound lab, and a library. The school has a safe and spacious ground (courtyard setting) for physical activities such as football, volleyball, and badminton. It also had a herbal garden at the back of the school. Bulletin boards

of different sizes are placed strategically inside and outside of the classrooms and within the main areas of the school premises. These bulletin boards are used for operational announcements and to reports the school events or school's activities, etc.

St. Mary School located far from center of the city about 1.5 kilometers. The environment near the school is surrounded by rice fields, and orchards. The majority of students are Buddhist. The remainders are Christian. The student parents' occupations are businessman, government officials, and state entrepreneurs. The majority of parents are of high socio-economic status. The average number of family member are about 4-5 persons. Two pre-service science teachers, Juntima and Napa, and two cooperating teacher, Jakchai and Dara, are teaching in this school.

Background Information of Pre-Service Science Teachers

The participants of this study were three pre-service teachers, Pattra, Juntima, and Napa (pseudonyms), studying in a five-years pre-service science teacher education program at Westernthani University (pseudonym). All of them were 23-years old female pre-service science teachers and majoring in general science. They were the fifth-year students who registered in two courses called internship 1 course and internship 2 course. Each internship course required the pre-service science teachers to practice full time teaching in the school for one semester, so for these two internship courses the pre-service science teachers practiced their teaching in the school for two semesters or one academic year. During these two internship courses in the school, each of them was required to complete a Classroom Research project as a fulfillment of the requirements for their bachelor degree in education (teaching science). All of the pre-service teachers had already learned the concepts of conducting Classroom Research in the third year of their teacher education program while they enrolled in the Classroom Research course.

The pre-service teachers in this study chose the school that they would like to practice their teaching by themselves by selecting from the 38 professional development school list provided by the faculty of education. The faculty of

education, Westernthani University, required the pre-service science teachers to practice their teaching in any grade levels in lower secondary level (grade seven to grade nine). The faculty of education gave priority to each professional development school in selecting grade level in the lower secondary level for the pre-service science teachers to practice their teaching during the internship period.

The Case of Pattra

Pattra selected to have her internship at St. Paul School and was assigned by her cooperating teacher, Pattama, to teach science in grade nine for three classrooms (class 9A, 9B, and 9C). The students in each class learned science for three periods a week, so Pattra totally taught science nine periods a week. She taught two periods on Monday and Friday, one period on Tuesday and four periods on Thursday. There were approximately 44 students with mixed ability and gender in each classroom. Pattra's Classroom was located on the second floor of the two-storey building. The students' seats were organized in three columns and each column comprised of row of two desks next to each other. The first column had six rows and the others had nine rows. There was one blackboard permanently fixed onto the wall in front of the room and a small clock was hung in the middle of the blackboard. School's motto, school's vision, the picture of Thai national flag, the picture of Jesus, and the picture of H.M.K. Bhumipol Adulyadej were stuck on the wall above the blackboard. The teacher's desk was situated near the front door of the room. Windows were located on the right side of the room. Two bulletin boards filled with trigonometry formulas and the history of Christmas day were attached to the wall in the back of the room. Two electrical fans were hung on the ceiling. In each column of the seat boys sat with boys in pairs, so as girls. An overview of Pattra's classroom is displayed in Figure 1.

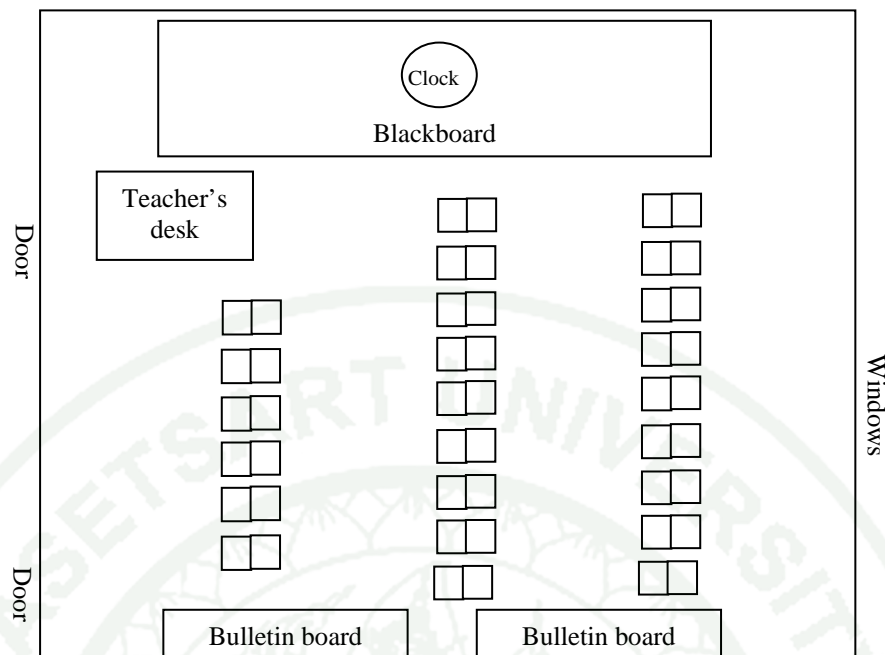


Figure 1 Layout of Pattra's Classroom

The Case of Juntima

Juntima selected to have her internship at St. Mary School and was assigned by her cooperating teacher, Jakchai, to teach science in grade eight for two classrooms (class 8A and 8B). Each class learned science for three periods a week, so Juntima totally taught science six periods a week. She taught two periods on Monday, Thursday, and Friday. There were approximately 30 students with mixed ability and gender in each classroom. Juntima's Classroom was located on the fourth floor of the four-storey building. The students' seats were arranged in three columns and each column comprised of six rows of two desks next to each other on a side. There was a blackboard permanently fixed onto the wall in front of the room. On the right and on the left sides of the blackboard were empty bulletin boards. Above the blackboard, on the wall, there were a small Thai national flag, a Christian cross, and the picture of H.M.K. Bhumipol Adulyadej. The teacher's desk was situated nearby the blackboard. There was a computer table next to the teacher's desk. On the right side of the room, there was a long bookshelf without books placed on it. On top of the bookshelf, there were students' science projects, three unused chairs, and a poster of Songkran festival.

Windows were also built along this side of the room. At the back of the room, there was another bookshelf filled with textbooks, exercise books, and school annual reports. Above this bookshelf there was a bulletin board displaying Mathematics formulas. Two electrical fans and a projector were hung on the ceiling. In each column of the seats a boy sat with a boy and a girl sat with a girl. An overview of Juntima's classroom is shown in Figure 2 below.

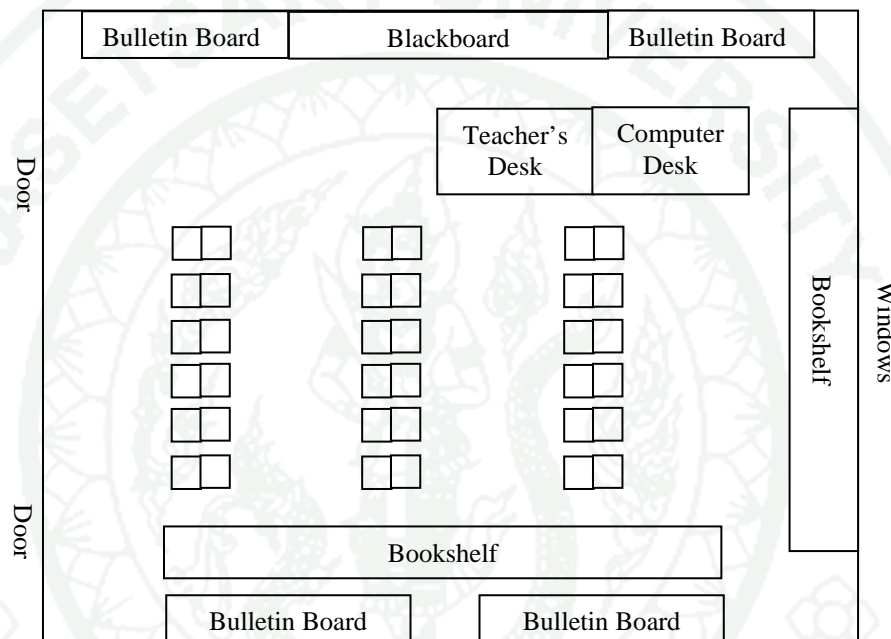


Figure 2 Layout of Juntima's Classroom

The Case of Napa

Napa selected to have her internship at St. Mary School and was assigned by her cooperating teacher, Dara, to teach science in grade seven for two classrooms (class 7A and 7B). Each class learned science for three periods a week, so Napa totally taught science six periods a week. She taught two periods on Monday, Tuesday, and Friday, There were approximately 37 students with mixed ability and gender in each classroom. Napa taught the students in a science laboratory which was located on the second floor of the four-storey building. This laboratory was very modern because it was renovated last year with a large amount of money. The six lab-

tables were arranged in the middle area of the room. Each table was surrounded by four or five chairs. There was a large whiteboard permanently attached to the wall in front of the room. There was a shelf on the left side of the whiteboard filled with plant-cell models, animal-cell models, and microscopes. On the right side of the whiteboard there were two cabinets. The first cabinet stored a skeleton model and the second cabinet stored audiovisual equipment such as television, VCD player, speakers, microphone, and projector. Next to the cabinets there was a fire extinguisher fixed to the wall. The teacher's table was near the whiteboard. There was a computer on the left side of the teacher's table and there was a sink on the right side of it. On the left side of the room there were two big built-in glass-fronted cabinets filled with lab equipment: chemical substances, balances, globe models, and a tank of fire extinguisher. On the right side of the room there were three sinks on top of the built-in cupboards. Windows were also located along this side. In the back of the room, there were two bulletin boards displaying the solar system and components of plant cells. Six electrical fans were hung on the ceiling. The class was divided into six groups of the students. Two groups were girls and four groups were mix genders. The layout of the science laboratory is shown in figure 3 below.

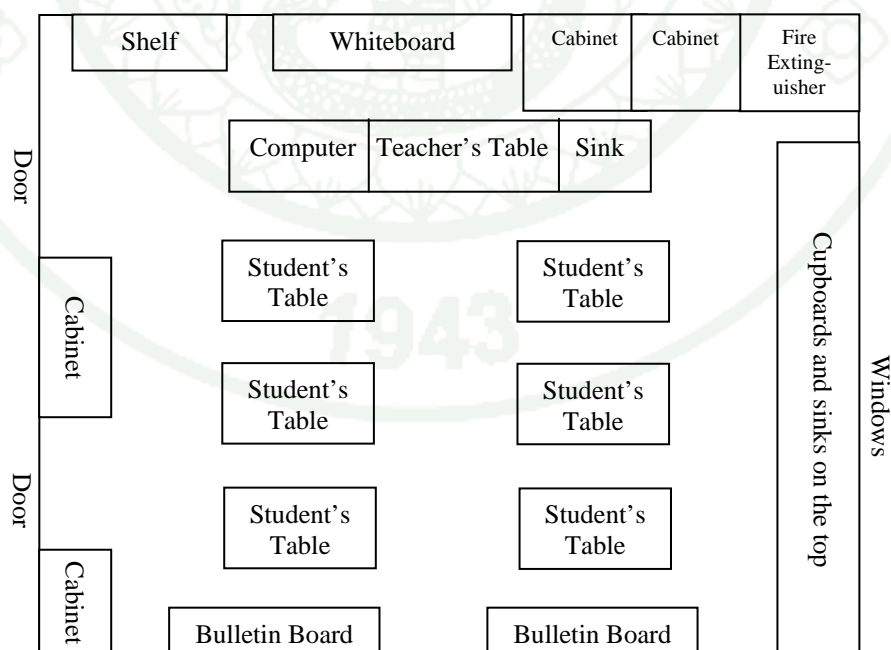


Figure 3 Layout of Napa's Classroom

Background Information of Cooperating teachers

The Case of Pattama

Pattama taught science at St. Paul School and was a Pattra's cooperating teacher. At the time of this study, Pattama was a 25 years old, female, in-service science teacher. For educational background, Pattama earned a bachelor degree in Science (Chemistry), from Nakornprathom Rajabhat University and a graduate diploma in Teaching Profession from Phetchaburi Rajabhat University. She started her teaching career as a science teacher at St. Paul school in year 2008. She had one year experience as a teacher. During the period of this study, 2009 academic year, she was assigned to teach 21 periods a week which including 8 periods for science in grade 8, 12 periods for science in grade 9, and 1 period for girl guide activities. Her science classes had approximately 44 students. After the head of Science department entrusted her to be a cooperating teacher for Pattra, she assigned Pattra to teach science in grade 9 instead of her for 9 periods, but the head of Science department assigned her the new responsibility to teach Chemistry in grade 10 for 6 periods. So she totally had teaching responsibility 18 periods a week for 2009 academic year and 9 other periods for supervising Pattra. Besides science teaching responsibility, Pattama also had other extra work including the dormitory teacher, the school cooperative officer and, and the supervisor of the science activity club.

Pattama did not have experience in supervising the pre-service science teachers. Pattra was the first pre-service science teacher that Pattama was responsible for supervising. The reason that the head of Science department entrusted her to be a Pattra's cooperating teacher was her teaching responsibility, teaching science in grade 9, met the requirement of the university which would like pre-service science teachers to practice their science teaching in lower secondary level. Furthermore, the head of Science department thought the age between Pattama and Pattra was not much difference, so it could result in a good relationship between two of them. With this reason, the head of Science department expected Pattra could sprightly share every opinion that emerged during the internship courses with Pattama.

The university did not inform or prepare anything for Pattama in supervising Pattra. The university did not clarify the role of cooperating teacher, the topic for supervising pre-service science teacher, and criteria for evaluating the pre-service science teacher during the internship courses. The pre-service science teacher just came to the school and gave the recommendation letter from the university to the school principal. Then the school principal asked the head of Science department to assign the science teacher in lower secondary level to be the cooperating teacher for pre-service science teacher. Pattama applied her previous experience when she was supervised by the university supervisor during her study in graduate diploma to supervise Pattra. Pattama has never conducted a Classroom Research project because she just started her career as a teacher in 2008, but she learned the concept of a Classroom Research in the Classroom Research course while she was studying in graduate diploma degree two years ago.

The Case of Jakchai

Jakchai taught science at St. Mary School and was a Juntima's cooperating teacher. At the time of this study, Jakchai was a 44 years old, male, in-service science teacher. For educational background, Jakchai earned a bachelor degree in Science (Biology) from Khonkaen University and another bachelor degree in education (Computer Education) from Phetchaburi Rajabhat University. He had started his career as a science teacher at St. Mary school 15 years ago. During the period of this study, 2009 academic year, he was assigned to teach 20 periods a week which including 6 periods for science in grade 8, 6 periods for science in grade 9, 2 periods for computer in grade 7, 2 periods for computer in grade 8, 2 periods for computer in grade 9, 1 period for ethics, and 1 period for boy scout activity. His science classes had approximately 30 students. After the school academic section informed him to be a cooperating teacher for Juntima, he assigned Juntima to teach science in grade 8 instead of him for 6 periods, so he totally remained his teaching responsibility for 14 periods a week for this academic year plus 6 periods in supervising Juntima. In addition to his teaching he also worked for the audiovisual section in the school, and the homeroom teacher for the students in 8A classroom.

Jakchai had one year experience in supervising the pre-service science teacher. He was assigned from the school academic section to be the Juntima's cooperating teacher because he already had experience in supervising a pre-service science teacher in 2008 academic year. Furthermore, his teaching responsibility, teaching science in grade 8, met the requirement of the university which would like the pre-service science teachers to practice their teaching during the internship courses in lower secondary level.

The university did not advise about the role of the cooperating teacher, and the topic the university would like him to supervise Juntima. In addition, the university did not provide any information to him to use as a guideline for supervising Juntima. The university just only contacted the school academic section and asked for the collaboration from the school academic section to choose the science teacher to take care of Juntima during the internship period. Jakchai prepared to supervise Juntima by applying his prior experience while he was the school mentor. Jakchai used to attend two workshops about conducting a Classroom Research project which were organized by the academic section of the St. Mary school. He used to conducted one Classroom Research project in the topic of 'Using questioning technique to enhance grade nine students' science achievement score'. The Classroom Research project that Jakchai conducted was of an informal format which consisted of 3-5 pages.

The Case of Dara

Dara taught science at St. Mary School and was a Napa's cooperating teacher. At the time of this study, Dara was a 28 years old, female, in-service science teacher. For educational background, Dara earned a bachelor degree in Science (Physics) from Silpakorn University and a graduate diploma in Teaching Profession from Phetchaburi Rajabhat University. She started her teaching career as a science teacher at St. Mary School five years ago in academic year 2004. During the period of this study, 2009 academic year, she was assigned to teach 24 periods a week which including 12 periods for science in grade 6, 6 periods for science in grade 7, 4 periods for mathematics in grade 7, 1 period for ethics, and 1 period for girl guide activity.

Her science classes had approximately 36 students. After she was appointed from the school academic section to be a cooperating teacher for Napa, she assigned Napa to teach science in grade 7 instead of her for 6 periods, so she retained her teaching responsibility for 18 periods a week for this academic year plus with 6 periods in supervising Napa. Besides her teaching responsibilities, Dara also had other extra work including the homeroom teacher for the students in 7A classroom, the school cooperative officer, and the staff of the school academic section.

Dara had one year experience in supervising pre-service science teachers. She was assigned from the school academic section to be the Napa's cooperating teacher because the school academic section would like Napa to practice her teaching in grade 7 that correspond to Dara responsibility. The school academic section assigned Napa to teach science in grade 7 because in the second semester of academic year 2008, Napa spent the time in the Practicum 3 course in this school. Napa was asked to write one lesson plan for demonstrating science teaching to the students in grade 8 for one period. The lesson plan and Napa teaching practice showed that she held a weak understanding of science content knowledge. The school academic section assigned Napa to teach science in the primary level for her following internship courses in this year, but it did not meet with the university requirements which would like the pre-service science teachers to practice their teaching during the internship courses in lower secondary level. The staffs of the school academic section finally assigned Napa to teach in grade 7 because they thought the science topics in grade 7 were not difficult when compared with the science topics in grade 8 and grade 9. They thought that assigning Napa to teaching science in grade 7 should be the best way to help her to teach science with confidence.

The university did not inform Dara with anything to help her in supervising Napa. The university did not clarify the role of cooperating teacher, and the topic that the university would like her to supervise Napa. In addition, the university did not give any evaluation forms to her. The university just sent the pre-service science teacher to the school and gave the recommendation letter from the university to the school principal. Then the school principal asked school academic section to choose

the science teacher to be the cooperating teacher for pre-service science teacher. Dara supervised Napa by applying her prior experience when she was supervised by the university supervisor during her study in her graduate diploma. Dara has never attended any workshops about conducting the Classroom Research project, but she took the Classroom Research course while she was studying for her graduate diploma degree. Dara used to conduct three Classroom Research projects on the topics of 'Reading the science problems to the grade six students for promoting their listening skill in the science classroom', 'Enhancing grade six students' learning by implementing the group process in science classroom', and 'Promoting grade seven students' calculating skill in mathematics classroom'. The Classroom Research projects that Dara conducted were of an informal format which consisted of 3-5 pages.

Background Information of University Supervisor

The Case of Permpon

Permpon was a university supervisor of Pattra, Juntima, and Napa. At the time of this study, he was a 59 years old, male, university lecturer in the faculty of Science. For educational background, Permpon earned a bachelor degree in Education (Physics Teaching), from Srinakharinwirot University and a master degree in Science (Physics) from Chiang Mai University. He has started his career as a university lecturer at Westernthani University 35 years ago. During the period of this study, 2009 academic year, he was assigned to teach undergraduate students in five courses which included Physics 1, Physics 2, Modern Physics, Electronics, and Electromagnetic. Each course was taught for three hours a week, so he had teaching responsibility for 15 hours a week. In addition to his teaching he also had other extra responsibilities such as the head of Physics department, the curriculum development board of the Westernthani University laboratory school, the guest speaker in Physics teaching for the schools around the Westernthani University, and the part-time lecturer for the provincial office of the non-formal and informal education. In the 2009 academic year, Permpon was assigned by the Westernthani University to be the university supervisor for six

pre-service science teachers who practiced their teaching in four difference professional development schools. He was assigned to be the university supervisor for the pre-service science teachers because he was now the only one in the faculty of Science that collaboratively worked with the staff from the faculty of Education in planning and implementing the field experience courses for the pre-service science teachers. The other university lecturers in the Faculty of Science graduated with pure and applied science degrees and they did not have experience in working collaboratively with the staff from the Faculty of Education, so they did not know how to supervise pre-service science teachers in science teaching during the internship period.

Permpon had six year experiences in supervising pre-service science teachers during the internship courses. He used to attend one workshop about conducting a Classroom Research project which was organized by the Faculty of Education, Westernthani University. He used to conduct the experimental research in the field of Physics, but he had never conducted a Classroom Research project in the field of Education.

Design for Current Research

This research study comprises of three main phases: the exploratory phase, the developmental phase, and the implementation phase.

The exploratory phase explores the pre-service science teachers' understanding of Classroom Research before engaging in the initiative. The pre-service science teachers understanding of Classroom Research is explored by questionnaire and semi-structured interview. All of the fifth-year eight pre-service science teachers in the Westernthani University who have been enrolled in the internship courses in the academic year 2009 were explored for their understanding about Classroom Research. The researcher distributed the questionnaires to the pre-service teachers on June 3rd, 2009, and interviewed them on June 9th-10th, 2009 (the first semester of academic year 2009).

The developmental phase aims to develop the initiative. The initiative was developed based on the collected data in the exploratory phase about the pre-service science teachers' understanding of Classroom Research before engaging in the initiative accompany with the cooperating teachers' and university supervisor's background information about the understanding of Classroom Research, the experiences in conducting Classroom Research, the experiences in supervising Classroom Research to the pre-service science teachers, and the supports that they preferred to receive for helping them to supervise Classroom Research to the pre-service science teachers. The researcher developed the Supervision Handbook of Classroom Research (SHCR) and organized the workshop for enhancing the cooperating teachers and university supervisor understanding of Classroom Research and for guiding them how to use the SHCR to supervise Classroom Research to the pre-service science teachers. The initiative was designed and developed during October, 2008 – July, 2009 under the supervision of research committee which consists of two science educators: one from the faculty of Education, Kasetsart University and one from the Department of Curriculum and Pedagogy, the University of British Columbia, Canada.

In the implementation phase, the researcher follows through the implementation of the initiative to study the impact of the initiative on pre-service teachers' practice of Classroom Research, the cooperating teachers' and university supervisor's supervision of Classroom Research to pre-service teachers, the development of pre-service teachers' understanding of Classroom Research, and the factors that support or hinder the pre-service science teachers' practice of Classroom Research. In this phase, the researcher selected three pre-service science teachers from eight pre-service science teachers in the exploratory phase by using purposive sampling for in-depth study. The research participants in this phase were three pre-service science teachers, three cooperating teachers, and one university supervisor who were responsible to supervise the selected three pre-service science teachers. One pre-service teacher and cooperating teacher was at the St. Paul School. Two pre-service teachers and cooperating teachers were at the St. Mary School. The initiative was implemented from July, 2009 to March, 2010. The researcher's role during the

implementation of the initiative was a facilitator for cooperating teachers and university supervisor. The researcher provided recommendations and guidance to cooperating teachers and university supervisor when they confronted difficulties or confusion in supervising Classroom Research to the pre-service teachers. The timeline in implementing the initiative is shown in table 2.

Table 2 The timeline in implementing the initiative

Stage of the Initiative	Responsibility of cooperating teachers and university supervisor	Timeline
Generating Research Question	Supervise pre-service teachers to explore the classroom situation and generate the research question	July – September 2009
Reviewing Literature	Supervise pre-service teachers to review literature and report the result of literature review	September – October 2009
Developing the Research Plan and Research Instrument	Supervise pre-service teachers to choose the research design for conducting the Classroom Research project, develop the intervention, and develop the research instrument	October – December 2009
Collecting Data	Supervise pre-service teachers to implement the intervention and research instrument in the classroom	January – February 2010
Analyzing Data	Supervise pre-service teachers to analyze the gathered data	February – March 2010
Writing the Classroom Research Report	Supervise pre-service teachers to write the Classroom Research report	March 2010

In this phase, the data that was collected from the pre-service teachers, the cooperating teachers, and a university supervisor formed the basis research findings of the case studies which was the principle research design employed in this research. Multiple data collection methods have been used in this phase. These were semi-structured interviews, journal writing, observation, and document reviews. The phases of study, research questions, instrument, and timeline are summarized in Table 3.

Table 3 Data Collection and Timeline

Phases of Study and Research Questions	Participants	Instrument	Timeline
Exploratory phase <i>RQ I:</i> What are the pre-service science teachers' understandings of Classroom Research before engaging in the initiative?	Eight fifth-year pre-service teachers	The Understanding of Classroom Research Questionnaire Pre-service teachers interview about understanding of Classroom Research before engaging in the initiative	June 2009 (First semester, academic year 2009)
Developmental phase		Supervision Handbook of Classroom Research (SHCR) Workshop	October 2008 (Second semester, academic year 2008) – July 2009 (First semester, academic year 2009)
Implementation phase <i>RQ II:</i> How do pre-service science teachers' understanding and practice of Classroom Research evolve over the course of the initiative?	Three fifth-year pre-service teachers from the first phase of the study	Pre-service teachers' journal about practice of Classroom Research Pre-service teachers interview about understanding of Classroom Research after engaging in the initiative Observation Pre-service teachers' Classroom Research report	July 2009 (First semester, academic year 2009) – March 2010 (Second semester, academic year 2009)

Table 3 (Cont'd)

Phases of Study and Research Questions	Participants	Instrument	Timeline
<i>RQ III</i> : What supports about Classroom Research do pre-service science teachers receive from the cooperating teachers and university supervisor over the course of the initiative?	Three fifth-year pre-service teachers from the first phase of the study Three cooperating teachers One university supervisor	Cooperating teachers and university supervisor journal about the supervision of Classroom Research to pre-service teachers Cooperating teachers and university supervisor interview about the supervision of Classroom Research to pre-service teachers	July 2009 (First semester, academic year 2009) – March 2010 (Second semester, academic year 2009)
<i>RQ IV</i> : What factors support or hinder the pre-service science teachers' practice of Classroom Research?	Three fifth-year pre-service teachers from the first phase of the study Three cooperating teachers One university supervisor	Interview about factors that support or hinder the pre-service teachers' practice of Classroom Research	March 2010 (Second semester, academic year 2009)

Data Gathering Methods and Data Analysis

This section discusses the objectives, the process of development and the structure of all instruments used in the three phases of study. The instruments used in this study include (from Table 3):

1. The Understanding of Classroom Research Questionnaire
2. Pre-service teachers interview about understanding of Classroom Research before engaging in the initiative
3. Supervision Handbook of Classroom Research (SHCR)
4. Workshop
5. Pre-service teachers journal about practice of Classroom Research
6. Pre-service teachers interview about understanding of Classroom Research after engaging in the initiative
7. Observation
8. Pre-service teachers' Classroom Research report
9. Cooperating teachers and university supervisor journal about the supervision of Classroom Research to pre-service teachers
10. Cooperating teachers and university supervisor interview about the supervision of Classroom Research to pre-service teachers
11. Interview about factors that support or hinder the pre-service teachers' practice of Classroom Research

1. The Understanding of Classroom Research Questionnaire

The researcher developed the questionnaire to explore the pre-service teachers' understanding of Classroom Research. There were three parts in the questionnaire which asked about the demographics of the pre-service teachers, understanding about Classroom Research, and the willingness to engage in the initiative for enhancing the pre-service science teachers' understanding and practice of Classroom Research.

Part 1: The demographics

The items of this part were check list. The pre-service teachers would be checked about sex, age, GPA score, and major field of the study.

Part 2: Understanding about Classroom Research

The items of this part were seven open-ended questions to explore the pre-service teachers' understanding about Classroom Research. The questions were regarding the concept of Classroom Research, and how to conduct each stage of Classroom Research project which were clarified into six stages: generating the research question; reviewing the related literature; developing the research instrument; collecting data; analyzing data; and writing research report.

Part 3: The willingness to engage in the initiative

The items of this part were check list. The pre-service teachers were asked to checked whether they were interested in to engage in the initiative for enhancing the pre-service science teachers' understanding and practice of Classroom Research or not.

The questionnaire was developed under the supervision of research committee. In addition, the questionnaire was sent to the other three educators who were the lecturers in the Classroom Research course (two from the Department of Education, Faculty of Education, Kasetsart University, and one from the Department of Education, Faculty of Education, Westernthani University) for approval of format, content, and wording. Feedback involved clarifying jargon, disambiguating items, and adding items to ensure a broad sampling of understanding of Classroom Research. The researcher revised the questions in the questionnaire after receiving feedbacks. Then the questionnaire was tried out with 15 pre-service science teachers at a university in Nakornprathom province, Thailand to make sure that the questionnaire would be sufficient and appropriate in terms of language, number of items, and time

needed to complete the questionnaire. The questionnaire is available in Appendix A. The pre-service teachers were allowed an hour to complete the questionnaire.

2. Pre-service teachers interview about understanding of Classroom Research before engaging in the initiative.

Semi-structured interviews were conducted with all eight pre-service teachers after they completed the Understanding of Classroom Research Questionnaire. The interview protocols were derived from the questions in the questionnaire in order to clarify their understanding that the researcher did not clearly understand from the answers in the questionnaire. The interview protocols were commented by advisory committee and the three educators who reviewed the questionnaire. Interview data was recorded by audiotape recorder. Transcription was completed soon after an interview had occurred. The interview protocols are shown in Appendix B. The average interviews time were 20 minutes for each pre-service teacher. Interviews were audio taped and transcribed.

3. Supervision Handbook of Classroom Research (SHCR)

The Supervision Handbook of Classroom Research (SHCR) was developed by the researcher. To design and develop the SHCR, the researcher took into consideration the findings of the pre-service teachers' understanding of Classroom Research in the exploratory phase in conjunction with the cooperating teachers' and university supervisor's background information from the interviews about the understanding of Classroom Research, the experiences in conducting Classroom Research, the experiences in supervising Classroom Research to the pre-service science teachers, and the supports that they preferred to receive for helping them to supervise Classroom Research to the pre-service science teachers. The SHCR is intended to enhance the cooperating teachers' and university supervisor's understanding of Classroom Research concept, the stages in conducting a Classroom Research project, and to guide the idea how they can supervise the pre-service teachers to conduct a Classroom Research project. The researcher studied the concept

in conducting Classroom Research project from various text books and research articles. The content of SHCR consisted of seven topics: general concept of Classroom Research, generating research question, reviewing literature, developing the research plan and research instruments, collecting data, analyzing data, and writing a Classroom Research report. The SHCR was developed under the supervision of research committee and it was reviewed by two educators from the Department of Education, Faculty of Education, Kasetsart University.

4. Workshop

The researcher organized the one-day workshop named “The supervision of Classroom Research to the pre-service science teachers” for introducing the SHCR to the three cooperating teachers and a university supervisor who were responsible to supervise the three pre-service science teachers which were selected to be the research participants for in-depth study of the research project. First, the findings of pre-service science teachers understanding of Classroom Research from the first phase of the study were presented to show which topics of Classroom Research the pre-service teachers understood or did not understand. Then the researcher discussed with cooperating teachers and university supervisor about the information according to seven topics in the SHCR. The cooperating teachers and a university supervisor were given opportunity to share the ideas in implementing the SHCR that the researcher distributed to them to supervise Classroom Research to the pre-service teachers. After the discussion in each topic, the cooperating teachers and university supervisor were asked to do the activity sheets for assessing their understanding in supervising Classroom Research to the pre-service science teachers. In the end of the workshop, the researcher discussed his role in this study and then he summarized the timeline in implementing the initiative to the cooperating teachers and university supervisor. The workshop was run twice before they started to supervise Classroom Research to the pre-service science teachers because the cooperating teachers in the professional development schools and the university supervisor could not find free time on the same day. The first workshop was organized on July 11th, 2009 for the two

cooperating teachers in St. Mary School. The second workshop was organized on July 12th, 2009 for a cooperating teacher in St. Paul School and a university supervisor.

5. Pre-service teachers journal about practice of Classroom Research

While implementing the initiative, each pre-service teacher was asked to write journal entries following 6 topics which were proposed by the researcher and was reviewed by the thesis advisor. The topics of the journals focused on how they conducted their Classroom Research project in each stage: generating research question, reviewing literature, developing the research plan and research instruments, collecting data, analyzing data, and writing a Classroom Research report. In addition, they were also asked to write down about their cooperating teachers and university supervisor supervision of Classroom Research in each stage. The pre-service teachers journal about practice of Classroom Research is available in Appendix C.

6. Pre-service teachers interview about understanding of Classroom Research after engaging in the initiative

When the pre-service teachers completed their Classroom Research project, they were interviewed about their understanding of Classroom Research after engaging in the initiative regarding the concept of Classroom Research, generating the research question; reviewing literature; developing the research instrument; collecting data; analyzing data; and writing a research report. The interview protocols came from the question in part 2 of the Understanding of Classroom Research Questionnaire and the question in the interview protocol about understanding of Classroom Research before engaging in the initiative. The pre-service teachers in St. Mary School were interviewed on March 18th. A pre-service teacher in St. Paul School was interviewed on March 19th, 2010. The average interviews time were 30 minutes for each pre-service teacher. The interview conversations were audiotape recorded and consequently transcribed and analyzed. The interview protocols are shown in Appendix B.

7. Observation

During the implementation of the initiative, the pre-service teachers teaching practice were observed and recorded by videotape recorder in order to see how pre-service teachers implemented the lesson plans that they developed for using in the Classroom Research project. The number of observations was different depending on the lesson plans that each pre-service teacher developed for using in their Classroom Research project. Pattra was observed five times on 8, 15, 22 January, 2010 and 5, 19 February, 2010 while she was teaching the topics of the solar system, planets in the solar system, universe and galaxy, fixed stars, and space technology respectively. Juntima was observed five times on 15, 22, 29 January, 2010 and 9, 12 February, 2010 while she was teaching in the topics of physical and chemical changing and states of the matters, changing of states of the matters and closed system and opened system, energy and melting, energy and chemical reaction, and the effects of chemical reaction towards the human and environment respectively. Napa was observed four times on 26 January, 2010 and 2,9,16 February, 2010 while she was teaching the topics of cell structure and cell duty, diffusion process, osmosis process, and photosynthesis process respectively. During the observation, the researcher was a non-participant observer.

8. Pre-service teachers' Classroom Research report

The pre-service teachers' Classroom Research report was another source of information that the researcher used for investigating the pre-service teachers' practice of their Classroom Research projects. The researcher used the information in the pre-service teachers Classroom Research reports to triangulate with the data that was collected from interviewing and journal entries about why the pre-service teachers conducted the Classroom Research project with the students in the class that they selected, what was the research question, what were the topics that they wrote in the literature review, what was the research design of their study, how they collected data, how they analyzed data, and how they wrote the Classroom Research reports.

The researcher collected the pre-service teachers' Classroom Research reports in March 2010 (the end of the second semester of the 2009 academic year).

9. Cooperating teachers and university supervisor journal about the supervision of Classroom Research to pre-service teachers

During the implementation of the initiative, each cooperating teacher and university supervisor was asked to write journal entries every time after they supervised the Classroom Research to each pre-service teacher. The topics that they wrote about were regarding how they supervised the pre-service teachers to conduct the Classroom Research projects in six stages: generating the research question; reviewing literature; developing the research plan and research instruments; collecting data; analyzing data; and writing a research report. The topics of the journals were reviewed by the thesis advisor. The cooperating teachers and university supervisor journal form about the supervision of Classroom Research to pre-service teachers is available in Appendix D.

10. Cooperating teachers and university supervisor interview about the supervision of Classroom Research to pre-service teachers

The researcher interviewed each cooperating teacher and university supervisor to clarify some points that the researcher did not understand clearly enough regarding the collected information from their journal entries throughout the initiative. The interviews focused on the supervision of Classroom Research to each pre-service teacher following six stages of conducting Classroom Research project that were mentioned in the SHCR: generating the research question; reviewing literature; developing the research instrument; collecting data; analyzing data; and writing a research report. The interview conversations were audiotape recorded and consequently transcribed and analyzed. The interview protocols are shown in Appendix B.

11. Interview about factors that support or hinder the pre-service teachers' practice of Classroom Research

After the pre-service teachers completed their Classroom Research project in March 2010, the pre-service teachers, cooperating teachers, and university supervisor were interviewed to express their opinions about the factors that support or hinder the pre-service science teachers' practice of Classroom Research. The pre-service teachers and cooperating teachers in St. Mary School were interviewed on March 18th. The pre-service teachers and cooperating teachers in St. Paul School and a university supervisor were interviewed on March 19th, 2010. The average time for each interview was about 30 minutes. The interview conversations were audiotape recorded and consequently transcribed and analyzed. The interview protocols are shown in Appendix B.

Data Analysis in the First Phase

The research focus of this phase is to find out the pre-service teachers' understanding of Classroom Research before engaging in the initiative. The approach to analysis involved an inductive process to establish themes. All transcripts of the semi-structured interview were transcribed verbatim and typed out. First, the data from the questionnaire and interview transcripts were read and re-read. The researcher categorized statements which drawn from each pre-service teacher to determine the differences and commonalities between the pre-service teachers' understanding of Classroom Research. Then the researcher identified the common themes about the three cases pre-service teachers. Finally, the quotes from the pre-service teachers were presented to support the themes.

Data analysis in the Third Phase

The process of analyzing data in this phase involved an inductive process which was the same as mentioned in the first phase. Interview data from all audiotaped were transcribed verbatim and typed out. Observational data from

videotaped were transcribed. The researcher read and re-read the data from interview and observation transcripts, journal entries, and pre-service teachers Classroom Research report to identify themes about the pre-service teachers' understanding of Classroom Research after engaging in the initiative, the pre-service teachers' practice of Classroom Research, the cooperating teachers' and university supervisor's supervision of Classroom Research to the pre-service science teachers, and the factors that support or hinder the pre-service teachers' practice of Classroom Research. The quotes from the pre-service teachers, cooperating teachers and university supervisor were presented to support the themes. These data provide full descriptions of situations that occurred while implementing the initiative throughout the research study.

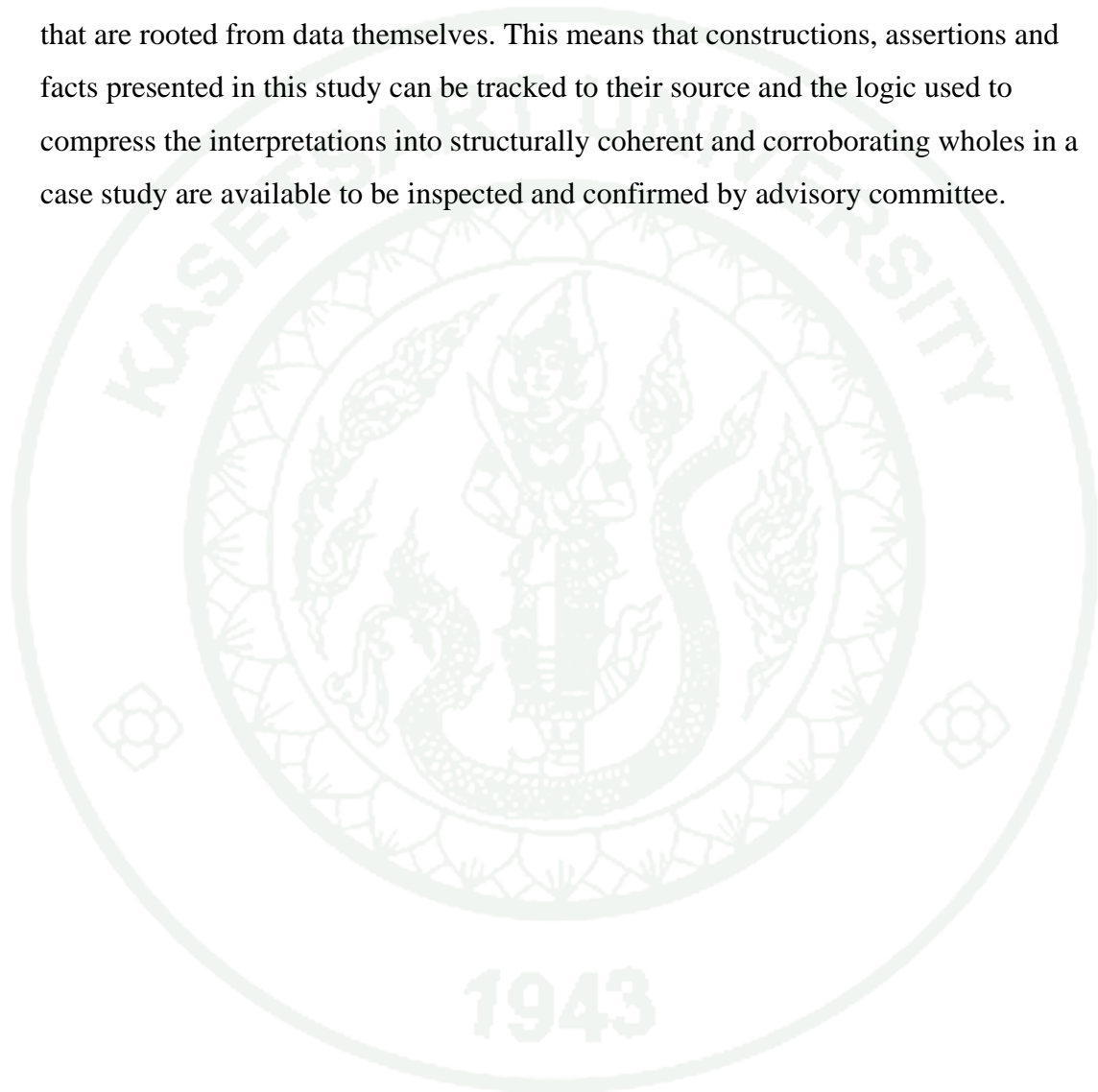
Strategies to enhance the trustworthiness of this research study

To ensure the credibility of this study, the researcher studied the participants in their school contexts for a substantial period of time. Triangulation in this study refers to the use of multiple data collection methods and multiple data sources. Multiple data collection method included journal entries, interviews and pre-service teachers' Classroom Research report. Journal entries and interviews come from the three group of research participants included pre-service teachers, cooperating teachers, and university supervisor. Member checking was another technique used to promote credibility of the study. The research participants were given a copy of transcripts and interpretations of the data gathered from the interviews to check whether the transcripts and the interpretations were consistent with their answers or meanings.

To ensure the transferability of this study, the researcher wrote in-depth descriptions and used multi-case studies in the research study to explain the context of the study and the findings. The researcher described the context of the situation being studied in detail, in order to help the readers to make judgments about the applicability of the findings.

The dependability of this study was enhanced by providing clear descriptions of research methods used to collect data, the context of the study, and the process to analyze and to triangulate the collected data.

To address confirmability, this research assures the integrity of the findings that are rooted from data themselves. This means that constructions, assertions and facts presented in this study can be tracked to their source and the logic used to compress the interpretations into structurally coherent and corroborating wholes in a case study are available to be inspected and confirmed by advisory committee.



CHAPTER IV

THE EXPLORATION OF PRE-SERVICE SCIENCE TEACHERS’ UNDERSTANDING OF CLASSROOM RESEARCH BEFORE ENGAGING IN THE INITIATIVE

Overview of the Chapter

This chapter provides the results of the data analysis to answer the first research question, namely: “What are the pre-service science teachers’ understandings of Classroom Research before engaging in the initiative?” The pre-service science teachers were asked to complete the Understanding of Classroom Research Questionnaire and followed by an interview regarding the Classroom Research in order to clarify their understanding of Classroom Research at the beginning of June, 2009. In this chapter, the common findings across the three case-study pre-service science teachers are illustrated and discussed. Throughout the dissertation, pseudonyms, Pattra, Juntima, Napa, Pattama, Jakchai, Dara, and Permpon are used to protect the three pre-service science teachers’, the three cooperating teachers’ and the university supervisor’s identities respectively.

Pre-Service Science Teachers’ Understanding of Classroom Research Before Engaging in the Initiative

The Concept of Classroom Research

**Classroom Research was conducted for promoting students’ learning or
Classroom Research is a step-by-step problem-solving process.**

Pattra and Napa perceived the concept of Classroom Research as a process that the teachers implemented new teaching technique into the classroom for promoting the students’ learning. For Pattra, Classroom Research was small scale

research that she could conduct in her classroom context by employing a new teaching technique which she learned from the teaching methodology course in the classroom. Then she observed the results of the new teaching technique whether it could promote the students' learning or not (Pattra's response in the questionnaire: June, 2009). Pattra explained more details during the interview as the following

“The new teaching technique for conducting the Classroom Research means the technique that can promote the students' participation in the classroom. It is not a teaching by lecturing. If my students gain more achievement score compared with the teaching by lecturing, it means the new teaching technique is effective in promoting the students' learning” (Pattra's interview #1: June 9th, 2009).

According to Napa, Classroom Research was a process that she organized various kinds of learning activity into the classroom to enhance the student's learning achievement, as she illustrated below

“Classroom Research means introducing learning activities to the students such as group discussion, doing science experiment, and watching VCD or DVD about the topic which the students learned. The intention of Classroom Research is to encourage the student's motivation to learn and to help low-achievement students to improve the score or/and to promote high-achievement students to gain more and more score” (Napa's interview #1: June 9th, 2009).

On the other hand, Juntima understood Classroom Research as a step-by-step problem solving process that has many purposes. She thought that Classroom Research was complicated and could be conducted by the experienced teachers to solve the problems in their day-to-day teaching. According to her, the purposes of Classroom Research were to formulate new theory in education and to generalize the research results to another similar context. She responded in the questionnaire as follow

“Classroom Research was the research done by the university lecturers or the school teachers who have taught for many years in order to solve the problems that occurred in routine teaching. There were four steps in conducting a research which the researchers should follow step by step including, identifying the problem, developing the research instrument, collecting data, and analyzing and interpreting data. The purposes of the Classroom Research were 1) to find new knowledge for formulating new theory in education; 2) to use the research result to determine the strategy for solving another similar problem; and 3) to use the research result for predicting the similar situations which occur in another context in the future (Juntima’s response in the questionnaire: June 3rd, 2009).

Generating Research Question

The research question comes from the researcher’s interest or from the other person suggestion.

Pattra and Napa understood that research question came from their interest. The research question should be manageable within the time available for conducting the Classroom Research project. According to Pattra, the research question did not come from the classroom situation but it came from her interests and concerns. She thought that she could generate the research question by reviewing literature and select a question that she was interested in to try out in her classroom, as she stated

“I can generate the research question by reviewing literature and selecting a question that I am interested in to try out in my classroom. To generate the research question, I consider in two aspects. First, the research question must be manageable and suitable with my ability. I must ensure I have enough knowledge to find the way to answer the research question. Second, the research question should be worthwhile for investigation and it must be fit in time that I have for completing my Classroom Research project. I have to

finish Classroom Research project in my internship period in the school” (Pattra’s interview #1: June 9th, 2009).

For Napa, a research question in her Classroom Research project should come from her interest and should be manageable. There were variety of techniques that could be used to generate the research question such as analyzing students’ achievement scores, observing the students’ behavior, and checking the students’ exercise books, as Napa explained

“Generating the research question is very important for me in conducting my Classroom Research project because it is the first time for me to conduct a research. If the research question is difficult to collect the data for finding the answer, I am afraid I will not finish my Classroom Research project before the end of the internship period. The research question should be easy for collecting the data to answer it. The research question that I am now interested in is about promoting the students’ learning by organizing various kind of learning activities in the classroom” (Napa’s interview #1: June 9th, 2009).

In contrast, Juntima did not have idea for generating research question. She would like her university supervisor or cooperating teacher generated the research question for her. Juntima expressed her idea during the interview as

“I do not have any ideas for generating research question because it is just one month of my teaching experience in the school. I do not have many experiences in teaching. I do not know what problem occurs in my classroom. I would like my university supervisor and/or cooperating teacher who have more teaching experience to tell me about ‘what problem in the classroom that I should select for generating my research question” (Juntima’s interview #1: June 9th, 2009).

Reviewing Literature

Reviewing literature provides a theoretical framework or is used to find ideas to generate the research question for conducting the Classroom Research project.

Juntima and Napa understood that reviewing literature meant linking the research topic with the educational theories found in books, theses, and research articles for providing the theoretical framework to the Classroom Research project. For Juntima, reviewing literature is to relate the research topic to the previous research findings to gain more insight about the investigation. The literatures were the research articles and theses. In addition, she stated that reviewing literature gave a chance for her to see research methodology that was employed in other studies for guiding her idea in conducting her Classroom Research project, as she explained

“Reviewing literature helps me identify what has been done before and it enhances my understanding of the issues associated with my research topic. Reviewing the literature helps me gain insights about the topic as well as guides me to seek for appropriate activities in conducting Classroom Research project. I can see some examples of teaching techniques used by other teachers; the results of using each teaching technique; and methods for collecting and analyzing data. This knowledge is very useful for me in writing my research framework” (Juntima’s interview #1: June 9th, 2009).

According to Napa, reviewing literature provided her with more understanding about educational theories related to the research topic that she would like to conduct in her Classroom Research project. She indicated

“The university library provides a large amount of information for reviewing literature. My university library has a lot of books, theses and research articles for investigating. Reviewing literature provides a theoretical framework for my Classroom Research project. It helps me bridge theories in education onto

my research project. For example, if I would like to implement the inquiry learning approach for promoting the students' motivation to learn in my classroom, I should review about 'what the concept of inquiry learning is', and 'how proper learning activities are organized based on inquiry learning'. Bridging the educational theories with my research topic produces the credibility to my Classroom Research project because it shows that my study derived from the educational theories which appear from the books and other previous research" (Napa's interview #1: June 9th, 2009).

On the other hand, Pattra understood about reviewing literature in different way. She understood that reviewing literature meant the process that she immersed herself with books, dissertations, and research articles for finding the ideas to generate the research topic and research question in her Classroom Research project, as well as to sharpen the focus of her study. She stated

"When I review the literature, I will go to the university library and search for books, dissertations, and research articles to see the trends of research topics and research questions conducted by the others in the present time. The information gain from reviewing literature can help me generate the research topics and research questions. If my research topic and research question is up-to-date, it shows that my Classroom Research project is interesting and valuable to carry out. Reviewing literature also helps me decide whether the research question which I am interested in is appropriate and feasible" (Pattra's interview #1: June 9th, 2009).

Developing Research Instruments

The research instruments should be developed by researcher and be approved by experienced persons and tried out before collecting data or should be chosen from previous research.

Pattra and Juntima understood that the research instruments for collecting data were questionnaire, interview, test, and observation. The research instruments should correspond with the type of data that needed to be collected for answering the research question. The research instruments should be verified and approved by experienced person such as cooperating teacher or university supervisor and then tried out before using to collect data in order to make sure the research instruments could provide the valid data for answering the research question. For Pattra, the resources used for developing the research instruments were the teacher's handbook and textbooks from variety of publishers. Before using the research instruments in the classroom, they should have been approved by some experienced and knowledgeable persons, as she explained

“It is very essential to send the research instruments such as the pre-test and the post-test that are developed to my cooperating teacher and my university supervisor for verifying the efficiency of the research instruments. My cooperating teacher and my university supervisor have more experience than me so they can help me examine whether the research instruments can provide data for answering my research question or not. If the research instruments are verified and approved by the experienced persons like my cooperating teacher and my university supervisor, it means the research instruments are valid to be used in my Classroom Research project and will produce the reliable data for the research” (Pattra's interview #1: June 9th, 2009).

According to Juntima, developing the research instruments composed of five steps: 1) reviewing literature for getting the idea about constructing a pre-test and a post-test; 2) constructing test items for the pre-test and post-test and making sure the test items covered all of the content that students learned; 3) sending the test drafts to the cooperating teacher and university supervisor for recommendations and checking for content validity; 4) revising and editing the tests following the cooperating teacher's and university supervisor's recommendations; 5) trying out the tests and then using the tests for collecting data with the research participants. According to the

five-steps of research instrument development mentioned earlier, trying out the research instrument was the most crucial step. She explained

“The important thing I keep in mind for developing the research instrument is that the research instruments, the pre-test and post-test, should be tried out before using them in the classroom because it will inform me about the weaknesses of the pre-test and post-test. Trying out the tests can tell me about language that I use in them whether they are clear enough for the students to understand. If the wordings are difficult for the students to understand, I can revise them for producing the best result in evaluating the students’ learning” (Juntima’s interview #1: June 9th, 2009).

In contrast, Napa did not understand about developing the research instruments. She understood that research innovations such as lesson plans and instructional materials were the research instruments. She explained that a development of research instruments could be carried on by studying various formats of instructional materials or learning activities employed in previous research. Then she chose one learning activity or instructional material that she was interested in and applied in her classroom to observe the outcome of students’ learning after applying the learning activity or instructional material in her classroom, as she explained

“I can develop the research instruments by first reading the research articles or former pre-service science teachers’ Classroom Research reports to find out what learning activities or instructional materials were used in those research. Then I choose one learning activity or instructional material that I am interested in and applied in my classroom. I observe the outcome of students’ learning with the activity or instructional material that I applied in my classroom. Finally, I compare it with the results found in the previous research” (Napa’s interview #1: June 9th, 2009).

Collecting Data

There are various methods that can be used to collect data.

All three pre-service teachers understood that they could use many methods for collecting data such as pre-test, post- test, questionnaire, interview, and observation. But the reasons for each pre-service teacher to choose methods for collecting data are vary. For Pattra, to select the data gathering methods, she paid attention to the evidence that she needed and the time available for her to complete the Classroom Research project, as she expressed

“I can use many kinds of data gathering methods in my Classroom Research project such as, using questionnaire, conducting interview, giving a test, and observing actions. Each data gathering method has its own strengths and weaknesses, so it is important for me to choose the right method for collecting the data for my Classroom Research project. The criteria, for me, to select data gathering methods are: 1) it must provide the data that can answer my research question and 2) it must be suit with the timeline for carrying out my Classroom Research project. Interviewing may not be the appropriate method for my Classroom Research project because it takes time for me to transcribe”
(Pattra’s interview #1: June 9th, 2009).

According to Juntima, to choose the type of data gathering methods, she considered about the type of data that she needed to answer the research question. She stated

“Questionnaire, interview, test, and observation are common methods usually used for collecting data. If I want to collect quantitative data, such as student achievement score, test should be used as my data collection method. On the other hand, an interview should be used, if I want to collect the qualitative data, such as students’ opinion, student’s attitude. The data collection methods depends on the research question that is generated by considering about which

type of data needed to collect for answering the research question” (Juntima’s interview #1: June 9th, 2009).

Napa also understood that there were a variety of methods to collect the data included questionnaire, interview, test and observation. But the data collection methods employed in the Classroom Research project should be feasible and suitable with the timeframe to carry out the Classroom Research project, as she stated

“In selecting data collection methods, I consider about how it is difficult for me to collect the data. I have many responsibilities during the internship period. I do not have much time to devote to collect the data. I think a test is the simple form of data collection methods and most suitable to be used in my Classroom Research project. This method is useful for collecting the data from a large number of students within a short period of time” (Napa’s interview #1: June 9th, 2009).

Analyzing Data

Descriptive statistics are used to analyze data.

Pattra and Juntima understood that data could be analyzed by using descriptive statistics such as frequency, percentage, mean, standard deviation, and t-test. They stated that data analysis was a process of manipulating the collected data to find the meaning of collected data for answering the research questions and to test the research hypotheses. Pattra explained that

“There were five steps for analyzing the data including 1) considered the hypotheses of the research that have already been made before conducting the Classroom Research project; 2) checked the entirety and accuracy of collected data; 3) determined the statistical methods such as percentage, frequency distribution, the average (mean) that will be employed for analyzing the data; 4) calculated the statistic value; and 5) presented the finding of the research by

explaining whether the research findings accepted or rejected the research hypotheses” (Pattra’s response in the questionnaire: June 3rd, 2009).

According to Juntima, the data could be analyzed by first examining the students’ scores gained from the pre-test and post-test. Then she calculated the statistical value such as frequency, percentage, mean, standard deviation, and t-test. Finally, described how the collected data could answer the research question (Juntima’s response in the questionnaire: June 3rd, 2009).

However, Napa had no idea about data analysis. She did not see the difference between the process of data collection and data analysis, as she stated

“The data can be analyzed by employing the questionnaire, interview, observation, and test with the students in the classroom to get the information from them. A questionnaire and test provide quantitative data. An interview and observation provide qualitative data” (Napa’s interview #1: June 9th, 2009).

Writing a Classroom Research Report

Classroom Research report is the same format as the thesis-typed format.

All three pre-service teachers understood that the Classroom Research report comprised of five chapters like the thesis-typed format included: chapter 1- introduction and background of the study; chapter 2- related literature; chapter 3- research methodology; chapter 4- results of the study; and chapter 5- conclusion, discussion, and recommendations for further studies. Each pre-service teacher provided additional details about writing the Classroom Research report. For Pattra, she proposed that bibliography, appendix, and the researcher’s profile should be attached on the back part of the research report (Pattra’s interview #1: June 9th, 2009).

For Napa, she elaborated that the Classroom Research report should be written very clearly in such a way that the research could be replicated by the others who are interested in conducting similar Classroom Research topic (Napa's interview #1: June 9th, 2009).

For Juntima, she expressed that the Classroom Research report could also be written in an informal format which may comprise of three to five pages, but it should provide important details about background of the study, research question(s), purposes of the study, data collection methods and data analysis process, research findings, and recommendation for further studies (Juntima's response in the questionnaire: June 3rd, 2009).

Discussions in Relation to the First Research Question

The discussions of the pre-service science teachers' understanding of Classroom Research before engaging in the initiative are provided below.

Conducting Classroom Research is to promote the students' learning or to use the research result to determine the strategy for solving another similar problem.

The pre-service teachers understood the concept of Classroom Research in two ways. First, Pattra and Napa understood that Classroom Research intended to promote the students' learning by implementing new teaching technique in the classroom. This notion agree with the notion of Tabachnick and Zeichner (1998), Ritjaroon (2004), and Wongwanich (2007) which mentioned that Classroom Research is research that is conducted by the teachers for improving their own teaching practices and to enhance the students learning. Classroom Research is conceived as a small scale intervention for investigating alternative strategies or innovations to develop student's learning. Second, Juntima understood Classroom Research as a step-by-step problem solving process which intended to generalize the research results to another similar context. This notion did not agree with Noffke and Zeichner (1987), Wongcherdtum (2006),

Wongwanich (2007), and Johnson (2008) in that Classroom Research is a research undertaken by teachers in order to increase the understanding of their own teaching practice and/or to increase the capability in solving problems and making decisions. The essential characteristic of Classroom Research is that it is conducted by the teachers in their classroom context for solving a local problem in the classroom and immediately applies the research results to develop the teachers' teaching practices for the most benefit of their students. Classroom Research does not intend to generalize conclusions or to apply the research results to large populations because Classroom Research is usually conducted with the small sample size and there are many variables that are uncontrolled or unaccounted for.

Research question did not ground in the classroom context.

Pattra and Juntima did not understand about generating the research question. The research question did not emerge from the classroom context. Pattra understood that the research question was generated by reviewing literature and select a question in the previous research that she was interested in to try out in her classroom. For Juntima, she would like her university supervisor or cooperating teacher generated the research question for her. Only Napa understood about generating the research question. For her, the research question grounded in the classroom situation by analyzing students' achievement scores, observing the students' behavior, and checking the students' exercise books. This notion corresponded with Tabachnick and Zeichner (1998), Kerdtum (2002), Mills (2006), and Johnson (2008) in that the research question should ground in the classroom context because Classroom Research tries to find the solution of a problem in the classroom with the intention of improving teachers' teaching practice and/or promoting the students' learning.

Reviewing literature provides a theoretical framework for the Classroom Research project or finds the ideas to generate the research question or to see research methodologies that are used in other studies.

All three pre-service teachers understood about reviewing literature. They understood that reviewing literature meant linking the research topic with the educational theories found in books, theses, and research articles to provide theoretical framework for the study. In addition, reviewing literature also gave them the idea in generating the research question and allowed them to see research methodologies that were employed in other studies for guiding the idea in conducting their Classroom Research project. This finding agreed with Mertler (2006), Johnson (2008), and Ross-Fisher (2008) which proposed that reviewing literature means relating the research question to the theory and the finding of previous research that appeared in academic journals, books, theses, school or district documents, and web sources. In addition, Koshy (2005) and Mertler (2006) expressed that reviewing the literature helped the researchers to see the examples of classroom applications about teaching techniques, the results of each teaching technique, and methods of data collection and data analysis. Reviewing literature gave the ideas to the researchers about the method for gathering and analyzing data that they may employ in their study.

The research instruments should be reviewed by the experienced persons and tried out before implementing with the research participants.

Pattra and Juntima understood about developing the research instruments. They mentioned that the research instruments should be verified and approved by experienced person and then tried out before using to collect data to make sure the research instruments will provide the valid data for answering the research question. This finding agreed with Ritjaroon (2004) and Wongcherdtum (2006) which mentioned that there were five steps in developing the test included reviewing the literature to get the ideas for developing the test, developing the test, sending the test to the experts for recommendations, revising the test following the experts' recommendations and tried out the test, second revising the test and implementing the test with the research participants. In contrast, Napa did not understand about developing the research instruments. She expressed that a development of research instruments could be operated by studying various formats of instructional materials

or learning activities from previous research and selected one instructional material or learning activity to try out in the classroom.

There are various methods that can be used to collect data.

All three pre-service teachers understood that they could use many methods for collecting data such as pre-test, post-test, questionnaire, interview, and observation. This finding was consistent with Kerdtum (2002), Ritjaroon (2004), Mills (2006), Wongwanich (2007), and Johnson (2008) which mentioned that a researcher may employ various methods for collecting data such as observation, questionnaire, interview, and test depended on the type of data that needed to answer the research question.

The data can be analyzed by using descriptive statistic.

Pattra and Juntima understood that data could be analyzed by using descriptive statistics such as frequency, percentage, mean, standard deviation, and t-test. This finding agreed with Kerdtum (2002), Taber (2007), Johnson (2008), Ross-Fisher (2008), and Sanghiran (2010) which mentioned that the way to analyze data depended on the type of data which had been gathered. It commonly used descriptive statistics e.g. percentage, mean score, and standard deviation to analyze quantitative data in a Classroom Research project.

The Classroom Research report comprises of five chapters.

All three pre-service teachers understood that the Classroom Research report comprised of five chapters like the thesis-typed format included: chapter 1- introduction and background of the study; chapter 2- related literature; chapter 3- research methodology; chapter 4- results of the study; and chapter 5- conclusion, discussion, and recommendations for further studies. This finding aligned with Wongcherdtum (2006), Mertler (2007), and Johnson (2008) in that a Classroom Research report is written using an academic writing style which usually comprised of

five chapters: chapter 1- introduction; chapter 2- review of the literature; chapter 3- research methodology; chapter 4- findings; and chapter 5- conclusion. Academic writing enhances the credibility of the report. The prime directive in academic writing is clear communication, thus, ideas are presented in a logical or clearly manner so that the reader is able to gain a maximum amount of understanding within a minimum amount of time and effort.

In summary, all pre-service science teachers understood about Classroom Research in the topics of reviewing literature, collecting data, and writing a Classroom Research report. On the other hand, the pre-service science teachers had alternative understanding about Classroom Research in the topics of the purpose of Classroom Research, generating the research question, developing the research instruments, and analyzing data.

CHAPTER V

DEVELOPMENT OF THE INITIATIVE

Overview of the Chapter

This chapter discusses the process of developing the initiative that aims to enhance the cooperating teachers and university supervisor understanding of Classroom Research and the ability in supervising Classroom Research to pre-service science teachers for promoting the pre-service science teachers' understanding and practice of Classroom Research.

Reasons to Develop the Initiative

Results From the Exploratory Phase

The exploratory phase revealed that the pre-service science teachers had alternative understanding about Classroom Research in the topics of the purpose of Classroom Research, generating the research question, developing the research instruments, and analyzing data. For the purpose of Classroom Research, one pre-service teacher understood that the purposes of Classroom Research were to formulate new theory in education and to generalize the research results to another similar context. For generating the research question, two pre-service teachers did not understand in the way that the research question should come from the classroom situations. They understood that the research question could be generated by reviewing literature and select a question in the previous research to try out in the classroom or asking the university supervisor or cooperating teacher to generate the research question for them. For developing the research instrument, one pre-service teacher understood that the research instruments could be developed by studying various formats of instructional materials or learning activities from previous research and selected one instructional material or learning activity to try out in the classroom. For analyzing data, one pre-service teacher had no idea about data analysis. She

understood that the data could be analyzed by employing the questionnaire, interview, observation, and test with the students in the classroom to get the information from them.

Results From the Background Information of the Cooperating Teachers and a University Supervisor

The background information from the interviews of the cooperating teachers and the university supervisor showed that they thought they had not enough understanding about conducting a Classroom Research project. For example in generating the research question, they would like to know the criteria for selecting the problems in the classroom to generate the research questions. In reviewing literature, they were uncertain about how much literature should be reviewed for conducting the Classroom Research project and how to report the results of the literature review. In analyzing data, they would like to know more how to calculate the statistics values such as standard deviation. In writing research reports, they were not sure about the information that should be included in the Classroom Research report. All three cooperating teachers did not know their role in supervising the Classroom Research to the pre-service teachers. They indicated that the university did not clarify the role of cooperating teacher and the topics that they should supervise the pre-service teachers in conducting a Classroom Research project. The cooperating teachers preferred the university to clarify the role of the cooperating teachers in supervising Classroom Research to the pre-service teachers before the beginning of the internship period. The cooperating teachers felt uncomfortable in supervising Classroom Research to the pre-service teachers because they did not have much experience in conducting Classroom Research project in a five-chapter format which was the format the university required the pre-service teachers to do. For cooperating teachers, they were only experienced to conduct Classroom Research projects in a 3-5 pages format. For the university supervisor, he used to conduct the experimental research in the field of Physics, but he had never conducted a Classroom Research project in the field of Education.

The cooperating teachers and university supervisor indicated that the support which they preferred to receive for supervising the pre-service teachers in conducting a Classroom Research project was to attend a workshop about conducting a Classroom Research project for enhancing their understanding about each stage of conducting a Classroom Research project. In addition, they would like to have the supervision handbook of conducting Classroom Research project for guiding them how to supervise the Classroom Research to the pre-service teachers.

The researcher also interviewed the deputy dean of the faculty of education, Westernthani University about the plan from the faculty of education in helping the cooperating teachers and the university supervisor to supervise Classroom Research to the pre-service science teachers during the internship period. The deputy dean of the faculty of education stated that:

“There is no plan for helping the cooperating teachers and the university supervisor in supervising Classroom Research to the pre-service science teachers. I think the cooperating teachers and the university supervisor already have the knowledge and the experience in conducting the Classroom Research project because it is the requirement of the National Education Act B.E. 2545 (2002) that every teacher should conduct the Classroom Research project for developing the suitable learning for the students...The faculty of education board has just been changed. There is no one responsible to do this job”
(Deputy Dean’s interview: December, 2008).

The Development of the Initiative

The pre-service teachers’ internship experience usually involves three main persons including, the pre-service teacher, the cooperating teacher, and the university supervisor (Beck and Kosnik. 2002). From this perspective, the researcher in this study acts as the outsider researcher. The researcher cannot directly supervise the pre-service teachers, so the researcher works collaboratively with the cooperating teachers, who were assigned from the professional development school, and the

university supervisor, who was assigned from the Westernthani University to supervise the Classroom Research to the pre-service teachers during the internship period.

The Cambridge Advanced Learner's Dictionary (2005) defined the word initiative as 'a new action or movement through careful planning and imagination. Initiative often intended to solve a problem without needing to be told what to do from others'. The Positive Online Dictionary (2011) elaborated that 'the expression to take the initiative conveyed the notion of grabbing an opportunity to do or create something worthwhile of taking that first important step'.

The results of the first phase, the background information from the interviewing with the cooperating teachers and university supervisor, and the interviewing with the deputy dean led the researcher to develop the initiative which comprised of developing the SHCR and organizing the workshop for enhancing the cooperating teachers' and university supervisor's understanding of Classroom Research and for guiding them how to use the SHCR to supervise the pre-service science teachers to conduct a Classroom Research project in order to promote the pre-service science teachers' understanding and practice of Classroom Research.

The Development of the SHCR

In developing the SHCR, the researcher took into consideration the findings of the pre-service teachers' understanding of Classroom Research in the exploratory phase in conjunction with the cooperating teachers' and university supervisor's background information about the understanding of Classroom Research, the experiences in conducting Classroom Research, the experiences in supervising Classroom Research to the pre-service science teachers, and the supports that they preferred to receive for helping them to supervise Classroom Research to the pre-service science teachers.

The SHCR is intended to enhance the cooperating teachers' and university supervisor's understanding of Classroom Research concept, the stages in conducting a Classroom Research project, and to guide the idea how they can supervise the pre-service teachers to conduct a Classroom Research project. The researcher studied the concept in conducting Classroom Research project from various textbooks and research articles. Regard to the content and organization of content of the SHCR as shown in Table 4, the SHCR consisted of seven topics: general concept of Classroom Research, generating research question, reviewing literature, developing the research plan and research instruments, collecting data, analyzing data, and writing a Classroom Research report. The description of the content in each topic is briefly outlined below.

The First Topic: General Concept of Classroom Research

This topic aimed to introduce the general concept of Classroom Research to the cooperating teachers and university supervisor. It provided the information about the meaning of Classroom Research, the characteristics of Classroom Research, the intention of Classroom Research, and the six stages in conducting Classroom Research which proposed by Johnson (2008) that were the basis for developing the SHCR.

The Second Topic: Generating Research Question

This topic described about the intention of generating research question such as to find the focus of the study and to determine the research methodology. Things that should be considered in generating research question such as the research question must be manageable, the research question should be worthwhile for investigating, and the research question should be appropriate with the restriction of time and the researchers' skill levels of data collection and data analysis. Methods for generating research question such as analyzing students' achievement scores, observing the students' behavior, and checking the students' exercise books. Finally,

the worksheets number one, two, and three (See Appendix E) for using to supervise pre-service teachers in generating the research question are provided.

The Third Topic: Reviewing Literature

This topic described about the reasons and sources for reviewing the related literatures. The steps for reviewing the related literatures which including (i) located possible sources for reviewing literature such as library and internet sites, (ii) searched for journal articles, theses, and books, (iii) skimmed the journal articles, theses, and books to see whether they provided the information that related to the research question or not, (iv) took careful notes about the information that was directly related to the research question. The example of presenting the results of the literature review such as how to report the theoretical framework of the study and how to report the findings from the previous related research. The worksheets number four (See Appendix E) for using to supervise pre-service teachers in reviewing literature is provided.

The Fourth Topic: Developing Research Plan and Research Instruments

This topic described about the objectives for developing the research plan and research instruments. An overview of the research designs such as experimental research, survey research, and correlational research. The components of the research plan such as the research purposes, the research participants, the data needed to be collected, the research instruments for collecting data, when the data be collected, and how the data be analyzed. The example of research plan. The methods for developing questionnaire, test, and how to interviews and to record the observation field notes. And the worksheets number five (See Appendix E) for using to supervise pre-service teachers in developing the research plan and research instruments is provided.

The Fifth Topic: Collecting Data

This topic described about the data collection methods that frequency employed in a Classroom Research project such as questionnaire, test, interview, and observation. And the worksheets number six (See Appendix E) for using to supervise pre-service teachers in collecting data is provided.

The Sixth Topic: Analyzing Data

This topic described about the purposes for analyzing data. The methods for analyzing data such as how to use the descriptive statistic for analyzing the quantitative data and how to use the inductive analysis for analyzing the qualitative data. And the worksheets number seven (See Appendix E) for using to supervise pre-service teachers in analyzing data is provided.

The Seventh Topic: Writing a Classroom Research Report

This topic described about the example of how to write the chapter one, two, three, four and five of the Classroom Research report. And the worksheets number eight and nine (See Appendix E) for using to supervise pre-service teachers in writing a Classroom Research report are provided.

The SHCR was developed under the supervision of research committee. Then the SHCR was reviewed by two educators from the Department of Education, Faculty of Education, Kasetsart University who taught the Classroom Research to the pre-service teachers for many years for approval of content and format of the SHCR. The researcher revised the SHCR following the recommendations from the research committee and the two educators before introducing the SHCR to the cooperating teachers and university supervisor to use to supervise the Classroom Research to the pre-service teachers.

Table 4 The organization of content of the SHCR

Topics	Contents	Worksheets for using to supervise the pre-service teachers
1. General concept of Classroom Research	The meaning, the characteristics and the intentions of Classroom Research	-
	The stages in conducting a Classroom Research project	
2. Generating research question	The intention of generating research question	Worksheet # 1 Teaching Journal
	Things that should be considered in generating research question	Worksheet # 2 The Summary of Situation in the Classroom
	The method for generating research question	Worksheet # 3 Generating the Research Question
3. Reviewing literature	The reasons and sources for reviewing the related literatures	Worksheet # 4 Conducting the Literature Review
	The steps for reviewing the related literatures and the presentation of the results of the literature review	
4. Developing the research plan and research instruments	The objectives for developing the research plan and research instruments	Worksheet # 5 Research Planning
	An overview of research designs	
	The components of the research plan and the methods for developing research instruments	

Table 4 (Cont'd)

Topics	Contents	Worksheets for using to supervise the pre-service teachers
5. Collecting data	The data collection methods that frequency used to collect data	Worksheet # 6 A Data Collection Schedule
6. Analyzing data	The purposes for analyzing data The methods for analyzing the quantitative and qualitative data	Worksheet # 7 Data Analysis Form
7. Writing a Classroom Research report	The components of Classroom Research report How to write the chapter 1,2,3,4, and 5 of the Classroom Research report	Worksheet # 8 Reflection on Classroom Research process Worksheet # 9 Classroom Research Report Planning

The organization of the workshop

After the SHCR was developed, the researcher organized the one-day workshop for introducing the SHCR to the three cooperating teachers and a university supervisor who were responsible to supervise the three pre-service science teachers which were selected to be the research participants for in-depth study of this research project. First, the findings of pre-service science teachers understanding of Classroom Research from the first phase of the study were presented to show which topics of Classroom Research that the pre-service teachers understood or did not understand to plan how to supervise them. Then the researcher discussed with cooperating teachers and university supervisor about the information according to seven topics in the SHCR. In each topic, there were the activities sheets for the cooperating teachers and university supervisor to do for checking their understanding of Classroom Research and the way how they could use the SHCR to supervise the pre-service teachers to conduct a Classroom Research project. The workshop was run twice on July, 2009 because the cooperating teachers in the professional development schools and the

university supervisor could not find free time on the same day. The detail of the workshop is shown in table 5. In the table the abbreviation of the CR means Classroom Research, CT means cooperating teachers, US means university supervisor, PST means pre-service science teachers, and min means minutes.

Table 5 The detail of the workshop

Topics in the SHCR	Objectives	Activities	Time
1. General concept of Classroom Research	<p>The CT and US identified the characteristics and intentions of CR</p> <p>The CT and US explained the stages in conducting a CR project</p>	<p>The discussion between the researcher and the CT and US about the meaning, the characteristics and the intentions of Classroom Research and the stages in conducting a CR project followed the information in the SHCR</p> <p>The CT and US did activity sheet# 1 name 'General concept of Classroom Research' to explain the characteristics and intentions of Classroom Research and the stages in conducting a CR project</p> <p>The CT and US constructed the concept map to summarize the characteristics and intentions of CR by using the vocabularies that appeared in the activity sheet#2 name 'Concept map about CR'</p>	35 min
2. Generating research question	<p>The CT and US explained the method for generating the research question and things that should be considered in generating research question</p> <p>The CT and US suggested the way for</p>	<p>The discussion between the researcher and the CT and US about the method for generating the research question and things that should be considered in generating research question followed the information in the SHCR</p> <p>The researcher guided the CT and US how to use the worksheet number 1,2, and 3 in the SHCR to supervise the PST to generate the</p>	50 min

Table 5 (Cont'd)

Topics in the SHCR	Objectives	Activities	Time
	supervising the PST to generate the research question	research question The CT and US did activity sheet# 3 name 'Generating research question' to explain the method for generating the research question and how to supervise the PST to generate the research question	
3. Reviewing literature	The CT and US explained the reasons and identified sources for reviewing the related literatures The CT and US explained how to review and present the result of literatures review The CT and US suggested the way for supervising the PST to reviewing the literature	The discussion between the researcher and the CT and US about the reasons and sources for reviewing the related literatures, and the methods for reviewing literature and presenting the results of the literature review followed the information in the SHCR The researcher guided the CT and US how to use the worksheet number 4 in the SHCR to supervise the PST to review literature The CT and US did activity sheet# 4 name 'Reviewing literature' to explain the reasons and sources for reviewing the related literatures, and the methods for reviewing literature and presenting the results of the literature review	50 min
4. Developing the research plan and research instruments	The CT and US identified the objectives for developing the research plan and research instruments The CT and US explained the components of the research plan and the methods for developing research plan	The discussion between the researcher and the CT and US about the objectives for developing the research plan and research instruments, the components of the research plan, and the methods for developing research plan and research instruments followed the information in the SHCR The researcher guided the CT and US how to use the worksheet number 5 in the SHCR to supervise the PST to develop the research plan	60 min

Table 5 (Cont'd)

Topics in the SHCR	Objectives	Activities	Time
	and research instruments The CT and US suggested the way for supervising the PST to develop the research plan and research instruments	The CT and US did activity sheet# 5 name 'Research planning' to explain how to supervise the PST to develop the research plan	
5. Collecting data	The CT and US explained the data collection methods that frequency used to collect data The CT and US suggested the way for supervising the PST to collect data	The discussion between the researcher and the CT and US about the data collection methods that frequency used to collect data in a Classroom Research project followed the information in the SHCR The researcher guided the CT and US how to use the worksheet number 6 in the SHCR to supervise the PST to plan to collect data The CT and US did activity sheet# 6 name 'Collecting data' to explain the data collection methods, the criteria for selecting the data collection methods to employ in a Classroom Research project, and how to supervise the PST to collect data	50 min
6. Analyzing data	The CT and US explained the purposes and methods for analyzing data The CT and US suggested the way for supervising the PST to analyze data	The discussion between the researcher and the CT and US about the purposes and methods for analyzing the quantitative and qualitative data followed the information in the SHCR The researcher guided the CT and US how to use the worksheet number 7 in the SHCR to supervise the PST to plan to analyze data	50 min

Table 5 (Cont'd)

Topics in the SHCR	Objectives	Activities	Time
		The CT and US did activity sheet# 7 name 'Analyzing data' to explain the purposes and methods for analyzing data, and how to supervise the PST to analyze data	
7. Writing a Classroom Research report	The CT and US explained the components of Classroom Research report and how to write each chapter of the Classroom Research report The CT and US suggested the way for supervising the PST to write a Classroom Research report	The discussion between the researcher and the CT and US about the components of Classroom Research report and how to write the chapter 1,2,3,4, and 5 of the Classroom Research report followed the information in the SHCR The researcher guided the CT and US how to use the worksheet number 8 and 9 in the SHCR to supervise the PST to plan to write the Classroom Research report The CT and US did activity sheet# 8 name 'Writing a Classroom Research report' to explain the components of Classroom Research report, and how to supervise the PST to write the Classroom Research report	55 min

CHAPTER VI

RESULTS AND DISCUSSIONS

Overview of the Chapter

This chapter provides the results of the analysis from multiple data sources for answering the second research question: “How do the pre-service science teachers’ understanding and practice of Classroom Research evolve over the implementation of the initiative?”, the third research question: “What supports about Classroom Research do pre-service science teachers receive from the cooperating teachers and university supervisor over the implementation of the initiative?”, and the fourth research question: “What factors support or hinder the pre-service science teachers’ practice of Classroom Research?”

The pre-service science teachers were asked to write journals to describe how they conducted a Classroom Research project and to write down about their cooperating teachers and university supervisor supervision of Classroom Research in each stage while they conducted a Classroom Research project. The cooperating teachers and university supervisor were interviewed to express about the supports that they give to the pre-service teachers in conducting the Classroom Research project. When the pre-service teachers completed their Classroom Research project, they were interviewed about their understanding of Classroom Research after engaging in the initiative. The pre-service teachers, cooperating teachers and university supervisor were also interviewed on their opinions about the factors that support or hinder the pre-service science teachers’ practice of Classroom Research. The practice of Classroom Research and the understanding of Classroom Research after engaging in the initiative, the supports that the cooperating teachers and university supervisor give to the pre-service teachers in conducting the Classroom Research project, and the factors that support or hinder the pre-service science teachers’ practice of Classroom Research are illustrated and discussed in this chapter.

The Practice of Pre-Service Science Teachers' Classroom Research During the Implementation of the Initiative

The Case of Pattra

The Implementation of the Initiative

After Pattama attended the workshop about “The supervision of Classroom Research to the pre-service science teachers” which was organized by the researcher on July 12th, 2009, she started to implement the initiative with Pattra. Pattama supervised Classroom Research for Pattra in every stage from generating the research question until writing the research report. The supervision process went from July 14th, 2009 to March, 6th, 2010. The timeline in supervising each stage of Classroom Research is displayed in Table 2 in the third chapter of this dissertation. In contrast, the university supervisor, Permpon, did not play a major role in supervising Classroom Research to Pattra due to he did not have much time to supervise Pattra in the school. He only supervised Classroom Research to Pattra about selecting the research design and developing the research instruments. The practice of Pattra's Classroom Research is described below.

Generating Research Question

The research question comes from the problem in the classroom that affects the teacher's self-confidence in teaching and the students' learning.

Pattama discussed with Pattra about what Pattra would like to do for her Classroom Research project on July 14th, 2009. Pattra indicated her willingness to continue conducting Classroom Research project in the same topic that she used to develop while she was studying the Classroom Research course in the third year of her pre-service teacher education program. Her previous Classroom Research topic was ‘Using inquiry technique to enhance the students' science problem solving skills’. Pattama stated that

“Pattra expressed that she would like to continue conducting her previous Classroom Research topic which she developed in the Classroom Research course because it could reduce a lot of her works. She had already written chapter one to chapter three. During this internship period in the school, she just collected data, analyzed data, and wrote the Classroom Research report in the remaining chapters, chapter four and five. With this strategy, she thought she will have more time to concentrate in preparing her teaching for the students in the classroom” (Pattama’s Journal #1: July 17th, 2009).

Pattama did not agree with Pattra’s idea. Pattama explained to Pattra that it was not the correct concept of conducting the Classroom Research project if Pattra still continued on her previous Classroom Research topic since her Classroom Research project was not based on the situation in the current classroom. Pattama encouraged Pattra tried to find the problem in the classrooms that Pattra taught for generating a new research question. Pattama suggested Pattra to observe the classrooms and to record the information about the situations that occurred in the classrooms into Worksheet number one; named ‘Teaching Journal’ for two months from the mid- of July, 2009 to the mid- of September, 2009. This worksheet was the component of the SHCR that was developed by the researcher. The SHCR was distributed to the cooperating teachers and university supervisor in the workshop before they started to supervise the Classroom Research to the pre-service science teachers on July 11th – 12th, 2009. This worksheet comprised of four questions including (1) What went well in the classroom?; (2) What went poorly in the classroom?; (3) What surprised pre-service science teachers during their teaching?; and (4) What questions did pre-service science teachers end today with? for guiding the pre-service science teachers to record the information about classroom situation.

Pattama asked Pattra to record the information followed the questions appeared in the Worksheet number one every period after she finished her teaching. After two months of recording the information into the worksheet number one, Pattama gave the worksheet number two to Pattra and asked Pattra to read through her worksheet number one entries in chronological order, and then group the information

into four themes following the four questions that appeared in the worksheet number one into worksheet number two to summarize the classroom situations. The information in worksheet number two revealed two main problems, the students lacked of attention to learn and the students got low achievement scores, that usually occurred in Pattra classroom, as Pattra wrote

Pattama asked me to summarize the classroom situations that I recorded in the worksheet number one. She assigned me to do the worksheet number two named 'The summary of situation in the classroom'. In doing this worksheet, if the same situation occurred in the other periods of my teaching I was asked to put the check mark (✓) in front of that situation to see the frequency of the situation. When I reread all of the information in worksheet number one and grouped the information into worksheet number two, I found that the students in class 9B had misbehavior in the classroom during my teaching practice. First, they always talked and teased each other while I was teaching. They did not pay attention to my teaching. They did not jot down the information into their notebooks. Some of them did homework in another subject during my class. It wasted a lot of my time to admonish them. I could not teach them according to my lesson plans. Second, when I asked them to do the exercise at the end of each period for checking their understanding, they could not do it. They could not send the exercise to me within the class period. They sent the exercise to me in the next day. With this situation, I did not know how much the students understood the content that I taught since they may copy the answers from their friends for completing the exercises. The mid-term test score showed me that most of them got the science achievement score only 55-60 % of total scores that did not satisfy me. I would like them to get the achievement score in science subject above 60 % of total scores (Pattra's Journal #1: September 18th, 2009).

Pattra thought these problems may result from her teaching practice which lacked the promotion of the students participation in the classroom. She would like to

change her teaching practice from lecture-based method to student center-based method, as she stated

When I started my teaching practice in this school, I did not have much confidence to teach the student. I felt nervous every time I had to teach. Mostly, I taught the students by lecturing. I jotted down the content that I would like to teach in each period in the paper. Then I went into the classroom, read the content in the paper to the students, and asked them to jot down the information in their notebooks word by word. I thought the students may be bore with this teaching technique and resulted them to not pay attention in my teaching. They did not have much opportunity to participate in the learning activities. I wanted to change my teaching practice to be based on more student center approach. I thought using questioning technique as my teaching strategy was good and may benefit to my students because it could promote the students' participation in the classroom (Pattra's Journal #1: September 18th, 2009).

Pattra thought the problems of the students' lack of attention to learn and low achievement score were suitable for generating research question in her Classroom Research project because they affected both of the students and herself, as she explained

The students did not pay attention during my class and got low achievement score were the important and urgent problems that I was interested and wanted to find the solution through the process of conducting Classroom Research project. Since, it reduced my self-confidence in teaching. It led me to think that I was an inefficient teacher. I could not encourage the students to learn and could not help them to understand the science concepts that I taught. In addition, the students' low achievement score in science subject may result for their further study in higher level. It was my responsibility as a teacher to find the new teaching technique that could encourage the students' attention to

learn and to help them get more achievement score in science subject (Pattra's Journal #1: September 18th, 2009).

Pattra decided to conduct her Classroom Research project with the students in class 9B with the research question 'Will the use of questioning technique enhance the 9th grade students' science achievement score?' There were 44 students in this classroom, 21 boys and 23 girls. The students in this classroom were mixed ability. There was also one autistic student in this classroom. The students in this classroom learned science three periods a week; one period on Tuesday and two-continuous-period on Friday. The science period on Tuesday was operating from 2.20 p.m. to 3.10 p.m., and the science periods on Friday were operating from 8.30 a.m. to 10.10 a.m.

Pattra was interested in employing the questioning technique to solve the problems because she noticed that the students in class 9B showed greater attention to learning when she asked them questions in the classroom, as she described

The information in worksheet number one and number two showed me that in the periods which I taught the students in class 9B by asking them the questions, they obviously showed their attention to my teaching. They were eager to answer my questions. One question from me produced many answers from the students. Sometimes, the student asked me the question why his/her answer was not correct. They would like me to explain more. This made me realize about the content that my student did not understand. The student's question produced a lot of discussions in the class. This situation surprised me a lot because they were not usually interacted with me while I was teaching by lecturing. I thought questioning technique could hold the students' attention to my instruction and help them to understand the science content better which may lead them to get higher science achievement score (Pattra's Journal #1: September 18th, 2009).

Reviewing Literature

Her literature review relies on the old information of her previous Classroom Research topic.

Initially, Pattra reviewed the literature by herself without asking recommendations from Pattama because Pattra thought she had the experience in reviewing the literature while she was studying in the Classroom Research course. Pattra used the information in the second chapter of her previous Classroom Research project as a basis for writing her literature review. She copied three topics in the second chapter of her previous Classroom Research project for reporting the results of her literature review in her new Classroom Research project. These three topics were the meaning and the characteristic of teaching, the meaning and the characteristic of inquiry learning, and the meaning and the specific characteristic of science. Pattra expressed her idea in reporting these old topics in her new Classroom Research project as

“When I take practicum 2 and Classroom Research courses during the third year of my pre-service science teacher education program, the instructor in the Classroom Research course assigned me to observe the classroom in Phetnipat school (pseudonym), the professional development school in Practicum 2 course, in order to find the ideas to generate the research question. My cooperating teacher in Phetnipat School told me that she taught the students based on inquiry learning approach followed the educational reform policy which intends the teacher not to teach science by lecturing. The science teachers should teach the students by promoting the students’ participation in the classroom. One teaching technique that my cooperating teacher always uses is asking question to the students, so I understand questioning technique is one of teaching method based on the inquiry learning approach. For this reason, it is a good idea if I include the topic about the meaning and the characteristic of teaching and the meaning and the characteristic of inquiry learning in my literature review of the new Classroom Research project. I

would like to provide the ideas to the readers consecutively from general area, teaching, to more specific area that I use as a framework in my Classroom Research project, inquiry learning in science subject. The reason that I include the topic about the meaning and the specific characteristic of science in the literature review because I am a pre-service science teacher, so I should give detail in this topic to show my understanding toward my major field of study. In addition, these topics are approved by the instructor in the Classroom Research course, so I want to remain them in the second chapter of my new Classroom Research project” (Pattra’s Interview #2: September 30th, 2009).

University library is the resource for reviewing literature.

After, Pattra sent the first draft of her literature review to Pattama for comments on September 28th, 2009, Pattama recommended many things to Pattra because she thought the first draft of Pattra’s literature review had many weaknesses. Pattama thought the topic that Pattra wrote in the first draft of her literature review did not correspond with Pattra’s Classroom Research topic. Pattama introduced the worksheet number four named ‘Conducting the literature review’ to Pattra for helping Pattra conduct the literature review. First, Pattama asked Pattra to write the research hypothesis of her Classroom Research project. Pattra wrote the research hypothesis of her Classroom Research project as ‘The 9th grade students’ gain more science achievement score after the implementation of questioning technique in the classroom’ (Pattra’s Classroom Research Report). Second, Pattama asked Pattra to identify the keywords which appeared in the research hypothesis of her Classroom Research project. Pattra identified two keywords from her research hypothesis including questioning technique and achievement score. Then Pattama recommended Pattra to search the related literature by typing the keywords that Pattra identified into search engine in the university library database for finding books, research articles, or theses and used them as the resources for writing the literature review in the second chapter of Pattra Classroom Research report.

Pattra spent two weeks, October 1st to October 15th, 2009, in revising her literature review. After revising the literature review, Pattra sent the second draft of her literature review to Pattama on October 15th. In this draft Pattra made some changes for her literature review. She still kept the topic about teaching and inquiry learning but she added new details about the implementation of questioning technique in the classroom and achievement scores. The source of information that Pattra used for reviewing the literature was mostly based on the books in the university library. Pattra did not review any related research in her second draft of the literature review. So Pattama suggested Pattra to search and write more detail about the findings from related research in order to see what other researchers had found out about using questioning technique in the classroom to enhance the students' achievement score to give Pattra ideas about what additional ways she could explore in her Classroom Research project and to see the data collection and data analysis that were used by others. Pattra reviewed the related research by typing keyword 'questioning' in search engine of the university library database for finding the theses which were conducted on using questioning technique in the classroom to enhance the students' achievement score. Then, in each related research, Pattra took notes about the research topic, name of the researcher, the research participants, the data collection methods, and the research findings. She also recorded details about year and place of publication in order to use for writing the bibliography (Pattra's Journal #2: October 26th, 2009).

In the last draft, Pattra finally wrote five topics as a result of her literature review. The first topic was teaching. It comprised of three sub-topics including the meaning of teaching, the component of teaching such as teacher, student, and content subject, and the necessary principles related to teaching such as psychology of learning principle, and the principle for evaluating the students' learning. The second topic was inquiry learning. This topic mentioned about the meaning of inquiry learning, the importance of inquiry learning, procedures for organizing inquiry learning, the intention of inquiry learning, and the teacher's role in inquiry learning. The third topic was the implementation of questioning techniques in the classroom. This topic provided the detail about the importance of using questioning techniques in the classroom, the intention of asking question to the students, techniques for asking

questions, and the teacher's response toward the students' answers. The fourth topic was the achievement score. This topic described about the meaning of achievement score, the factors that impacted the students' achievement scores, and the measurement and evaluation of achievement scores. The last topic was the related research. In this topic Pattra showed the research finding from five related research about the implementation of questioning technique in the classroom for enhancing the students' achievement scores. Pattra described the detail about the name of the researcher, the year of publication, the research topic, the research participant, the data collection methods, and the research finding appeared in each related research (Pattra's Classroom Research Report).

Developing the Research Plan and Research Instruments

Selects the research design that is easy for collecting the data.

After generating the research question and reviewing the literature, Pattama suggested Pattra to use the information from her literature review to create a research plan. Pattama gave the worksheet number five named 'Research planning' to Pattra for helping her to write the research plan. The worksheet led Pattra to identify the research participants, the required data for answering the research question, the research design of the study, the research instrument for collecting the data, the timeline for conducting the Classroom Research project, and the method for analyzing the collected data (Pattra's Journal #3: October 31st, 2009). Pattra was interested in experimental research design, as she stated

“From all research design I learned in the Classroom Research course, I understand the experimental research design the most. I think this research design is easy to conduct. I just develop the pre-test and post-test for collecting the data. Then compare each students' pre- and post-test scores to see whether they gain more achievement score or not after the implementation of questioning technique in my classroom” (Pattra's Interview #3: November 4th, 2009).

Pattra had some problems in determining the research design that she would like to use in her Classroom Research project. From her research question, Pattra thought that she could employ two types of the experimental research design: a one group pretest-posttest design, and a static-group comparison design. She discussed this problem with her university supervisor and her cooperating teacher to help her selected the type of experimental research design she should employ in her Classroom Research project. As the result of the discussion, Pattra decided to employ a one group pretest-posttest design in her Classroom Research project because it was easier to conduct, as she wrote

My university supervisor and cooperating teacher agreed with my idea in employing the experimental research design in my study. This research design was suitable with my research question that intended to compare the students' achievement scores before and after implementing the questioning technique in the classroom. They recommended me the same in selecting the type of experimental research design for employing in my Classroom Research project. They recommended me to consider about the weakness and strength of the one group pretest-posttest design and the static-group comparison design. They told me to employ the research design that was not too difficult to conduct because I did not have much experience in conducting the Classroom Research project and the time for conducting the Classroom Research project was limited. The discussion led me to employ the one group pretest-posttest design in my Classroom Research project because this type required the students only in one classroom to be my research participant. It corresponded with my research question and it was easy for me in conducting the Classroom Research project and collecting the data. I just developed one series of lesson plan based on the questioning technique as the research intervention and developed the pre- and post-test as the research instrument for collecting the data. I was not interested in the static-group comparison design because it required the students in two classrooms to be my research participant and I should write two series of lesson plan which enhanced my workloads. The first series was the normal lesson plans which teach the

students by lecturing in the control group. The second series was the lesson plan based on the questioning technique for using with the students in the experimental group. Writing two series of lesson plans wasted a lot of my time. I did not want to write the two series of lesson plans in the same semester (Pattra's Journal #4: November 9th, 2009).

Selecting the teaching topic which provides the time frame for developing the lesson plans, pre-test, and post-test.

After Pattra already clarified the research design of her Classroom Research project, Pattama assigned Pattra to identify the independent variable and the dependent variable. Pattra identified the independent variable and the dependent variable of her Classroom Research project as teaching by questioning technique and the 9th grade students' science achievement score, respectively. Next, Pattra decided the learning topic for writing the lesson plans based on the questioning technique. In the second semester, there were three topics for her to teach including heredity, ecology, and universe and galaxy. Pattra chose the topic of 'universe and galaxy' to write the lesson plans for conducting her Classroom Research project for the following reason.

"I would like to conduct my Classroom Research project while I am teaching in the topic of 'universe and galaxy' because it is the last topic for teaching the students in the second semester. It provides me the time for writing the lesson plans and developing the pre- and post-test to collect the data. I think, I cannot finish developing the lesson plans, the pre-, and the post-test before I teach the topic of heredity and ecology" (Pattra's Interview #4: November 16th, 2009).

There were five sub-topics in the topic of universe and galaxy. They were solar system, planets in the solar system, universe and galaxy, fixed stars, and space technology. Pattra wrote five lesson plans for teaching these sub-topics for 15 periods in total which comprised of three periods in the topic of solar system, four periods in the topic of planets in the solar system, two periods in the topic of universe and

galaxy, three periods in the topic of fixed stars, and three periods in the topic of space technology. Pattra's lesson plans comprised of the name of the lesson plan, time for teaching each lesson plan, main concept, learning objectives, learning activities, learning assessment, and instructional materials. The learning activities were separated into three components: introduction, teaching, and summary. She applied the Bloom's taxonomy for developing the lesson plans. In the introduction component, she used the questions to examine the students' prior knowledge for example, 'When mention the word universes, what do you think about?', 'How many planets are there in the solar system?'. In the teaching component, she asked the questions together with the explanation for providing and elaborating the students' ideas, such as 'What is a comet?', 'What is the composition of the comet?', 'What were the differences between a fixed star and a planet?'. In the summary component, the questions were used to encourage the students to think over the content that they learned in each period for instance, 'What did we learn today?', 'How did the solar system originate?' Pattra sent each lesson plan to Pattama one week before implementing the lesson plan in the classroom for asking recommendations. Pattama observed Pattra's teaching every period while Pattra was teaching in the topic of 'universe and galaxy'. On the other hand, her university supervisor, Permpon, came to observe her class only one time while she was teaching the sub-topic of 'planet in the solar system', so her university supervisor gave the recommendations to her for only one lesson plan out of five lesson plans that she developed for using in her Classroom Research project.

The textbooks and teacher handbook are the resources for developing research instrument.

Pattra developed the pre- and post-test as her research instrument for collecting the data to answer her research question. In developing the pre-test and post-test, Pattra used the information from the teacher handbook and the 9th grade science textbooks which were published by four different publishers. She developed the pre- and post-test by modifying the open-ended questions which appeared in the exercises of the science textbooks into a multiple-choice format. The pre- and post-

test comprised of 30 test items. She expressed her idea for developing the pre- and post-test as

“I developed the multiple choice format of the pre- and post-test because it was easy for me to grade the student scores. In addition, the multiple choice format did not take a lot of time for the students to complete the test, so it allowed me to make an appointment with the students to do the tests in their free time. I could not appoint the students to do the pre-test and post-test during my science class due to the school had many activities in the second semester. If I appointed the students to do the pre- test and post-test in my science class, I could not finish teaching all of the content in the textbook before the second semester final examination. I decided to have 30 test items in the pre- and post-test because I thought 30 test items were appropriate for assessing the students’ learning. There were not too many or too few test items” (Pattra’s Journal #5: December 12th, 2009).

At the beginning, Pattra would like to develop only one test for the students to do two times for the pre-test and post-test, but Pattama did not agree with her because it was nonsense for the students to do the same test twice, as Pattra wrote

I intended to use the same test for the students to do in the pre-test and post-test, but Pattama did not agree with me. She recommended me to develop two tests. The first one used for the pre-test and another one used for the post-test. She explained that the period of time for the pre-test and post-test was different only one month. Assigning the students to do the same test within a short period of time may lead the suspicion to the students why they must do the same test for two times. Furthermore, the students may remember the test items in the pre-test and answer in the same manner in the post-test which could produce the inaccurate research finding (Pattra’s Journal #5: December 12th, 2009).

Pattra discussed this with her university supervisor, Permpon, about developing the pre-test and post-test. Instead of developing the two different tests for using in the pre-test and post-test, Permpon recommended Pattra to develop one test for using in the pre-test. Then, he recommended Pattra to rearrange the test items and the choices of each test item in the pre-test in new order for using in the post-test. Permpon provided the reason for his recommendation as

“I do not expect much for the pre-service science teachers in conducting the Classroom Research project. For me, the intention of conducting Classroom Research project during the internship courses just want the pre-service science teachers to know the process of Classroom Research project about how to generate the research question, how to review the literature, how to develop the research instrument, how to collect and analyze the data, and how to write the Classroom Research report. Develop only one test for using in the pre-test and rearrange the sequence of test items and the choices of each test item in the pre-test for using in the post-test is enough for the pre-service science teachers to learn about how they can develop the research instrument for conducting their Classroom Research project. I would like the pre-service science teachers to concentrate more on teaching practice than conducting the Classroom Research project. The important job of teacher is teaching not researching” (Permpon’s Interview #2: December 16th, 2009).

Pattra discussed with Pattama again after the discussion with Permpon. Finally, Pattama allowed Pattra to develop the pre- and post-test following the Permpon’s recommendation because Pattama thought that the university supervisor had the first priority in recommendation for the pre-service science teachers during the internship period. When Permpon recommended Pattra to develop only one test for collecting the data, Pattama inevitably followed Permpon’s recommendation.

The research instrument is approved and tried out before implementing in the classroom.

Pattra sent the first draft of her pre- and post-test to Pattama and the school academic section for approval of format, content, and wording. Next, she revised the pre- and post-test following Pattama's and the school academic section's feedback. Then she tried out the test with the students in class 9A to make sure that the test was clear for the students to understand and the time she planned to provide for the students to complete the test was suitable. Finally, she implemented the test with the students in class 9B which were the research participants of her Classroom Research project. Pattra did not send the pre- and post-test to her university supervisor for recommendations because in the time that she developed the pre- and post-test, her university supervisor did not come to observe her teaching in the school (Pattra's Journal #6: December 29th, 2009).

Collecting Data

Implementing the lesson plans allows Pattra to improve her teaching practice.

The classroom observations revealed that before introducing a new concept, Pattra used questioning to assess the students' prior knowledge needed for teaching the new concept such as 'When mention the word universes, what do you think about?' and 'How many planets are there in the solar system?'. She took time at the beginning of the class to ask questions in order to connect the day's ideas and concepts that she had presented in the previous class. During teaching, she used questioning and students' explanations of the concept in order to assess student learning. When a student gave an incorrect or incomplete answer, she always asked the follow-up questions to challenge the students to think more deeply or to reconsider the evidence in the textbook and information sheets. Finally, she pointed out what was incorrect about the answer and filled in the necessary points to complete the answer. In the first period of implementing the questioning technique, Pattra

struggled with the students' response. When she asked the questions to the students, all of the students in the class answered her questions at the same time. She felt uncomfortable with this situation, as she wrote

In the first period that I implemented the questioning technique in my class, I faced the problem about the students' response. When I asked the questions to them, all of the students in the classroom answered my questions at the same time. I did not know whether who answered the right answers and who answered the wrong answers. I could not explain the right concept to the students who did not understand the lesson and answered the wrong answer which may lead them to get the low achievement scores. Furthermore, my class was very noisy and disturbed other classrooms. In the next period, I informed the students that if they would like to answer my question, they must raise their hands and wait until I called his/her name. I was happy with the new technique because it could reduce the classroom's noise and I could know how student understood the lesson that I taught from his/her answers. I could explain the right concept to the students who answered the wrong answer (Pattra's Journal #7: January 13th, 2010).

Pattra questioning technique was flexible along with the progression of her Classroom Research project. She was not strict that the students should wait until they had the permission from her to answer in every question. She employed many techniques in asking the questions to the students such as asking the students to answer the question at the same time, calling the name of the student to answer the question, and asking a volunteer to answer the question, as she explained

I used three main techniques for asking the question to the students. First, I permitted all of the students in the class to answer at the same time, if the questions related to their daily life or they could use their prior knowledge to answer the question. I used this technique to promote the students' participation in the classroom. Second, I called the name of the student to answer the question in the case of he/she did not pay attention to learn or

talking with his/her friend. Third, I asked the volunteer for answering the question when the question is about the new concept that I taught to them and there were many students showed their willingness to answer the question. I asked for the volunteer for this situation because I wanted to assess how the students understood the new concept I taught. If I found that they did not understand, I could explain to them again for making more understanding to them (Pattra's Journal #7: January 13th, 2010).

Appoint the students to do the pre- and post-test outside the teaching period because of the time constraint.

For collecting the data to answer her research question, Pattra made the appointment with the students to do the pre- and post-test at the school cafeteria after the school finished at 3.10 p.m. The pre-test took place on January 6, 2010 two days before she taught the topic of universe and galaxy and the post-test took place on February 26, 2010, two days after she finished teaching in the topic of universe and galaxy. She provided the time for the students to complete the pre-test (30 minutes), and the time for completing the post-test (20 minutes). Pattra provided the details for collecting the data as the following:

The classroom that I taught was very small. It crowded with the students' desks and chairs. The students' desks and chairs located very close together. I decided to arrange the pre- and post-test at the school cafeteria to prevent the students' cheating. I made the appointment with the students to do the pre-and post-test after the school finished at 3.10 p.m. because I was afraid I did not have enough time to teach all of the content in the textbook before the second semester final examination if I appointed the students to do the pre-and post-test during my science class. I provided the time for the students to complete the pre-test 30 minutes, but I provided the time for the students to complete the post-test 20 minutes due to in the pre-test most of the students completed the test within 20 minutes. For this reason, they should not use the time more

than 20 minutes in completing the post-test (Pattra's Journal #8: February 28th, 2010).

Analyzing Data

Descriptive statistics are used to analyze data.

To analyze data, Pattra related her gathered data to her research question and determined the statistical methods she would use to analyze the data for answering her research question. She decided to use descriptive statistics to analyze the data because her collected data, the students' pre- and post-test scores, were the quantitative data. In the first step, Pattra drew a table for comparing each student's pre- and post-test scores. She calculated the difference of each student's pre- and post-test scores and calculated the mean score of the students' pre- and post-test scores and filled in the table. Then she sent the table to Pattama for recommendations. Pattama recommended Pattra to calculate the standard deviation of the students' pre- and post-test scores to show the reader the distribution of the students' scores in the pre- and post-test (Pattra's Journal #9: March 3rd, 2010). Pattra could not calculate the standard deviation value because the instructor in the Classroom Research course did not teach her the in-depth detail for analyzing the data, as she stated

“The instructor in the Classroom Research course emphasizes to teach only in the topics which are necessary for writing the first-three chapter of the Classroom Research report. She spent a lot of time to teach about generating the research question, reviewing the literature, and developing the research plan. She did not emphasize to teach about data collection, data analysis, and writing the Classroom Research report. She spent the last 2 class periods, 6 hours, to teach about data collection, data analysis, and writing the Classroom Research report. She told us to read the detail of data collection, data analysis, and writing the Classroom Research report in the course material that she gives to us by ourselves” (Pattra's Interview #5: March 8th, 2010).

Pattama explained ‘how to calculate the standard deviation by showing the formula for calculating the standard deviation value in the SHCR to Pattra and explaining to Pattra how to calculate the value of $\sum x^2$ and $(\sum x)^2$ which appeared in the formula for calculating the standard deviation value, as Pattra stated

“I do not understand basic concept of Mathematics for calculating the standard deviation. I understand that $\sum x^2$ and $(\sum x)^2$ were the same value and can calculate both value by finding the square value of each students’ score and then find the summation of each the square value of the students’ score. Pattama explain to me about ‘what is the difference between $\sum x^2$ and $(\sum x)^2$ ’, and showed the example of how to calculate each value by using the raw data, students’ scores which I collected during my Classroom Research project” (Pattra’s Interview #5: March 8th, 2010).

After the discussion with Pattama, Pattra constructed two tables for her data analysis. The first table showed each student’s pre- and post-test scores, the difference of each student’s pre- and post-test scores, the value of mean score and standard deviation of students’ pre- and post-test scores. Pattra used the information from this table to conclude the research finding as described below

There were 39 students got the post-test score more than pre-test score. Three students got the same score in the pre- and post-test, and two students got the post-test score less than the pre-test score (Pattra’s Classroom Research report).

The second table was the frequency distribution table to show how many of the students got the pre- and post-test scores in each range of the score percentage. The table showed that none of the student got the pre-test score in the range 80-100%, but there were 3 students who got the post-test score in this range. None of the student got the pre-test score in the range 70-79%, but there were 11 students who got the

post-test score in this range. There were four students got the pre-test score in the range 60-69%, but there were 17 students got the post-test score in this range. There were 10 students who got the pre-test score in the range 50-59%, but there were 11 students got the post-test score in this range. There were 30 students got the pre-test score in the range 40-49%, but there were 2 students who got the post-test score in this range. Pattra concluded the information from this table as

The research finding showed that 30 students got the pre-test score lower than 50% of the total score, but there were only 2 students got the post-test score in this range. Most of the students, 17 students, got the post-test score in the range 60-69% of the total score. It could conclude that questioning technique could develop the students' achievement score which correspondence with my research hypothesis as 'The 9th grade students gained more science achievement score after the implementation of questioning technique in the classroom (Pattra's Classroom Research report).

Pattra also provided additional qualitative data for her data analysis. She described that in the first-two period she implemented the questioning technique in the classroom, the students were eager to answer her questions. But there were some students who did not pay attention to learn, they still played and talked to each other. In the following periods, she provided more wait time for the students to think and asked thoughtful, open-ended questions. She encouraged the students to ask questions of each other as well as to ask her. She told the students that she was not concerned as much about right or wrong answers, but she would like them to share their ideas in the class. She emphasized the greater importance of creating addition questions, rather than just getting the right answer from them, to prompt their thinking and to help them reach a conclusion. Pattra drew another conclusion that questioning technique could motivate the students' attention to learn, as she wrote

As the research progressed, the students had more confidence to answer the questions. They answered the questions with no fear whether their answers will be right or wrong. They answered the question for sharing the ideas with

me and other students in the classroom. The students' answers and questions produced many discussions in the class that I had never seen this situation in the first semester which I mainly taught the students by lecturing. The questioning technique enhanced the students' attention. It reduced the students' disruptive behavior. The students paid more attention on my teaching. They tried to share their opinion or asking question to me rather than playing or talking together. They could do more exercise in each period (Pattra's Classroom Research report).

Writes the discussion in term of how the research findings accept or reject with the research hypothesis.

Pattra asked for Pattama's recommendation about writing the conclusion and discussion because she did not know how to write the conclusion and discussion. Pattama explained to Pattra to write the conclusion by summarizing the trends that emerged from her data analysis. For the discussion, Pattama recommended Pattra to critique and provide the reasons in term of how the research findings accepted or rejected with the research hypothesis (Pattra's Journal #10: March 6th, 2010). The conclusion and discussion of Pattra's Classroom Research findings can illustrate below

The students' pre- and post-test scores showed that questioning technique could develop the students' science achievement score. There were 39 students got the post-test score more than pre-test score, and three students got the same score in the pre- and post-test. The reason may be because these three students had limited time to prepare themselves for doing the tests. They were the member of school football team. They spent a lot of time to be trained and attend the competition, so they may do the pre- and post-test by using their prior knowledge only. There were two students got the post-test score less than 50% which did not reach the pass criterion that I specified. It may result from their behavior. They lacked of responsibility and did not pay attention to

learn. They often absented the class, and one of them was an autistic student (Pattra's Classroom Research report).

Writing the Classroom Research Report

Writes the Classroom Research report follows the format of university's thesis typing.

Due to the instructor in the Classroom Research course assigned Pattra to read the course material by herself for writing the Classroom Research report, so Pattra did not feel confident which information she should write in each chapter of her Classroom Research report. She consulted with Pattama and Pattama introduced the example of Classroom Research report in the SHCR to Pattra as a framework for writing the Classroom Research report, as she wrote

Pattama introduced the example of Classroom Research report in the SHCR to me to see the components of the Classroom Research report. I learned about writing the significance of the research, the research objectives, the delimitation of research, the definition of terms, the literature review, the research methodology, and the research findings from the Classroom Research report that Pattama presented to me. Due to the Faculty of Education required me to write my Classroom Research report in the five-chapters format, so Pattama recommended me to see the example of how could I write my Classroom Research report from the theses in my university library which comprised of five chapters; the same format that I should write for my Classroom Research report (Pattra's Journal #10: March 6th, 2010).

After consulting with Pattama, Pattra wrote her Classroom Research report with the following details. In chapter 1, she provided the data about the background information of why she was interested in conducting her Classroom Research project in the topic of 'Developing the 9th grade students' science achievement score by using teacher questioning technique', the research participants, the independent and

dependent variable of her study, the selected science topic for teaching by questioning technique, the number of periods for teaching by questioning technique in the selected science topic, definition of terms, and research hypothesis. In chapter 2, she wrote five topics as a result of her literature review which including teaching, inquiry learning, the implementation of questioning technique in the classroom, the achievement score, and the related research about implementing the questioning technique in the classroom. In chapter 3, she explained the research participants, the research design of her Classroom Research project, the process for developing the lesson plans and the pre- and post-test, and the method she used for analyzing the data. In chapter 4, she gave the detail about her research results. She presented the tables for comparing the students' pre- and post-test scores. In the last chapter, chapter 5, she wrote about the conclusion and discussion, and recommendation for further studies. Besides the 5 chapters mentioned earlier, Pattra also included the preface of acknowledgement, table of content, bibliography, and appendix in her Classroom Research report. The appendix comprised of lesson plans, pre-test and post-test that she used in her Classroom Research project.

Summary of Pattra's Practice of Classroom Research

At the beginning, Pattra did not understand how to generate the research question. She wanted to continue on her previous Classroom Research topic that she used to develop while she was studying in the Classroom Research course. Her cooperating teacher explained to Pattra that it was not the correct concept for conducting the Classroom Research project because her Classroom Research project was not based on the situation which happened in the classroom. The cooperating teacher encouraged Pattra to find a problem in the classroom that Pattra taught for conducting her Classroom Research project. Pattra followed her cooperating teacher's recommendation. She generated a new research question by observing and recording the classroom situations for two months. Then she chose a problem that affected her self-confidence in teaching and affected the students' learning to generate a research question. Her research question was 'Will the use of questioning technique enhance the 9th grade students' science achievement score?'

Pattra did not concern much about reviewing literature. Some parts of her literature review relied on the information that she used to write in her previous Classroom Research topic with the reason that it was approved by the instructor in the Classroom Research course. She did not consider whether it related to her new Classroom Research topic or not. She reviewed literature in five topics: teaching, inquiry learning, the implementation of questioning technique in the classroom, the achievement score, and the related research findings.

Pattra employed the one group pretest-posttest research design to conduct her Classroom Research project because she thought this research design was easy to conduct and it corresponded with her research question. Pattra developed the research instrument, a pre- and a post-test, by using the information from the teacher handbook and the 9th grade science textbooks. She sent the draft of her pre- and post-tests to her cooperating teacher and the school academic section for approval of format, content, and wording. Then she revised and tried out the tests before using them to collect data.

During the implementation of lesson plans based on questioning technique, Pattra used a lot of techniques for asking the questions to the students. She asked the students to answer the question at the same time, called the name of the student to answer the question, and asked a volunteer to answer the question. Pattra taught according to the lesson plans that she developed, then she compared the students' pre- and post-test scores to see whether the students gained more achievement score after the implementation of questioning technique in the classroom or not.

Pattra used the descriptive statistics to analyze her data. Pattra wrote her Classroom Research report followed the format of her university's thesis typing which comprised of five chapters.

The Case of Juntima

The Implementation of the Initiative

After Jakchai attended the workshop about “The supervision of Classroom Research to the pre-service science teachers” with the researcher on July 11th, 2009, he started to implement the initiative with Juntima. Jakchai supervised Classroom Research for Juntima in every stage from generating the research question until writing the research report. The supervision process started from July 14th, 2009 to March, 1st, 2010. The timeline for supervising each stage of Classroom Research is displayed in Table 3 in the third chapter of this dissertation. In contrast, the university supervisor, Permpoon, did not play a major role in supervising Classroom Research to Juntima due to Juntima did not consult him about conducting the Classroom Research project. He only supervised Classroom Research to Juntima in writing the lesson plans and using the instructional material for organizing the learning activities during the time Juntima conducted her Classroom Research project. The practice of Juntima’s Classroom Research is described below.

Generating Research Question

The research question comes from the problem in the classroom which affects Juntima’s self-confidence in teaching.

Juntima started to conduct her Classroom Research project on July 14th, 2009, by discussing with Jakchai about the supports that she needed from him to conduct her Classroom Research project. At first, Juntima indicated her willingness to continue conducting Classroom Research project in the previous research topic that she developed while she was studying the Classroom Research course in the third year of her pre-service teacher education program. Her previous Classroom Research topic was ‘Constructing the activities for developing the 8th grade students science process skills’. Jakchai stated that

“Juntima told me that she did not want to waste the time in generating the new research topic. She has already finished writing chapter one to chapter three in her previous Classroom Research topic and they were approved by the instructor in the Classroom Research course. During this internship period, she just develops and implements the research innovation with the students in the classroom to collect the data. Then she analyzes data and writes the research report in chapter four and five. She thought, if she continue on her previous Classroom Research topic, she could complete her Classroom Research project in the first semester and she will has more time to concentrate on other works that the university requires her to do during the internship period such as teaching the students and cooperating with other pre-service teachers in the school to conduct the extracurricular activity for the students” (Jakchai’s Interview #2: July 15th, 2009).

Jakchai disagreed with Juntima’s idea to continue on her previous Classroom Research topic. He explained Juntima that continuing on her previous Classroom Research topic was not the correct concept for conducting the Classroom Research due to the research question did not come from the situation in her current classroom, as he said

“The intention of conducting the Classroom Research project is to find the strategy for solving the problems which happen in the classroom. But continuing on her previous Classroom Research topic is just like Juntima conducts the Classroom Research project in the topic that she was interested in. She had the research question in her mind before she teaches the students in the classroom. Her Classroom Research project does not base on the situation that occurred in the classroom” (Jakchai’s Interview #2: July 15th, 2009).

Another reason that Jakchai disagreed with Juntima’s idea to conduct her Classroom Research project on the topic about ‘the students’ science process skill’

because from his experience, it was very difficult to develop the method for assessing the students' science process skills, as he said

“I used to be the provincial committee to develop the method for assessing the students' science process skill in the ‘Provincial academic skill competition’. The committee comprised of the university lecturers and the experienced science teachers from many schools around the province. We spent a lot of time in developing the test for assessing the students' science process skills. I am afraid that Juntima cannot develop the test for collecting the data to assess the progression of students' science process skills by herself due to she has no experience in science teaching and has limited time to conduct her Classroom Research project. She has lots of responsibility to do during her internship period in the school” (Jakchai's Interview #2: July 15th, 2009).

Jakchai recommended Juntima to generate the new Classroom Research topic by introducing the worksheet number one; named ‘Teaching Journal’ in the SHCR to Juntima and assigned her to observe and record the situations in the classroom every period after she finished her teaching followed the questions in worksheet number one for one and a half months from the mid- of July to the beginning of September, 2009. After one and a half months of recording the information into the worksheet number one, Jakchai gave the Worksheet number two and Worksheet number three to Juntima to help her consider the possible research questions for her Classroom Research project. Jakchai recommended Juntima to select the most frequent problem that occurred in the classroom to generate her research question. Juntima wrote

Jakchai assigned me to do the Worksheet number one, number two, and number three for generating the research question. In Worksheet number one, he asked me to record the information followed the four questions appeared in the Worksheet every period after I finished my teaching for 1.5 months. He suggested me to pay attention on recording the problems that occurred in the classroom in each period as much as possible. In Worksheet number two, he suggested me to read through the information in Worksheet number one

entries, and then group the information into four themes followed the four questions in the worksheet (What went well in the classroom?; What went poorly in the classroom?; What surprised me during my teaching?; and What questions did I end today with?) into worksheet number two named 'The summary of situation in the classroom'. If the same situations occurred in many periods of my teaching, he asked me to put the check mark (✓) in front of those situations to see the frequency. The information in worksheet number two revealed the problem about the students' lacked of participation in learning activities that most frequency occurred in my classroom. In Worksheet number three named 'Generating the research question', he entrusted me to specify about the problem in the classroom that I would like to do research, the reason why I was interested in that problem, the importance for researching in that problem, the research participants, the possible methods for solving the problem, the expecting research outcomes, the time for conducting the research, and the research question (Juntima's Journal #1: September 7th, 2009).

In looking back of her teaching practice, Juntima discovered that her teaching practice did not work well for the students to learn. The students did not enjoy the lesson as much as she anticipated. They seemed sleepy and did not participate much in the learning activities. They could not do the exercises and got low science achievement scores in the mid-term test. Juntima worried about this situation because it reduced her teaching confidence. The students' lack of participation in the learning activities and low achievement scores were the problems that Juntima was interested in to conduct her Classroom Research. A discussion with Jakchai encouraged Juntima to search for the theses and former pre-service teachers' Classroom Research reports in the university library for finding the ideas about the strategy which could solve the problem that she was interested in conducting for her Classroom Research project. The literature review led Juntima to come up with the idea about the formative assessment which relied on asking the questions to the students and assigning the students to do the exercise in each teaching period. She thought that by this strategy,

her students would be able to understand the lesson better and led them to gain higher science achievement scores, as she expressed

The formative assessment gave me the instant information about students' understanding. I could assess the students' understanding suddenly within the period of my teaching when I asked them the questions or in the next period after I checked their exercise or homework. If I found the students did not understand the lesson, I could explain more details to them for their better understanding. I did not want to wait until the mid-term test or final test for assessing the students' understanding. With this strategy, I thought my students could gain more science achievement score. Furthermore, the formative assessment method could promote the students' participation in the classroom by answering my question. I expected the students will enjoy with my new teaching technique more than teaching by lecturing that I taught them before I conducted the Classroom Research project (Juntima's Journal #2: September 20th, 2009).

Juntima decided to conduct her Classroom Research project with the students in class 8A with the research question 'Will an instruction focused on the formative assessment method increase the 8th grade students' science achievement scores in the topic of matter and properties of matter?' There were 30 students in this classroom, 14 boys and 16 girls. The students in this classroom were mixed ability. This classroom learned science three periods a week; one period on Tuesday and two-continuous-period on Friday. The science period on Tuesday was operating from 9.20 a.m. to 10.10 a.m., and the science period on Friday was operating from 1.00 p.m. to 2.40 p.m. Juntima gave the reason for conducting her Classroom Research project with the students in class 8A as the following:

The students in this classroom got low science achievement score in the mid-term test. I was blamed from the school academic section which decreased my self-confidence in teaching. I would like to find the strategy to help the

students in class 8A to gain more science achievement score (Juntima's Journal #2: September 20th, 2009).

Reviewing Literature

Online database is a source for reviewing literature.

Jakchai used the worksheet number four named 'Conducting the literature review' in the SHCR for guiding Juntima to review the literature. First, he asked Juntima to think about the research question that she generated and to write the research hypothesis of her study. Juntima wrote the research hypothesis of her Classroom Research project as 'The 8th grade students gain higher science achievement scores in the topic of matters and properties of matters after the implementation of the formative assessment method'. Then, Jakchai asked Juntima to identify the keywords which appeared in her research hypothesis. Juntima identified two keywords including formative assessment method and achievement score. Next, Jakchai suggested Juntima about the sources for reviewing literature; he highly recommended Juntima to search the related literature from the website named 'www.thailis.or.th' because it was the website that collected the theses, dissertations, and research reports from most of the universities in Thailand. It was very easy for Juntima to access to a large amount of related research within a short period of time, as Juntima wrote

Jakchai told me to review the literature online from the website named 'www.thailis.or.th' because it could help me to save my time in investigating the related research. I could access to a huge number of theses, dissertations, and research reports due to most of the university in Thailand shared their database together through this website. I just typed the keywords that I had already identified in the search engine of this website, and then the website provided me the related research in a PDF file format. It was very helpful to me because I did not pay the money for photocopying. I could read the information in the computer which saved a lot of my budget for conducting

the Classroom Research project. Furthermore, I did not waste the time for going back to the university library. I could use the school's internet to search for the literature during my free time. He suggested me to read the abstract and scan the headings, subheadings, and research findings to find the related ideas with my research topic and record the information for reporting the result of my literature review. He warned me to record the full reference citation of each literature to save the time when I wrote the bibliography in the back of my Classroom Research project (Juntima's Journal #3: October 8th, 2009).

Juntima searched the related research about the students' achievement scores and the formative assessment method from the 'www.thailis.or.th' website. She typed these two keywords in the search engine of the website. When the website showed the related research, she skim read the abstracts, the chapter two, three, four and five for considering which research comprised of information that was necessary with her Classroom Research project. She selected three related research for using as the resources in reporting the result of her literature review. She wrote the second chapter, literature review, of her Classroom Research project by rewriting the information which appeared in the second chapter of related research. She wrote two main topics as a result of her literature review. The first topic was the formative assessment method. In this topic, she described the meaning and objective of the formative assessment method; the steps for implementing the formative assessment method in the classroom; the example of the formative assessment method such as the communication between the teacher and students or between the students and their friends during the class period, the performance assessment, and the portfolio assessment. The second topic was the achievement score that provided details about the meaning of achievement scores; factors that could affect the students' achievement scores such as classroom atmosphere, teacher's teaching method, student's motivation to learn; and the measurement and evaluation of students' achievement scores (Juntima's Classroom Research report).

Juntima sent the first draft of her second chapter to Jakchai and he suggested Juntima to add the information about the finding from related research in order to

show the reader about ‘what other researchers had found out about the implementation of the formative assessment method for developing the students’ achievement scores to see the examples of research intervention and methods of data collection and data analysis used by other teachers (Juntima’s Journal #4: October 22nd, 2009). For reporting the related research, Juntima provided the information from three related research. In each related research, she gave the information about the researchers’ name and surname, the year of publication, the original page number of each research finding, the research topic, the research participants, and the research finding. Finally, in reviewing the literature, Juntima wrote three topics for reporting the results of her literature review: the formative assessment method, achievement scores, and the related research findings about the implementation of formative assessment method for developing the students’ achievement scores (Juntima’s Classroom Research report).

Developing the Research Plan and Research Instruments

Literature review leads to the decision of the research design.

Juntima started to create a research plan by discussing with Jakchai about the timeline for conducting her Classroom Research project. Jakchai suggested Juntima to schedule the time for developing the lesson plans and research instrument, collecting the data, analyzing the data, and writing the Classroom Research report. Then, Jakchai introduced Juntima the example of a research plan in the SHCR and gave worksheet number five named ‘Research planning’ to Juntima for giving her ideas about writing the research plan. In developing the research plan, Juntima first considered the research design for her Classroom Research project. Then, she wrote about the research participants, the research instrument for collecting the data, the method for analyzing data, and the timeline for conducting the Classroom Research project. The information from her literature review led Juntima to employ the one group pretest - posttest design in her Classroom Research project because this research design was commonly used by other researchers and easy to conduct, as she expressed

“I am interested in the one group pretest -posttest design because from my literature review, I see most of the researchers who had the similar research question of mine employed this type of research design in their study. They used the pre-test and post-test to collect the data for comparing the students’ achievement score before and after the implementation of formative assessment. I think this research design harmonize with my research question. I have knowledge in this research design while I was studying in the Classroom Research course. I think this research design is not difficult to conduct. It is good for me to conduct my first Classroom Research project with the simple research design to make sure I can complete my Classroom Research project before I finish the internship period. With this research design, I can conduct my Classroom Research project with the students in only one classroom. I just develop the pre-test and post-test for collecting the data. Then compare the students’ pre- and post-test scores to see whether they gain more achievement score after the implementation of formative assessment method in my classroom or not” (Juntima’s Interview #2: October 30th, 2009).

Develops the lesson plans in the topic that most confident to teach.

After Juntima clarified the research design, then she specified the independent variable and the dependent variable in her Classroom Research project as the formative assessment method and the 8th grade students’ science achievement scores, respectively. Next, she determined the learning topic for developing the lesson plans based on the implementation of formative assessment method. In the second semester, she had three topics for teaching included matters and properties of matters, light and vision, and forces in daily life. Juntima chose the topic of ‘matters and properties of matters’ to develop the lesson plans for implementing in her Classroom Research project because she was confident about teaching this topic the most, as she stated

“I decided to develop the lesson plans in the topic of ‘matters and properties of matters’ because I have strong knowledge in this topic. I understand all of the content in this topic. I am confident about teaching this topic. I have many

ideas for developing the lesson plans based on the implementation of formative assessment method. I know how to construct the questions to ask the students in the classroom and how to design the exercise sheets for the students to do at the end of each period. I was less confident in teaching the topic of light and vision, and forces in daily life. I think I have weak knowledge in these two topics. While I was studying in the science method courses, I did not understand well in the topic which related to the field of Physics. I do not have any ideas to develop the question or to design the exercise sheet for the students to do. I am afraid if I conduct my Classroom Research project in these two topics, it may lead to the unexpected research result. The students may get not much achievement score in these two topics, and may affect my grade in the internship courses” (Juntima’s Interview #3: November 9th, 2009).

Juntima developed 7 lesson plans for teaching the topic of ‘matters and properties of matters’ which comprised of the following sub-topics: 1 period in the topic of physical and chemical changing, 2 periods in the topic of states of the matters, 2 periods in the topic of changing of states of the matters, 2 periods in the topic of closed system and opened system, 2 periods in the topic of energy and melting, 2 periods in the topic of energy and chemical reaction, and 2 periods in the topic of the effects of chemical reaction towards the human and environment. In conducting her Classroom Research project, Juntima totally implemented the lesson plans based on the formative assessment method for 13 periods. Juntima’s lesson plans comprised the details about the school name, the semester and academic year of teaching, subject code, lesson plan’s name, number of periods for teaching the lesson plan, learning objectives, main concepts, learning activities, instructional materials, learning resources, and the measurement and evaluation of students’ learning. The learning activities were separated into 3 components: introduction, teaching, and summary. Due to Juntima gave the definition of term of ‘the formative assessment method’ as ‘the strategy that provided the opportunities for the students to express their thinking and understanding during the class periods by answering the teacher’s questions and doing the exercises in order to assess the students’ learning in each teaching period’,

so she used a lot of questions for driving her lesson plans in the topic of ‘matters and properties of matters’. For example in the ‘states of the matters’ lesson plan, she used questions to examine the students’ prior knowledge in the introduction component. She encouraged the students to give examples of matter in their daily lives. Then she asked the students ‘How many types state of the matters you find in your daily lives?’, ‘What are those states’, ‘Why each matter has different state?’. In the teaching component, she asked questions together with the explanation for providing and elaborating the students’ ideas. She classified students into seven groups. Each group comprised of three to four students. First, she asked the students in each group to hug to each other and then moved from one point to another point. Second, she asked the students in each group to hold their hands to each other and then moved from one point to another point. Third, she asked the students in each group to release their hands from each other and then moved from one point to another point. After these activities, Juntima asked the students with the following questions ‘Which activity is easiest to move?’, ‘Which activity is the most difficult to move?’, ‘Which activity is easy to change the shape of your group?’, ‘Which activity is difficult to change the shape of your group?’ Then Juntima explained the concept about force between particles to the students. In the summary component, the questions in the exercise sheet were used to encourage the students to revise the content that they learned for instance, ‘From the learning activities what does each student represent for?’, ‘Which state of the matter does the first activity represent? Why?’, ‘Which state of the matter does the second activity represent? Why?’, ‘Which state of the matter does the third activity represent? Why?’ which state of the matter cannot change the shape following the container? Why?’

Juntima sent each lesson plan to Jakchai one week before implementing the lesson plan in the classroom to ask for his recommendations. Jakchai observed Juntima’s teaching only 6 periods out of 13 periods during the implementation of lesson plans in Juntima’s Classroom Research project because he usually was called by the school principal to work for the school audiovisual section. On the other hand, her university supervisor, Permpon, came to observe her class only one time while she was teaching in the topic of ‘matters and properties of matters’, so her university

supervisor gave the recommendations to her only one lesson plan out of 7 lesson plans that she developed for using in her Classroom Research project (Juntima's Journal #7: January 31st, 2010). Permpon gave recommendation to Juntima's lesson plan about using the instructional material. He would like Juntima to use picture or slide presentations as a component of her teaching to promote the students' learning. In addition, he recommended Juntima to write the detail of each component of the lesson plan as much as possible such as writing the questions that she would like to ask to the students and indicating the answers of each question to help her know how much of the correctness of the students' answer. He told Juntima that the detail that she wrote in the lesson plans could affect to the confidence of her teaching practice. The details will inform Juntima about the things that she should do in the classroom. The more detail in the lesson plans led to the more confidence in teaching (Permpon's Journal #3: January 15th, 2010).

The textbooks and teacher handbook are the resources for developing the pre-test and post-test.

Juntima consulted with Jakchai about developing the tests for using in the pre-test and post-test. She would like to develop only one test for the students to do twice for the pre-test and post-test due to the fact that she did not know how to develop the two parallel tests that had an equal difficulty level for collecting the data in order to compare the students' achievement score before and after the implementation of the formative assessment method in the classroom. Jakchai agreed with Juntima, but he suggested Juntima to make some changes in the pre-test before using in the post-test to prevent the problem about the students' lacked of attention in doing the same test twice, as she wrote

My cooperating teacher agreed with me to develop only one test for collecting the data in the pre-test and post-test, but he suggested me to rearrange the sequence of test items and the choices of each test item in the pre-test in new order before assigning the students to do in the post-test. He told me that it was very difficult and spent a lot of time to develop the two parallel tests that

had the same difficulty level for comparing the students' achievement score before and after the implementation of the formative assessment method (Juntima's Journal #5: November 22nd, 2009).

Juntima developed the pre- and post-test following her cooperating teacher suggestion. She rearranged the sequence of test items and the choices of each test item in the pre-test in a new order before assigning the students to do the post-test. She developed the pre- and post-test by considering the expected learning outcomes in the topic of 'matters and properties of matters' in the teacher handbook. Then she reviewed all of the content of this topic which appeared in the students' textbook. Next, she developed the test items and made sure the test items covered the expected learning outcomes and all of the content that students learned. She developed the test items by adapting the test items from the 8th grade science textbooks which were published by many publishers. Juntima's pre- and post-test comprised of 30 test items; 20 test items were the multiple choice format, and the other 10 test items were matching format. She clarified her idea for developing the pre- and post-test as the following

I used my own experience in developing the pre- and post-test. When I was a student, I was not much enjoying doing only the multiple choices test item. It was boring for doing a lot of multiple choices test item, so I included the matching test items format in my pre- and post-test. I thought this technique could encourage the students to pay more attention for doing the test which will lead to the accurate data for comparing the students' achievement score before and after the implementation of the formative assessment method in my classroom. I developed the test items by adapting the test items from the 8th grade science textbooks which were published by five different publishers (Juntima's Journal #5: November 22nd, 2009).

The research instrument is approved and tried out before implementing in the classroom.

Juntima sent the first draft of her pre- and post-test to Jakchai and the head of science department for content validity and checking the wording and test format. Next, she revised the pre- and post-test followed Jakchai's and the head of science department's recommendations. Then she tried out the tests with the students in class 8B to make sure that the tests were clear for the students to understand and the time she planned to provide for the students to complete the tests was proper. Finally, she implemented the pre-test and post-test with the students in class 8A which were her research participants. Juntima did not send the pre- and post-test to her university supervisor for recommendations because in the time that she developed the pre- and post-test, her university supervisor did not come to observe her teaching in the school (Juntima's Journal #6: December 22nd, 2009). The pre-test took place two days before she taught the topic of 'matters and properties of matters' on January, 14th, 2010 and the post-test took place two days after she finished teaching the students in the topic of 'matters and properties of matters' on February, 15th, 2010.

Collecting Data

Conducting the Classroom Research project enhances the confidence in teaching.

Juntima defined the meaning of 'the formative assessment method' in her Classroom Research project by modifying from the definitions of term about 'formative assessment method' which appeared in the related research. She defined the meaning of 'the formative assessment method' in her Classroom Research project as 'the strategy that provided the opportunities for the students to express their thinking and understanding during the class periods by answering the teacher's questions and doing the exercises in order to assess the students' learning in each teaching period'. So in her teaching, Juntima used the questions to drive her lesson. She used questioning to review students' prior knowledge. She then began the mini-

lecture to provide the key concepts of a particular topic. Information sheets and exercise sheets drawn up by Juntima were distributed to students before teaching. She asked questions to prompt students to clarify their ideas and used the students' answers to drive the lesson. She shaped the learning activities to encourage students to take an active part in learning the material. When the students gave the incorrect or incomplete answers, she tried to challenge the student to reread and reconsider the information in the textbook and information sheets. Finally, she pointed out what was incorrect about the answer and filled in the necessary points to complete the answer. At the end of each period, she always had the students working on the exercise sheets. The format of the exercise was short answer questions and fill in the blank questions. The typical questions asked for information that the students could find in their textbook, information sheets, and notes. The exercise sheets contained five to ten items. Students were allowed to work on the exercise through informal small-groups. Juntima believed that information sheets and exercise sheets were the alternative way to support the student's learning because they provided time for the students to think and make sense of the concepts they learned in each period by completing the exercises at the end of each period. After everybody had finished the assignment, she asked students at random to share their answers. When the selected students had given their answers, other students considered whether they were right. In case they were not, the students could respond with an argument. Then the teacher wrapped up the discussion (Juntima's Journal #7: January 31st, 2010).

During the implementation of the lesson plans, Juntima faced the problem of time for teaching. The school had many additional activities which were not specified in the school long range plan that affected her teaching time. She could not follow the lesson plans that she wrote. At the beginning, she intended to spend 13 periods for teaching the topic of 'matters and the properties of matters', but in the real situation she had only 10 periods for teaching this topic. Conducting the Classroom Research project enhanced Juntima's sense of the teacher. It encouraged her to try to find the strategy for solving the problems in the classroom, as she wrote

My enthusiasm in teaching science enhanced while I was conducting the Classroom Research project. It encouraged me to investigate for new teaching strategies to solve the problem in the classroom. At the outset of the internship period, I was very nervous for teaching the students. I always dishearten when the students did not pay attention in my teaching. Sometimes, I thought teaching was very difficult to me and led me to think that I could not be a teacher in the future. But I changed my mind while I was conducting the Classroom Research project. Now I was ready to face every problem in the classroom. Problems in the classroom were the exercises for me to develop myself to be a quality teacher. The more problem I could solve, the more quality teacher I could be. Conducting the Classroom Research project will be the part of my teaching practice when I am going to be a teacher in the future (Juntima's Journal #8: February 12th, 2010).

The time constrain affects the arrangement of the pre-test and post-test.

Juntima made an appointment with the students to do the pre- and post-test after school finished at 4.30 p.m. She asked the students to rearrange the desks and chairs in the classroom to have more space between each desk than the usual class to avoid the students' cheating. She organized the time for the students to complete the pre-test 50 minutes, and 30 minutes for completing the post-test because the students did the post-test after they learned all of the concepts about 'matters and properties of matters', so they should spend less time in completing the post-test. Juntima provided the details for collecting the data as

I organized the tests in the classroom because the classroom had plenty of spaces. I asked the students to spread the desks and chairs around the classroom area for avoiding the students' cheating. The tests took place in the made up periods after the school finished time. In this semester, the school's activities wasted a lot of my teaching time. I was afraid I could not finish teaching all of the content in the textbook, if I organized the pre-and post-test during my teaching periods. I provided the time for the students to complete

the pre-test for one period, 50 minutes but I provided the time for the students to complete the post-test 30 minutes due to the post-test took place after the students had already learned all of the concept about 'matters and properties of matters' and it was the second time for them to do this test, so they should spend less time in completing the post-test (Juntima's Journal #9 February 16th, 2010).

Analyzing Data

Descriptive statistics are used to analyze data.

In analyzing the data, Juntima thought about what her research question was. Then, she looked at the collected data and determined the statistic methods that she should use for analyzing the data to provide the answer to her research question. Juntima used the descriptive statistic to analyze her data. She constructed the table for comparing each student's pre- and post-test scores. The first table consisted of four columns with the information about the students' number, the pre-test score, the post-test score, and the difference of each student's pre- and post-test scores, respectively from the left to the right. Below this table, she concluded the information in the table as

The table showed that all of the students gain more achievement score after the implementation of the formative assessment method in the classroom (Juntima's Classroom Research report).

Then Juntima built the second table to show the frequency distribution of how many the students' pre- and post-test scores were in each range of the score percentage. Juntima concluded the information from the table that after the implementation of formative assessment methods, all of the students got the post-test score more than 50% of total score which passed the school's assessment criterion. There were 11 students got the post-test score more than 80% of total score which

could imply that the formative assessment method led to the students' high achievement score in science subject (Juntima's Classroom Research report).

Juntima ended up her data analysis by presenting the third table. This table showed the mean score and the standard deviation of the students' pre- and post-test scores. She drew a conclusion for the third table as 'the mean score of the post-test was higher than the mean score of the pre-test, so it could conclude that the formative assessment method could enhance the 8th grade students' science achievement score in the topic of 'matters and properties of matters' (Juntima's Classroom Research report).

Juntima provided the detail for analyzing the data that Jakchai helped her a lot in calculating the mean score and the standard deviation. He taught her how to use the Microsoft Excel program to calculate these two statistic values, as she wrote

I did not know how to calculate the standard deviation value because the instructor in the Classroom Research course did not teach me in this topic. She assigned the students who studied in the course to make understanding about analyzing the data and writing the Classroom Research report by ourselves from the course material that she distributed to us. I got many helps from Jakchai. He taught me about using the Microsoft Excel program to calculate the mean score and the standard deviation. It was very easy and used little time. I just filled up the raw data of the students' pre- and post-test scores in the program. Then, the program automatically calculated the mean score and the standard deviation for me (Juntima's Journal #10: March 1st, 2010).

Writing the Classroom Research Report

Writes the Classroom Research report follows the thesis-typed format.

Juntima was not sure about what information she should include in each chapter of her Classroom Research report, so she asked for suggestions from Jakchai.

Jakchai explained to Juntima the details she should provide in each chapter and let Juntima to see the example of Classroom Research report in the SHCR. He also recommended to Juntima to check the format for writing her Classroom Research report in the theses that she had already searched while she was reviewing the literature. For writing the Classroom Research report, Juntima mostly relied on the format that appeared in the theses (Juntima's Journal #10: March 1st, 2010). She provided the following details in her Classroom Research report.

In the preliminary of the Classroom Research report Juntima included the abstract, the preface of acknowledgement, and the table of content. In chapter 1, introduction and significance of the study, she told the readers about why and how the study came about, her motivation and need for the study. She also wrote about the research objective, implication of the study, the research participants, the intervention, the selected science topic for implementing the intervention, the research hypothesis, the independent and dependent variables of her study, the period of time for conducting the research, and the definition of terms. In chapter 2, the literature review, she wrote three topics for reporting the results of her literature review which including the formative assessment method, the achievement score, and the findings of related research about implementing the formative assessment method in the classroom. In chapter 3, methodology, she indicated about the process for developing the lesson plans, pre-test, and post-test, the process for collecting the data, and the descriptive statistical used for analyzing the data. In chapter 4, finding of the study, she built three tables to compare the students' pre- and post-test scores and drew the conclusion for her study. In chapter 5, discussion and recommendation, she wrote about the discussion and recommendation for further studies. In the back of her Classroom Research report, Juntima included the bibliography and appendix. The appendix comprised of list of the experts who reviewing her research instrument, lesson plans, pre-test, post-test, and her biography.

Summary of Juntima's Practice of Classroom Research

The same as Pattra, Juntima did not understand how to generate the research questions. She understood that conducting a Classroom Research project during the internship period meant continuing on her previous Classroom Research topic that she used to develop in the Classroom Research course. Her previous Classroom Research topic was about developing the students' science process skills, but her cooperating teacher disagreed with her idea to continue on her previous Classroom Research topic. He thought it was not the correct concept for conducting a Classroom Research project because the research question was not based on the current classroom situation. Furthermore, it was difficult to develop the method for assessing the students' science process skills. Her cooperating teacher recommended Juntima to find a new Classroom Research topic by advising her to observe and record the problems in the classroom for one and a half months. Juntima selected the most frequent problem which occurred in the classroom for her research question. Her research question was 'Will an instruction focused on the formative assessment method increase the 8th grade students' science achievement scores in the topic of matter and properties of matter?'

Juntima reviewed literature for finding the ideas about strategies which could solve the problem that she was interested in conducting her Classroom Research project and for providing and guiding the framework for her Classroom Research. She reviewed literature in three topics: the formative assessment method, achievement scores, and the related research findings about the implementation of formative assessment method for developing the students' achievement score.

Juntima employed the one group pretest-posttest research design in her Classroom Research project because this research design was commonly used by other researchers who had similar research questions to hers and it was easy to conduct. She developed the pre- and post-tests as her research instruments for collecting the data to answer her research question. In developing the pre-test and post-test, Juntima used the information from the teacher handbook and the 8th grade

science textbooks which were published by various publishers. The research instruments were approved and tried out before being implemented in her classroom. Juntima taught according to the lesson plans that she developed, then she compared the students' pre- and post-test scores to see whether the students gained higher achievement scores after the implementation of formative assessment method or not.

Juntima used the descriptive statistics to analyze her data. She wrote her Classroom Research report followed the format of university's thesis typing which comprised of five chapters.

The Case of Napa

The Implementation of the Initiative

Dara started to implement the initiative with Napa after she attended the workshop about "The supervision of Classroom Research to the pre-service science teachers" with the researcher. Dara supervised Classroom Research for Napa in every stage from generating the research question until writing the research report. The supervision process started from July 18th, 2009 to March 5th, 2010. The timeline in supervising each stage of Classroom Research is displayed in Table 3 in the third chapter of this dissertation. In contrast, the university supervisor, Permporn, did not play a major role in supervising Classroom Research for Napa as he did not have much time to supervise Napa in the school. He only supervised Classroom Research for Napa about developing the pre-test and post-test. The practice of Napa's Classroom Research is described below.

Generating Research Question

The research question comes from the problem that affects most of the students in the classroom.

At the beginning, Napa asked Dara to generate the research question for her because she did not have any ideas for generating the research question. She did not know which problem in the classroom should be selected for generating the research question. Dara did not generate the research question for Napa because she wanted Napa to practice generating the research question by herself, as Dara stated

“Napa told me that this was her first experience for teaching full-time in the school. She did not know which problems in the classroom that she should select for generating the research question in her Classroom Research project. She would like me to generate the research question for her. I did not follow her request. I wanted her to generate the research question by herself” (Dara’s Journal #1: July 27th, 2009).

Dara recommended Napa to observe the classroom and record the classroom situations every period after she finished her teaching into worksheet number one named ‘Teaching Journal’ for one and a half months from the end of July to the mid-of September, 2009. Then, Dara assigned Napa to summarize the classroom situations into Worksheet number two named ‘The summary of situation in the classroom’ following the four questions in the worksheet number one (What went well in the classroom?; What went poorly in the classroom?; What surprised me during my teaching?; and What questions did I end today with?).

Napa faced the obstacle that there were many problems that occurred in her classroom. She did not know which problem she should select for generating her research question. She consulted with Dara to help her generate the research question. Dara explained to Napa about the objectives and things Napa should consider in generating the research question. She suggested Napa to think about the manageable research question. The research question should not be too difficult to collect the data for finding the answer. Dara guided Napa in selecting the problem that affected most of the students in the classroom, as Napa wrote

Dara suggested me to select the problem that affected most of the students in the classroom and was appropriate with my ability to find the answer of the research question. She told me that my Classroom Research project will be worthwhile with the time and endeavor I had spent, if it could affect many students in the classroom (Napa's Journal #1: September 28th, 2009).

Dara's recommendations led Napa to think about 'developing the 7th grade students' science achievement scores'. The information in worksheet number one revealed that the students in class 7A lacked sufficient attention to learn and got low science achievement scores, so if she conducted the Classroom Research project in this topic it should be worthwhile because it had the potential to affect many students in the class. In addition, it was easy for her to collect the data for answering the research question.

Napa was interested in employing a mind map in her classroom to develop the students' science achievement scores because the information in worksheet number one showed that the students in class 7A were unable to summarize what they learned in each period that resulted them in getting the low science achievement scores. The students usually did the homework in Art during her class. It sparked her idea to integrate the science concept with the students' Art skill by assigning the students the task of summarizing the science concepts that they learn in each period in the form of mind map and providing the opportunity for them to use their Art skill to decorate the mind map that they constructed, as Napa wrote

The students in class 7A usually did the homework of Arts subject during my teaching. They could not answer my questions in the following periods when I asked them to check their understanding of 'what they learned' in the previous periods. They could not do the exercises that I assigned to them during the class periods. I was blamed by my cooperating teacher because the students' science achievement scores in the first semester were low. I was interested in employing the mind map in my classroom for developing the students' science achievement score because the students loved to draw and paint. I noticed that

they pay many attentions in doing the Arts subject's homework. With this reason, I could integrate the content of science subject with the students' interesting in Arts by encouraging them to construct and decorate their mind map. I expected this technique should encourage the students to pay more attention in my class and could help them summarize the concepts that they learned in each period which should affect them to gain more science achievement score (Napa's Journal #1: September 20th, 2009).

Napa defined the mind map as 'a diagram used to represent the concepts that students learned in each period by arranging them around a central key concept in the form of groupings, branches, or areas in order to help students summarize and remember the concepts that they learned in each period'. Napa wanted to see if the mind map could help the students remembered the concepts that they learned which would enable them to get high science achievement scores or not (Napa's Journal #1: September 20th, 2009). Napa finally generated her research question as 'Will the students' construction of mind maps for summarizing the lesson develop the 7th grade students' science achievement scores in the topic of "plant mechanism"? There were 37 students, 17 boys and 20 girls. The students in this classroom were mixed ability. They learned science three periods a week; one period on Monday and two-continuous-period on Tuesday. The science period on Monday was operating from 2.50 p.m. to 3.40 p.m., and the science period on Tuesday was operating from 10.00 a.m. to 12.10 p.m.

Reviewing Literature

University library and online database are the sources for reviewing literature.

Napa conducted her literature review during the three-week break between the first and the second semester in October, 2009. She discussed with Dara the planning of her literature review. First, she presented three topics that she would like to report on her literature review to Dara which including the meaning of mind map, the format

of mind map, and the steps for constructing the mind map. Dara thought the topics that Napa presented to her did not cover the entire theoretical framework in her Classroom Research project because she only mentioned about the mind map. She did not mention about the achievement scores which was one of the keywords that appeared in her research question. Dara introduced the worksheet number four named 'Conducting the literature review' in the SHCR to Napa. She asked Napa to scrutinize of her research question that she generated and encouraged Napa to identify the keywords appeared in the research question. Napa identified two keywords, mind map and achievement scores.

Napa reviewed the literature from two main sources. The first was the Westernthani University library, and the second was the online database, www.thailis.or.th. She wrote that

Dara suggested me to find the literatures from the website www.thailis.or.th. She told me that this website collected the theses, dissertations, and research reports from most of the university in Thailand. It should benefit to me in finding the related research because I could access to various theses, dissertations, and research reports within the short period of time. I could download the file of related research and read from the computer screen which saved my money in photocopying. Dara told me to read the abstract, the chapter two, three, four and five of related research for finding the information that was necessary to conduct my Classroom Research project. She suggested me to read the information about mind map and achievement score in the second chapter of the related research to give me the idea in writing the second chapter, literature review, of my Classroom Research report and read the third chapter of the related research to see the methods of data collection and data analysis used by other teachers (Napa's Journal #2: October 15th, 2009).

Napa searched the related literature by typing the keywords that she identified in the search engine of the university library database and the homepage of the website www.thailis.or.th. She borrowed two books about the mind map from the

university library and downloaded the PDF file of five related research papers about ‘implementing the mind map in the classroom for developing the students’ achievement scores from the website to use as the resources for her literature review. She used a pencil to underline the topic sentence of each paragraph in the books and related research. She took note of the main ideas that were related to her Classroom Research topic and recorded the entire citation and all the page numbers in case she needed to find that material again and to prepare her for writing the references and bibliography. She reported the result of her literature review in the form what she had learned about the mind map and the achievement scores to provide the theoretical framework for her Classroom Research project. She began with an introductory sentence to describe how the literature review was organized throughout the second chapter of her Classroom Research report. She wrote

Dara recommended me to decide how to begin writing the review literature. For example, she gave the idea that I should start with the sentence “In this literature review, I first present the meaning of mind map, the benefit of implementing the mind map in the classroom, and followed by strategy for teaching by using the mind map to summarize the lesson”. She explained that starting with an introduction sentence kept me on track and informed the readers about what to expect from my literature review. Dara told me that the purpose of literature review was providing the theoretical framework of research study to the reader. She suggested me to report my literature review by synthesizing the information in term of what I learn from many sources of the literature about the concept of mind map, achievement score, and related research findings. At the end of each sub-topic, Dara recommended me to summarize the main idea of those sub-topics with my own word to show my understanding of the sub-topics and to help the readers know about what the main idea embedded in each sub-topic (Napa’s Journal #2: October 15th, 2009).

Napa wrote about three main topics in reporting the result of her literature review. The first topic was the mind map. In this topic, she described the meaning of

mind map, the steps in constructing mind map, and the benefit of mind map for promoting the students' learning. The second topic was the achievement scores that provided the detail about the meaning of achievement scores and the measurement and evaluation of students' achievement scores. The third topic was the related research that presented the research finding from five related research papers about the implementation of mind maps for developing the students' achievement scores. Napa gave details about the name of the researchers, the year of publication, the research topics, the research participants, and the research findings of each related research (Napa's Classroom Research report).

Developing the Research Plan and Research Instruments

With the research title written, the research question was clear, and a literature search was under way. Napa started to write the research plan to outline the whole process of the study. Dara recommended Napa to develop a research plan by letting Napa see the example of research plan in the SHCR. Dara explained to Napa about the components of the research plan that Napa should include in her research plan, for example; the research title, the background and significance of the research, the research objectives, the research hypothesis, the research participants, the research design, the definition of terms, the expected outcomes, the data collecting method, the data analysis method, and the timeline for conducting the Classroom Research project, as she wrote

Dara recommended me to write the research plan for providing the roadmap in conducting my Classroom Research project. She introduced the example of research plan and worksheet number five named 'Research planning' in the SHCR to me and persuaded me to think with the following questions: 'What was my research topic and research question?', 'Why was I interested in this research topic?', 'What was the expected outcome of my research?', 'What sources of information that could provide the answer for my research question?', 'How can I collect and analyze the data?', 'When will I develop

the lesson plan, pre-test, post-test?', and 'When will I collect and analyze data?' (Napa's Journal #3: November 1st, 2009).

The research design is suitable with research question and easy for collecting the data.

Napa scrutinized her research question and decided to employ the one group pretest-posttest research design in her study. She thought this research design was not difficult to conduct and could provide the answer to her research question, as she stated

"From my research question, I want to compare the development of the students' science achievement score before and after the implementation of mind map in my classroom. I think the one group pretest-posttest research design was suitable with my research question. Furthermore, I have some prior knowledge in this research design. With this research design, I just develop the pre-test and post-test for collecting the data. Then compare the students' pre- and post-test scores to see whether they gain more achievement score after the implementation of mind map or not? It was the simple research design that easy to conduct. I am confident to conduct my Classroom Research project with this research design" (Napa's Interview #2: November 10th, 2009).

Selects the teaching topic which provides the time for developing the lesson plans, pre-test, and post-test.

When the research design was identified, Napa specified the independent variable and the dependent variable of her Classroom Research project as the implementation of mind map and the 7th grade students' science achievement scores, respectively. Next, she considered about the learning topic for developing the lesson plans with the implementation of mind map. Napa decided to develop the lesson plans for using in her Classroom Research project in the topic of 'plant mechanism' because

it provided her time to develop the lesson plans and the pre- and post-test, as she stated

“I decided to develop the lesson plans in the topic of ‘plant mechanism’ because it was the last topic for me to teach in the second semester. I plan to start teaching this topic in the last week of January, 2010, so I have approximately three months for developing the lesson plans, the pre- and post-test. I think I cannot finish developing the pre- and post-test before I teach the topic of atmosphere and movement” (Napa’s Interview #2: November 10th, 2009).

There were four sub-topics on the topic of plant mechanism including, cell structure and cell function, diffusion process, osmosis process, and photosynthesis process. Napa wrote four lesson plans for teaching these sub-topics for 13 periods in total which could separate into 4 periods in the topic of cell structure and cell function, 3 periods in the topic of diffusion process, 3 periods in the topic of osmosis process, and 3 periods in the topic of photosynthesis process. Napa had five steps in developing the lesson plans. First, she analyzed the learning objectives and the content in the topic of plant mechanism that appeared in the teacher handbook which Dara gave to her. Second, she developed the lesson plans based on the St. Mary School format that Dara gave her lesson plans to Napa to see the example of writing the lesson plans. Napa’s lesson plans comprised of the school name, the semester and academic year of teaching, subject code, lesson plan name, number of periods for teaching the content, learning objectives, main concepts, learning activities, instructional materials, and the measurement and evaluation of students’ learning. The learning activities were separated into 3 components: introduction, teaching, and summary. Her lesson plans placed great emphasis on transmitting the knowledge from teacher to students. She lectured and assigned the students to do the exercise sheets. At the end of each period, Napa asked the students to construct a mind map for summarizing the concepts that they learned as their homework. She asked the students to hand in the mind map in the next day.

Napa constructed her own mind map for comparing with the students' mind map to evaluate 'how much each student could write the concepts that they learned in each period'. Third, she sent each lesson plan to Dara and the head of science department one week before implementing the lesson plan in the classroom to ask for the recommendations. Then, she corrected the lesson plans followed Dara's and the head of science department's recommendation. Last, she implemented the lesson plans in the classroom.

The teacher handbook is the resource for developing the pre-test and post-test.

Napa realized that she would need to collect evidence to compare the student's achievement scores before and after the implementation of mind map. She decided to use the pre-test and post-test as her research instrument for collecting the data. She developed the pre- and post-tests in the multiple choice format with 20 test items. She copied all of the test items from the teacher handbook which was developed by the staff of the St. Mary School network. The test items in the pre- and post-test were similar, but she rearranged the sequence of test items and the choices of each test item of the pre-test in a new order for using in the post-test. Although, Dara suggested to Napa to have at least 30 test items in the pre- and post-test because she thought 20 test items were not enough for assessing the students' learning, but Napa did not follow this advice. She relied on her university supervisor's recommendation which agreed with her in having 20 test items in the pre- and post-test. Napa expressed her ideas in developing the pre- and post-test with the following detail

"I developed the test items in multiple choice format because it saved my time to grade the students' score and it required not much time for the students to complete the test. My teaching time in the second semester is very limited, so having 20 test items in the pre- and post-test were good for me to allocate the time in my teaching period for 20 minutes to do the pre-test before I taught the topic of plant mechanism, and another 20 minutes to do the post-test after I finished teaching this topic. I thought the students in this classroom had short

concentration. If it had too many test items, they may be lazy and do not use all of their capability to do the tests beyond-20 test items. The situation that the students did not use all of their capability to do the tests may be unreliable to conclude my study that the students' construction of mind map for summarizing the lesson can really develop the 7th grade students science achievement score or not. My cooperating teacher wanted me to have 30 test items in the pre- and post-test for assessing the students' learning. She thought that 20 test items were too few to assess the students' learning. I discussed with my university supervisor, and he allowed me to have 20 test items in the pre- and post-test. My university supervisor recommended me to rearrange the sequence of test items and the choices of each test items of the pre-test in new order for using in the post-test. He told me that he just wanted me to know the process of developing the research instrument, so developing only one test with 20 test items for the pre-test and rearranging the sequence of test items and the choices of each test items of the pre-test for using in the post-test was enough. He wanted me to more concentrate on my teaching rather than on conducting the Classroom Research project" (Napa's Journal #4: January 20th, 2009).

Napa sent the pre- and post-tests to Dara and the head of science department for approving of test format, content, and wording. Next, she revised the pre- and post-tests following Dara's and the head of science department's recommendations. Then she implemented the pre- and post-tests with the students in the classroom. She did not try out the pre- and post-tests before implementing them in the classroom. She sent the pre- and post-tests to Dara and the head of science department one week before she implemented in the classroom. After Dara and the head of science department returned the tests to Napa, she only had time to revise the pre- and post-tests, but she did not have time to try out the tests (Napa's Journal #4: January 20th, 2010).

Collecting Data

Implementing the lesson plans allows Napa to make changes in the classroom.

Before teaching the topic of ‘plant mechanism’ Napa explained to the students about how to construct the mind map and told them the purposes that she would like the students to think about in constructing the mind map. The classroom observations revealed that Napa’s teaching practices focused on providing content to the students. Student needs and characteristics were not considered to be important parts of her teaching. She placed great emphasis on transmitting the knowledge from the teacher to the students. Therefore before teaching every topic, she often told students what topic was being taught. She asked the questions to review students’ knowledge learned from the previous periods at the beginning of the class. Then she lectured and assigned the students to do the exercise sheets that she distributed to them. At the end of each period, Napa asked the students to brainstorm and summarize what they had learned. She asked each student to construct a mind map for summarizing the concepts that they learned as their homework. She asked the students to hand in the mind map in the next day. There was a problem about the time that the students spent in constructing the mind map which led Napa to make change in the classroom, as she wrote

During the implementation of the lesson plans, I faced the problem about the time that students spent to construct the mind map. At first, I intended to provide 10 minutes in each period for the students to construct the mind map to summarize the concepts that they learned. But I found that the students could not finish constructing their mind maps within 10 minutes. The students consumed a lot of time in constructing the mind map. I changed my mind. I told the students to construct the mind map as their homework. I asked the students to send their mind maps in the next day. This change produced a good result to my students. They wrote many concepts in their mind maps. They produced colorful mind maps. When I asked the questions to them in the next

period for checking their understanding, they could answer my questions (Napa's Journal #5: February 10th, 2010).

Napa organized the pre- and post-test in the classroom. She asked the students to arrange the desks and chairs spread around the classroom area. Napa and Dara worked collaboratively in distributing the tests. She allocated 20 minutes of her teaching time for the students to complete the pre-test and post-test. The pre-test took place on January, 18 2010 before she started teaching the topic of 'plant mechanism'. The post-test took place on February, 23 2010 after she finished teaching the topic of 'plant mechanism' (Napa's Journal #6: February 25th, 2010).

Analyzing Data

Descriptive statistics are used to analyze data.

For analyzing the data, Napa conducted in five steps. She first considered the research question to determine the variable of the study. Then she checked the collected data to see whether they covered all research variables or not. Third, she selected the statistics for analyzing data. Fourth, she presented the research findings in the table form to make for easy understanding by the readers. Last, she wrote the conclusion of her Classroom Research project by explaining whether the research findings confirmed or refuted the research hypothesis. Napa used the descriptive statistics for analyzing her data. She drew two tables for analyzing the data. The first table was the comparison between the student's pre- and post-test scores. She presented each student's pre- and post-test scores and the difference of each student's pre- and post-test scores. She also calculated the mean score of the students' pre- and post-test scores and presented at the last row of the table.

Under the table Napa wrote the conclusion that the mean score of the students' post-test score was higher than the pre-test score, so it could concluded that the students' construction of mind map could develop the students' science achievement scores. The research findings agreed with the research hypothesis of my Classroom

Research project as the students got higher science achievement scores in the topic of plant mechanism after the using of students' construction of mind map to summarize the concepts in each teaching period (Napa's Classroom Research report).

Napa sent the result of her data analysis to Dara for suggestions. Dara suggested Napa to calculate the standard deviation (*S.D.*) of the students' pre- and post-test scores, but Napa could not calculate the standard deviation because the instructor in the Classroom Research course did not teach her in-depth detail in the process of analyzing the data, as she stated

"I do not know how to calculate the S.D. value. The instructor in the Classroom Research course did not teach me in this topic. I do not understand why I should calculate the S.D. and present in my Classroom Research report. Dara suggested me to calculate the S.D. and included it in my first table. She explained to me that for data analysis; the mean score should be presented accompany with the S.D. value for helping the reader know about the distribution of the students' score in the pre- and post-tests. The low value of the S.D. means most of the students get the score in the same range. On the other hand, the high value of the S.D. means the students' scores are varied. Some students may get very high scores, and some students may get very low scores. Dara explained to me step by step in calculating the S.D. value. She introduced the formula for calculating the S.D. value in the SHCR to me and explained how could I calculate the value of $\sum x^2$ and $(\sum x)^2$ because I did not understand the difference of $\sum x^2$ and $(\sum x)^2$ " (Napa's Interview #3: March 9th, 2009).

The second table was the frequency distribution table to show how many the students got the pre- and post-test scores in each range of the score percentage. Below this table, Napa concluded that all of the students got the post-test scores more than 50% of the total score which passed the school's assessment criterion. It showed that using of mind map could develop the students' science achievement score. Before the

use of mind map most of the students got the score below 50% of the total score, but after the use of mind map all of the students got the score more than 50% of the total score (Napa's Classroom Research report).

Writing the Classroom Research Report

Writes the Classroom Research report follows the thesis-typed format.

In writing the Classroom Research report, Napa followed the university thesis-typed format. Her cooperating teacher recommended her to write the Classroom Research report in the same format that her university required in typing a thesis. Dara suggested Napa to note the topics that she should include in each chapter of her Classroom Research report from the theses that stored in the university library (Napa's Journal #7: March 7th, 2010). Napa's Classroom Research report comprised of five chapters. Chapter 1 is introduction and significance of the study. Chapter 2 is the literature review. Chapter 3 is methodology. Chapter 4 is research finding. And Chapter 5 is discussion and recommendation. Napa Classroom Research report comprised of the following details.

In the preliminary part of the Classroom Research report Napa included the abstract, the preface of acknowledgement, and the table of contents. In chapter 1, introduction and significance of the study, she told the readers about her motivation and rationale for conducting this research topic. Then she wrote about the research objective, implications of the study, the research participants, the selected science topic for implementing the intervention, the independent and dependent variables of her study, the period of time for conducting the research, the research hypothesis, and the definition of terms. In chapter 2, the literature review, she wrote three main topics for reporting the results of her literature review. The first topic was the mind map. In this topic, she described the meaning of mind map, the steps in constructing a mind map, and the benefit of mind maps for promoting the students' learning. The second topic was the achievement scores where she provided details about the meaning of achievement scores and the measurement and evaluation of students' achievement

scores. The third topic was the related research where Napa presented the research finding from five related research papers about the implementation of mind maps in the classroom. Napa gave the detail about the name of the researcher, the year of publication, the research topic, the research participant, and the research finding of each related research. In chapter 3, methodology, she indicated the research design of her study, the research participants, the process for developing the lesson plans, pre-test, and post-test, the process for collecting the data, and the process for analyzing the data. In chapter 4, research finding, she constructed three tables to compare the students' pre- and post-test scores and to draw the conclusion for her study. In chapter 5, discussion and recommendation, she wrote about the discussion and recommendation for further studies. In the back of her Classroom Research report, Napa included the bibliography and appendix. The appendix comprised of list of the experts who reviewing her research instrument, lesson plans, the example of students' mind map, the pre- and post-test, and her biography.

Summary of Napa's Practice of Classroom Research

Napa did not know which problems in the classroom should be selected for generating her research question. She asked her cooperating teacher to generate the research question for her. Napa's cooperating teacher wanted Napa to generate the research question by herself, so she recommended Napa to observe and record the classroom situations for one and a half months. The classroom observation led Napa to generate a research question by herself. There were many problems that occurred in the classroom. Napa did not know which problems she should select for generating her research question, so her cooperating teacher guided Napa to select the problem that affected most of the students in the class because it would be worthwhile with the time and endeavor that Napa spent in conducting the Classroom Research project. Her research question was 'Will the students' construction of mind map for summarizing the lesson develop the 7th grade students' science achievement score in the topic of "plant mechanism"?'

Napa reviewed literature for providing a theoretical framework of her research study. Her literature review comprised of three main topics included mind maps, the achievement scores, and the research findings from previous research about the implementation of mind maps for developing the students' achievement scores.

Napa employed a one group pretest-posttest research design in her study because she thought this research design was easy to conduct and was suitable with her research question. Napa did not know how to develop the pre- and post-tests. She developed the tests by copying the test items from the teacher handbook. She sent the tests draft to her cooperating teacher and the head of science department for approving of tests format, content, and wording, but she did not try out the tests before implementing in the classroom. Napa taught according to the lesson plans that she developed and assigned the students to construct the mind maps for summarizing the concepts that they learned in each period as their homework. Then she compared the students' pre- and post-test scores to see whether the students gained higher achievement scores after she encouraged the students to construct mind maps for summarizing the lesson or not.

Napa used the descriptive statistics to analyze her data. Her Classroom Research report comprised of five chapters the same format of the university's thesis-typed format.

Common Findings of Pre-Service Science Teachers' Practice of Classroom Research

Common findings were derived from a cross-case analysis of the three pre-service science teachers' practice of Classroom Research project. The common themes that emerged in the findings are presented below.

Classroom research is a systematic investigation of the effects of teaching on student learning.

The pre-service teachers' practice of Classroom Research revealed that they perceived Classroom Research as a form of inquiry with the intention of improving the quality of their teaching practice for promoting the student's learning. Classroom Research provides the opportunity for them to implement the new teaching techniques such as questioning technique, formative assessment method, and constructing the mind maps in the classroom and to observe how the new teaching techniques affect to the students' achievement scores. The purpose of their Classroom Research is to make change of teaching and learning processes in the classroom.

A research question comes from the problem in the classroom.

All pre-service teachers observed and recorded the classroom situation to search for the problems to generate their research questions. Their research questions were grounded in the realities of their classrooms. For Pattra and Napa, they selected the problem about the students got low achievement scores to conduct their Classroom Research projects because this problem affected their confidence in teaching and affected most of the students in the classroom. For Juntima, she selected the problem that most frequently occurred in the classroom to generate as her research question.

Books, theses, research articles, and the former Classroom Research reports are the resources for reviewing the literature to provide the theoretical framework to the research study.

All pre-service teachers reviewed their literature by linking their research topics with the educational theories found in books, theses, and research articles for providing the theoretical framework for the Classroom Research project. Reviewing literature also informed their ideas to undertake their Classroom Research project by allowing them to see the examples of research intervention and methods of data collection and data analysis used by other teachers.

Pre-service teachers select the learning content that facilitates them to conduct the Classroom Research project.

All pre-service teachers were nervous and lacked of confidence in conducting their Classroom Research projects. They selected the learning content that was most beneficial for them to conduct the Classroom Research project. For Pattra and Napa, they selected the learning content in the last topic that the students learned in the semester to provide the time for developing the lesson plans, pre-tests, and post-tests. For Juntima she developed the lesson plans in the learning content that she was familiar with and had strong knowledge for helping her constructed the questions to ask the students in the classroom and design the exercise sheets for the students to do at the end of each teaching period.

Pre-service teachers employ the research design that is easy for conducting the Classroom Research project.

All pre-service teachers selected the research design that was not difficult to them for developing the research instruments, for collecting and analyzing data. They employed the one group pretest-posttest research design in their studies which mainly focused on the improvement of students' science achievement scores. They had knowledge and confidence to conduct their Classroom Research projects with this research design. Their practices, for the most part, agreed with their understandings before engaging in the initiative in that they perceived pre-tests and post-tests were the research instruments for collecting the data in their Classroom Research project. They stated that data could be analyzed by using the descriptive statistics which was the strategy for analyzing the quantitative data. They thought this research design corresponded with their research question which would like to compare the students' achievement score before and after conducting the Classroom Research project.

Classroom Research report is the same format as the thesis-typed format.

The three pre-service teachers wrote the Classroom Research report which comprised of five chapters like the thesis-typed format included: chapter 1- introduction and background of the study; chapter 2- related literature; chapter 3- research methodology; chapter 4- results of the study; and chapter 5- conclusion, discussion, and recommendations for further studies.

Pre-Service Science Teachers' Understanding of Classroom Research After Engaging in the Initiative

The Concept of Classroom Research

Classroom Research is an inquiry process for solving the problems in the classroom that intends to improve teaching and learning processes.

All pre-service teachers perceived Classroom Research as a form of inquiry process which intended to make change of teaching and learning processes in one's own classroom and to solve the problem in the classroom. For Pattra, she perceived Classroom Research as a form of inquiry with the intention of improving the quality of teaching practice and/or promoting student learning. She explained

“Classroom Research is the process that a teacher explores the problems in the classroom for finding the solutions of the problems. The problems can come from both teacher's teaching practice and students' learning behavior.

Classroom Research leads to the improvement of teacher's teaching practice and students' learning achievement” (Pattra's Interview #6: March 19th, 2010).

For Juntima, she understood Classroom Research as small scale research that the teachers could conduct concurrently with the routine teaching to find solutions to classroom problems. She stated

“Classroom Research means small scale research that the teachers try to find the solution of the problems which emerged in the classroom. Classroom Research emphasizes in developing a teacher’s teaching practice in order to promote the students’ learning. Classroom Research provides the opportunity for a teacher to implement a new teaching method in the classroom and to observe how a new teaching method affects to the students’ achievement scores. Classroom Research is an inquiry process which is similar to the five-steps of scientific method including: determining the problem for the study; forming the hypotheses; collecting data; analyzing data; and drawing a conclusion and/or reporting the result of the study. Classroom Research connects to the context in which it is conducted. The purpose of the Classroom Research is to make change of teaching and learning processes in one’s own classroom rather than generalize to other contexts” (Juntima’s Interview #4: March 18th, 2010).

In the case of Napa, she understood Classroom Research as a systematic process of inquiry about classroom situations in order to improve the teaching and learning processes, as she stated

“Classroom Research is about the investigation of a teacher’s daily teaching practice. Classroom Research encourages to the change of teacher’s teaching practice in order to promote the students’ learning; such as the way that I assigned the students to construct the mind map for encouraging their motivation to learn and for helping them to remember the learning contents which led them to gain more science achievement scores” (Napa’s Interview #4: March 18th, 2010).

Generating Research Question

A research question comes from the problem in the classroom.

All pre-service teachers understood that the research question should ground in the realities of their workplace. They observed and recorded the classroom situation for a period of time to find the problem to generate the research question. Pattra understood that a research question emerged from the problem in the classroom, as she expressed

“The recording of classroom situations in each period allows me to see the problems in my classroom. I chose a problem that most affect to my teaching practice and students’ learning to generate as my research question. To generate a research question I consider about the manageable of research question. Research question should be suitable with my ability to find the way to answer research question within the period of time available for me to undertake my Classroom Research project” (Pattra’s Interview #6: March 19th, 2010).

According to Juntima, the observation of classroom situations in every period of her teaching led her to generate ideas for her research question. She stated

“Before conducting the Classroom Research project I do not have any ideas in generating research question. I would like to continue on my previous Classroom Research topic. But Jakchai’s recommendation let me know that I can generate research question by observing and recording the problems in my classroom for a period of time. Then selects the most frequency problem that occurs in the classroom to generate as the research question” (Juntima’s Interview #4: March 18th, 2010).

For Napa, a research question could be generated by recording the classroom situations and thinking about what a teacher would like to do to improve the teaching and learning in the classroom. She stated

“To generate research question, the classroom should be observed for a period of time and record the data to see what are the problems occur in the

classroom that necessary to find the solutions. There were two criteria in generating research question: 1) research question should affect most of the students in the classroom to be worthwhile with the time and endeavor that spend to conduct the study, and 2) research question should appropriate with her ability to develop the research intervention for solving the problem. The data collection and data analysis should not be too difficult to undertake along with routine teaching” (Napa’s Interview #4: March 18th, 2010).

Reviewing Literature

Reviewing literature provides a theoretical framework to the study and guides the way for conducting the Classroom Research project.

All pre-service teachers understood that reviewing literature meant linking their research topic with the educational theories found in books, theses, and research articles for providing the theoretical framework for the Classroom Research project. Reviewing literature also informed their ideas as to how to best undertake their Classroom Research project by allowing them to see the examples of research interventions and methods of data collection and data analysis used by other teachers. For Pattra, reviewing literature could be undertaken by searching books, research journals, and theses that related to her research topic. Reviewing literature acted as a catalyst for her thinking to help her define the direction for conducting the Classroom Research project and provided a theoretical framework for her study. She mentioned

“The information from books, research journals, and theses sharpen the focus of my study. Reviewing literature gave the opportunity to me in synthesizing multiple dimensions of my topic. It informs me the way of thinking about how I can undertake my study. Reviewing literature provided a theoretical framework to my study by helping me bridge the educational theories with my research topic” (Pattra’s Interview #6: March 19th, 2010).

In the case of Juntima, reviewing literature meant relating her research topic to previous research to see what others have found out about her research topic and how they conducted their research. The literature review led Juntima to come up with an idea for undertaking her Classroom Research project, as she mentioned

“Reviewing literature enhances my understanding of the issues associated with my research topic. Reviewing the literature helps me gain insights about the topic as well as guides me to seek for appropriate strategies in conducting my Classroom Research project. It allows me to see the examples of research interventions and methods of data collection and data analysis used by other teachers. Reviewing literature guides me the way for conducting my study. Reviewing literature provides the theoretical framework for my study by connecting the educational theories with my research topic” (Juntima’s Interview #4: March 18th, 2010).

According to Napa, reviewing literature informed her ideas for conducting the Classroom Research project. The information from the literature provided a theoretical framework for her study, as she stated

“Literature review gives the opportunity to me in synthesizing multiple dimensions of my research topic. The information in books, theses, and research journals in the university library and online database are the great sources for me to get the ideas for conducting my study. It helps me bridge theories in education onto my teaching practice in the classroom” (Napa’s Interview #4: March 18th, 2010).

Developing Research Instruments

There are many steps for developing the research instruments.

All pre-service teachers understood that there were many steps for developing the research instruments. In the case of Pattra and Juntima, the research instruments

should be verified by experienced persons and tried out before use for data collection.

Pattra explained that

“There were five steps for developing the research instrument including: 1) reviewing the expected learning outcomes and learning content in the teachers’ handbook and science textbooks; 2) constructing the test items; 3) sending the test draft to the experienced persons for recommendations and checking for content validity; 4) revising and editing the tests following the experienced persons’ recommendations and trying out the test; 5) second revising the test and then implementing the test with the students in the classroom” (Pattra’s Interview #6: March 19th, 2010).

Juntima, clarified that

“There are eight steps in developing the research instruments included: 1) determine what data needed to answer research question; 2) review the literature for getting the ideas to develop the research instrument; 3) consider the expected learning outcomes in the teacher’s handbook; 4) develop a pre-test and a post-test by modifying the test items from the science textbooks; 5) send the test draft to the cooperating teacher and the head of science department for checking content validity, wording, and test format; 6) revise the test following the cooperating teacher’s and the head of science department’s feedback; 7) try out the test and second revise the test if any faults were found during try out; and 8) implement the test with the research participants” (Juntima’s Interview #4: March 18th, 2010).

For Napa, she developed her understanding about research instrument. She saw the difference between the research instruments and the research interventions. She realized that research instruments were a pre-test and a post-test that she used for collecting data in her Classroom Research project. In contrast, the research interventions were the introducing of mind map to the students in order to help them

summarized the concepts that they learned which led them to gain more science achievement scores. Napa expressed

“There were five steps in developing the research instruments includes: 1) determine the research instruments that can provide data for answering the research question; 2) develop the research instruments; 3) send the test draft to the cooperating teacher and the head of science department for feedbacks; 4) revise the test following the feedbacks; and 5) implement the test in the classroom” (Napa’s Interview #4: March 18th, 2010).

Analyzing Data

Descriptive statistics are used to analyze data.

All pre-service teachers understood that the data could be analyzed by using descriptive statistics such as frequency, percentage, mean, and standard deviation. Pattra understood that the methods for analyzing data should be suitable with the collected data. The qualitative data and the quantitative data required different methods for analyzing data. She employed descriptive statistics to analyze the data in her Classroom Research project because her collected data, the students’ pre- and post-test scores, were the quantitative data. She explained

“For my data analysis, I calculate the mean score and standard deviation to see whether my collected data accept or reject with my research hypothesis. I would like to compare the students’ pre- and post-test scores. If the mean score of the post-test is higher than the mean score of the pre-test, I can conclude that the research finding accept my research hypothesis and could answer my research question in that the use of questioning technique could enhance the students’ science achievement scores” (Pattra’s Interview #6: March 19th, 2010).

For Juntima, she realized that data analysis was the attempt to use the collected data to propose an answer of her research question. Descriptive statistics were used to analyze data, as she mentioned

“Data analysis is a way for manipulating the collected data in order to provide the answer to my research question. In my Classroom Research project, I analyze data by calculating the mean score and standard deviation of the students’ pre- and post-test scores to show the difference of the students’ pre- and post-test scores before and after implementing the formative assessment method in my classroom” (Juntima’s Interview #4: March 18th, 2010).

According to Napa, data analysis was a process of finding the meaning of collected data in order to provide the answer to a research question, as she explained

“There are five steps for analyzing data includes: 1) consider the research question to determine the variables of the study; 2) check the collected data whether they cover the entire research variables and could answer the research question or not; 3) select the statistical methods such as percentage, frequency distribution, and the average (mean) for analyzing data; 4) present the research findings in the table form to make an easy understanding for the readers; and 5) write the conclusion by explaining whether the research findings accept or reject the research hypothesis and how the research findings answer the research question” (Napa’s Interview #4: March 18th, 2010).

Writing the Classroom Research Report

Classroom Research report is the same format as the thesis-typed format.

All pre-service teachers understood that the Classroom Research report comprised of five chapters like the thesis-typed format included: chapter 1- introduction and background of the study; chapter 2- related literature; chapter 3- research methodology; chapter 4- results of the study; and chapter 5- conclusion,

discussion, and recommendations for further studies. Pattra knew that Classroom Research report comprised of five chapters like the thesis-typed format. The five chapters included chapter 1- introduction to describe about the significance of a research, the research participants, the independent and dependent variable of a study, the selected science topic for teaching by questioning technique, the definition of terms, and the research hypothesis; chapter 2- related literatures to provide a theoretical framework for the study; chapter 3 – research methodology to explain about the research participants, the research design, the process for developing the research instrument, and the method for collecting and analyzing data; chapter 4 - the research findings; and chapter 5 - the conclusion and discussion, and recommendation for further studies. In addition the preface of acknowledgement, table of content, bibliography, and appendix should also include in the Classroom Research report (Pattra’s Classroom Research report).

Juntima expressed

“The Classroom Research report comprised of three main sections which called preliminary section, text section, and supplementary section. The preliminary section includes the abstract, the preface of acknowledgement, and the table of content. The text section includes chapter 1- the significance of the study, the research objective, the research participants, the research intervention, the independent and dependent variables of her study, the period of time for conducting the research, and the definition of terms; chapter 2- the related literatures; chapter 3- methodology that indicates about the research design, the research participants, the process for developing the lesson plans, pre-test, and post-test, the methods for collecting and analyzing data; chapter 4- finding of the study and conclusion; and chapter 5- discussion and recommendations for further studies. The supplementary section includes the bibliography and appendix” (Juntima’s Interview #4: March 18th, 2010).

Napa expressed

“The Classroom Research report comprised three main sections. First is the preliminary section that includes the abstract, the preface of acknowledgement, and the table of content. Second is the text section that includes chapter 1- introduction and significance of the study, the research objective, the research participants, the research intervention, the independent and dependent variable of a study, the duration for conducting a research, the research hypothesis, and the definition of terms; chapter 2- the related literatures ; chapter 3- research methodology to provide the detail about the research design, the research participants, the process for developing the lesson plans, pre-test, and post-test, the process for collecting and analyzing data; chapter 4- research finding and conclusion of a study; and chapter 5- discussion and recommendations for further studies. Third is the supplementary section that includes the bibliography and appendix” (Napa’s Interview #4: March 18th, 2010).

Discussions in Relation to the Second Research Question

The discussions of the pre-service science teachers’ understanding and practice about Classroom Research over the implementation of the initiative are provided below.

Conducting Classroom Research project improves the teaching and learning processes.

The findings across the three pre-service teachers revealed that the pre-service teachers’ practice and understanding of Classroom Research after engaging in the initiative were developed, more or less, from their understanding before engaging in the initiative. Their understanding after engaging in the initiative was a bit different from their initial understanding in that they only mentioned conducting Classroom Research project for promoting the students’ learning. In their initial understanding,

they did not perceive that conducting Classroom Research project could also promote the improvement of their teaching practice. But, after engaging in the initiative, all pre-service teachers understood that Classroom Research was an inquiry process done by teachers which affected the improvement of both teaching and learning processes. The pre-service teachers changed their teaching technique when they conducted the Classroom Research project in order to study the new teaching technique which they implemented in the classroom whether it could enhance the students' achievement score or not. This notion was compatible with the notion of Tanya (2004), Wongwanich (2007), and Ross-Fisher (2008) in that the underlying premise of Classroom Research was to improve teaching and learning. To accomplish that goal, the teacher/researcher must determine whether and to what extent the intended result was occurring within the context that the specific intervention was employed in the research project. This is also in agreement with Noffke and Zeichner (1987) and Mills (2006) who stated that Classroom Research was a research that undertaken by teachers in order to increase the understanding of their own teaching practice and/or to increase the capability in solving the classroom problems. The essential characteristic of Classroom Research was that it was conducted by the teachers in their classroom context. The problems studied emerge from the classroom situation in their daily teaching. Teachers who conduct Classroom Research will gain more understanding about their students and improve the quality of their teaching practice.

Research question is generated by observing the classroom situation for a period of time.

All pre-service teachers realized that the research question should be ground in the realities of their workplace. Their cooperating teachers suggested them to generate the research question by observing the classroom and recording the classroom situation every period after their teaching for the duration of 1.5-2 months. The pre-service teachers selected the problem in the classroom to generate as their research question instead of continuing on their previous Classroom Research topic. This finding agreed with the studies of Ross (1987) and Smith and Sela (2005) in that they asked the student teachers to write the teaching diaries during the first month of their

teaching experiences in the school. The student teachers wrote about the problems that they faced during their teaching and expressed possible methods to solve the problems. The summary of the diaries led them to the identification of the research question they wished to examine in-depth. They were also asked to clarify a personal reason why they were interested in that research question and a plan of action for answering the research question. Sagor (2005) and Srisukwattananun (2008) wrote that recording the classroom situations was beneficial in generating the research question because it allowed the researchers to observe patterns and trends of the classroom situation. Recording the classroom situations led the research question to be ground in the real classroom atmosphere.

All pre-service teachers held a shared understanding in generating the research question. They selected the problem that most frequency occurred in the classroom and/or affected most of the students in the classroom to generate as their research question. This finding agreed with Koshy (2005) and Smith and Sela (2005) in that the student teachers wrote a list of problems in the classroom and chose the one which occurred often to generate a research question. Koshy (2005) pointed out that if the Classroom Research project addressed an issue that affected many students in the classroom, the time spent in conducting the research was considered well spent. In addition, the pre-service teachers proposed that the Research question should be suitable with their ability to find the way to answer the research question within the time they had to conduct the Classroom Research project. This idea also compiled with Sagor (2005), Mertler (2007), and Wongwanich (2007) which mentioned that the teachers should consider the feasibility of carrying out a study on the selected research question. The research question should be manageable and in accordance with the devoting amount of time and effort to conduct it. The Classroom Research needs to be focused and a small-scale investigation which the researcher could possibly achieve in the available time.

All pre-service teachers conducted their Classroom Research project in the topic related to developing the students' achievement score. This finding aligned with the findings of Singhatud (2008) and Srisuantang, *et al.* (2009), in that student

teachers usually struggled with the problems about the students' achievement and the students' undesirable behavior. These two problems reduced their confidence in teaching, so the student teachers mainly conducted their Classroom Research project to solve these problems that occurred in the classroom.

Reviewing literature provides the theoretical framework and guides the idea for conducting the Classroom Research project.

In reviewing literature, the pre-service teachers identified the keywords from the research hypothesis which derived from their research question. They used these keywords to search the related literature in order to provide the theoretical framework of the Classroom Research project and to guide the idea for collecting and analyzing data in their study. The cooperating teachers suggested the pre-service teachers to review literature from various sources including the books, theses, research articles, and the former Classroom Research reports that were conducted by former student teachers. This finding corresponded with the notion of Mertler (2006), Johnson (2008), and Ross-Fisher (2008) which proposed that reviewing literature means relating the research question to the theory and the finding of previous research that appeared in academic journals, books, theses, school or district documents, and web sources. Reviewing the work of others provided insight regarding what additional avenues could be explored. Sagor (2005) and Johnson (2008) mentioned that relating research topics to current theories and research findings enabled the researchers to link theory and practice by connecting what were found in the literature to what were happening in the classrooms. In addition, Koshy (2005) and Mertler (2006) expressed that reviewing the literature helped the researchers to see the examples of classroom applications about teaching techniques, the results of each teaching technique, and methods of data collection and data analysis. Reviewing literature generated ideas for the researchers about the methods for gathering and analyzing data that they may employ in their study.

The pre-service science teachers employ the quantitative research method in conducting their Classroom Research project.

All pre-service teachers employed the one group pretest-posttest design to conduct their Classroom Research project. This finding was consistent with Mertler (2006), Tanya (2006), Johnson (2008), and Ross-Fisher (2008) who proposed that the qualitative and quantitative research could be employed in the Classroom Research project. The important thing was the research design must align with the research question. The research design should generate the answer to the research question. For quantitative research, the test scores often were the primary data source. A common way to ascertain the impact of an intervention that was employed in the Classroom Research project was to look at the pre- and post-assessment data and to draw comparison between the two groups of data whether has there been growth or not?

In the overall picture, the research findings from this study could claim that the pre-service teachers conducted the Classroom Research project to find the solutions to problems, the students' low achievement scores, they confronted in their everyday lives. Conducting a Classroom Research project led to a change in their teaching practice in order to promote the students' learning and help them gain higher science achievement scores.

The research instrument should be reviewed by the experienced persons and tried out before implementing with the research participants.

All of the pre-service teachers developed the pre-test and post-test as their research instruments for collecting the data in their Classroom Research projects. They used the science textbooks and teacher handbook as the resources for developing the pre-test and post-test. To develop the research instruments, Pattra and Juntima firstly considered the expected learning outcomes in the topic that they chose for developing the lesson plans which appeared in the teacher handbook. Second, they reviewed all of the learning content that they were required to teach in the students' textbook. Third, they constructed the pre-test by modifying the questions and test items in the exercise of the science textbooks that were published by various publishers. Fourth, they sent the pre-test to the cooperating teacher and the staff of the school academic section for approval of test format and for providing the content

validity. Fifth, they tried out and revised the test before implementing it in the classroom. This finding agreed with Ritjaroon (2004) and Wongcherdtum (2006) which mentioned that there were five steps in developing tests included reviewing the literature to get the ideas for developing the test, developing the test, sending the test to the experts for recommendations, revising the test following the experts' recommendations and tried out the test, second revising the test and implementing the test with the research participants.

In contrast, Napa did not understand about how to develop the test. She developed the test by copying the test items from the teacher handbook which the cooperating teacher gave to her for guiding her idea about how the test items that should be included in the test. She did not try out the test because she did not have time. The time constraint forced her to implement the test with the research participants on the next day after she revised the test following the advices of the cooperating teacher and the staff of the school academic section. Consistent with the findings of Srisuantang, *et al.* (2009), the student teachers struggled with the problem in developing a research instrument. They did not understand the process for developing the research instrument and needed suggestions from the cooperating teachers and university supervisors. Strickland, *et al.* (2001) found that the student internship period was short in duration. It provided insufficient time to the student teachers for a well thought out design of a Classroom Research plan and developing the appropriate instrument for collecting the data.

Descriptive statistics are used to analyze data.

The three pre-service teachers used descriptive statistics to analyze their data because their collected data was quantitative data. They calculated the mean score and the standard deviation of the students' pre- and post-test scores. They compared the students' pre-test scores and post-test scores to see whether the students gained higher scores after the implementation of the research intervention or not. This finding was in harmony with the notion of Kerdtum (2002), Taber (2007), Johnson (2008), Ross-Fisher (2008), and Sanghiran (2010) which mentioned that the way to analyze data

depended on the type of data which had been gathered. For quantitative data in small-scale Classroom Research, it was often sufficient to use the descriptive statistics, e.g. percentage, mean score, and standard deviation to analyze and summarize the findings. All of the student teachers presented the results of their data analysis in table form. This finding aligned with Koshy (2005), Mertler (2006), Taber (2007), Johnson (2008), Ross-Fisher (2008), and Sanghiran (2010), in that the research findings may be presented graphically through table, chart or diagram to communicate findings visually and to help the reader to make sense of the data easily.

Writes the Classroom Research report in five-chapter format.

All of the student teachers wrote their Classroom Research report in the five-chapter format because it was a requirement of the university. This finding aligned with the ideas of Mertler (2006), Taber (2007), Johnson(2008), and Sanghiran (2010) which mentioned that the Classroom Research report should provide the readers with all the details they will need for understanding the research topic, the research procedures, the research results and conclusions. The Classroom Research report was generally comprised of the topics about a) the significance of the research for describing why the research topic was chosen to study and why the research topic was worth investigating, b) theoretical framework to briefly summarize the literature review by mentioning the key aspects that related to the research topic, c) methodology to describe the various forms of data be collected and to tell how to collect the data and to explain the methods that were used to analyze the data, d) research findings to report what the findings were, and e) conclusion and recommendation to summarize the study in terms of how the findings relate back to the objective of the study and to tell how the findings might be applied in other contexts or to provide advice as to what should be done differently.

Supports From the Cooperating Teachers in Conducting Classroom Research

The research question comes from the problems in the classroom.

All three cooperating teachers recommended the pre-service teachers to generate the research question for their Classroom Research by exploring the problems in the classroom. They introduced worksheet number one in the SHCR for guiding pre-service teachers to observe and record the classroom situation for one and a half to two months. The cooperating teachers guided the pre-service teachers to select the problem that most frequently occurred and affected many students in the classroom to generate their research questions. Pattama wrote that

Pattra would like to continue on her previous Classroom Research title which she developed while she was studying in the Classroom Research course. I did not agree with her idea because it was not the correct concept in conducting the Classroom Research project. Her Classroom Research project was not grounded in the classroom that Pattra taught, if Pattra continued on her previous Classroom Research title. I recommended Pattra to generate a new research question. I assigned her to do the worksheet number one in the SHCR for helping her generate the research question. I asked Pattra to record the classroom situations followed the four questions that appeared in the worksheet number one every period after she finished her teaching for two months (Pattama's Journal #1: July 17th, 2009).

After recording classroom situations on worksheet number one for two months, Pattama asked Pattra to summarize the classroom situations on the worksheet number two in the SHCR to see the frequency of each situation that occurred in the classroom. Pattama recommended Pattra to generate the research question by selecting the problem that most frequently occurred and affected many students in the classroom. Pattama stated

Pattra told me that there were many problems occurred in the classroom. She did not know which problem should be selected for generating as her research question. I recommended her to generate the research question by selecting the problem that most frequency occurred and affected many students in the classroom because I thought it was the urgent problem that needed to be solved (Pattama's Journal #2: September 21st, 2009).

In the same manner, Juntima indicated her willingness to continue conducting Classroom Research project in the previous research topic because she did not want to waste the time in generating a new research question and write the chapter one to chapter three again. She had already finished writing chapter one to chapter three in her previous Classroom Research topic. Jakchai suggested Juntima to generate the new research question, as Jakchai said

“I disagreed with Juntima's idea to continue on her previous Classroom Research project due to the intention of conducting Classroom Research project is to solve the problems in the classroom. But continuing on her previous Classroom Research topic likes Juntima conducts the Classroom Research project in the topic that she was interested in. Her Classroom Research project did not base on the situation that occurred in the classroom. I suggested Juntima to generate the new research question” (Jakchai's interview #2: July 14th, 2009).

Jakchai assigned Juntima to do the Worksheet number one, two, and three in the SHCR for generating the research question. In Worksheet number one, he asked Juntima to record the information following the four questions that appeared in the Worksheet every period after she finished her teaching for 1.5 months. In Worksheet number two, he asked Juntima to summarize the information in Worksheet number one to see the frequency of the problems in the classroom. In Worksheet number three, he asked her to specify the problem in the classroom that she would like to research, the reason why she was interested in that problem, the importance for researching in that problem, the research participants, the possible methods for

solving the problem, the expected research outcomes, the time required for conducting the research, and the research question.

In the case of Napa, she asked Dara to generate the research question for her. She did not know which problem in the classroom should be selected for generating the research question. Dara explained to Napa that in generating the research question, Napa should consider about: (i) the research question must be manageable, (ii) the research question should be worthwhile for investigating, and (iii) the research question should be appropriate with the time and Napa's skill levels of data collection and data analysis. Dara recommended Napa to observe the classroom and record the classroom situations into worksheet number one of the SHCR for one and a half months, as she wrote

Napa found many problems that occurred in her classroom. She did not know which problems she should select for generating her research question. I suggested Napa to think about the manageable research question. The research question should not be too difficult for her to collect and analyze data. The research question should affect most of the students in the classroom because it will be worthwhile with the time and endeavor Napa had spent for conducting the Classroom Research project (Dara's Journal #2: September 18th, 2009).

Books, research articles, and theses are the resources for reviewing literature.

All three cooperating teachers recommended the pre-service teachers to search for the related literatures from books, theses, and research articles. They asked the pre-service teachers to identify the keywords from the research hypothesis and use the keywords to search for the related literatures. In reviewing literature they recommended the pre-service teachers to describe the main concepts that they used to conduct the Classroom Research project such as questioning technique, formative assessment method, mind map, and achievement score for providing the theoretical framework of the study to the readers. In addition, they recommended the pre-service

teachers to report the findings from related research in order to see what other researchers had found out about similar Research studies.

In the case of Pattra, at first, she reviewed literature by herself. She copied three topics (the meaning and the characteristic of teaching, the meaning and the characteristic of inquiry learning, and the meaning and the specific characteristic of science) in the second chapter of her previous Classroom Research project for reporting the results of her literature review. Pattama thought the topics that Pattra sent to her not quite related to Pattra's Classroom Research project. To find the literatures that related to Pattra's Classroom Research project, Pattama asked Pattra to identify the keywords which appeared in the research hypothesis and recommended Pattra to use the keywords to search for the related literature, as Pattama wrote

I introduced the worksheet number four in the SHCR to Pattra for helping her reviewed the literature. I thought the topics that Pattra wrote in the first draft of her literature review quite not related to her Classroom Research title especially the topic about the meaning and the specific characteristic of science. I recommended Pattra to identify the keywords from research hypothesis which derived from her research question because it comprised of the variables of her study that could provide the theoretical framework for her Classroom Research project. Pattra identified two keywords including questioning technique and achievement score. Then I recommended Pattra to type the keywords into search engine of her university library database for finding books, research articles, and theses to use as the resources for her literature review (Pattama's Journal #3: October 2nd, 2009).

Pattra sent the second draft of her literature review to Pattama. In this draft, there were four topics included: teaching, inquiry learning, questioning technique, and achievement score. Pattra did not review any related research in her second draft of the literature review, so Pattama suggested Pattra to search and write more details about the findings from related research in order to see what other researchers had found out about using questioning technique to enhance the students' achievement

scores and to lead Pattra to see the research methodology that other people employed to conduct their research for guiding her the idea to conduct her Classroom Research project (Pattama's Journal #4: October 22nd, 2009).

Finally, Pattra wrote five topics as a result of her literature review which comprised of teaching, inquiry learning, questioning technique, achievement score, and the findings from related research. Pattama thought these topics were enough to include in Pattra's literature review because they provided the theoretical framework that Pattra used for conducting her Classroom Research project such as the intention of inquiry learning, the importance of using questioning technique in the classroom, the way of measuring and evaluating the students' achievement scores, and the findings from related research.

In Juntima's case, Jakchai also used the worksheet number four in the SHCR to guide Juntima to review the literature. First, he asked Juntima to think about the research question that she generated and to write the research hypothesis of her study. Then, Jakchai assigned her to identify the keywords from the research hypothesis and suggested her to use the keywords to search for the related literature from an online database. Jakchai wrote

Juntima consulted me about reviewing the literature. I asked her to write the research hypothesis and suggested her to identify the keywords from the research hypothesis. Juntima identified two keywords: formative assessment method and achievement score. I told her to review the literature online from the website named 'www.thailis.or.th' because it could save her time in searching the related research. She could access to a large number of theses, and research reports due to most of the university in Thailand shared their database together through this website. I suggested Juntima to read the abstract, the chapter two- related literature, and the chapter four- research findings of each related research for finding the related ideas with her research title and record the information into the table that appeared in the worksheet number four of the SHCR. I also reminded her to record the full reference of

each related research for writing the bibliography (Jakchai's Journal #3: September 25th, 2009).

Due to it was the first time and Juntima had not much time to conduct her Classroom Research project, it was too difficult for her to collect the information from the books, theses, and research reports and to write the result of her literature review on her own word. So Jakchai suggested Juntima to write the result of her literature review by rewriting the information about the formative assessment method and the achievement score which appeared in the second chapter of related research. Jakchai wrote that

I recommended Juntima to rewrite the information about the formative assessment method and the achievement score which she found in the second chapter of related research. I thought this information was reliable because they were approved from the theses advisory committee. Rewriting the information from related research benefited Juntima to see how to describe the theoretical framework of her study to the readers and it saved her time to report the result of her literature review (Jakchai's Journal #3: September, 2009).

For Napa, she discussed with Dara for planning her literature review. First, Napa presented three topics that she would like to report in her literature review which including the meaning of mind maps, the format of mind maps, and the steps for constructing the mind maps. Dara thought the topics that Napa presented to her did not cover all of the main concepts in her Classroom Research project. She did not mention the achievement score which was one of the keywords in her research question. Dara introduced the worksheet number four in the SHCR to Napa and asked Napa to identify the keywords from her research question for using to find the related literature, Dara wrote

To provide the theoretical framework for her Classroom Research project, I asked Napa to identify the keywords from her research question. Napa

identified two keywords: mind map and achievement score. I suggested her to type the keywords that she identified in the search engine of the university library database and the homepage of the website www.thailis.or.th. for finding the related literature. I suggested Napa to record the information that she found in the related literature into worksheet number four of the SHCR. I suggested Napa to begin writing the review literature by starting with the sentence “In this literature review, I first present the meaning of mind map, the benefit of implementing the mind map in the classroom...” to inform the readers about what to expect from her literature review. At the end of each sub-topic, I suggested Napa to summarize the main idea of those sub-topics with her own word to show her understanding of the sub-topics that she wrote and to help the readers know about the main idea that embedded in each sub-topic (Dara’s Journal #2: October 13th, 2009).

The research design should correspond with the research question and suitable with the pre-service teachers’ time to collect and analyze data.

According to all three pre-service teachers conducted their Classroom Research project for studying the improvement of students’ achievement score, they employed the quantitative research methods in their study. The cooperating teachers agreed with the pre-service teachers to conduct the Classroom Research project based on the one group pretest-posttest research design. They thought this research design could provide the answer to the pre-service teachers’ research questions. It was easy to collect and analyze data which corresponded with the restriction of time that the pre-service teachers had to conduct their Classroom Research project.

In Pattra’s case, after generating the research question and reviewing the literature, Pattama suggested her to create a research plan. Pattama gave the worksheet number five in the SHCR to Pattra for helping her created the research plan. The worksheet required her to identify the research participants, the required data for answering the research question, the research design of the study, the research instrument for collecting data, the timeline for conducting the Classroom Research

project, and the method for analyzing data. From her research question, ‘Will the use of questioning technique enhance the 9th grade students’ science achievement score?’, Pattra thought that she could employ two types of the experimental research methods, a one group pretest-posttest research design and a static-group comparison research design. She discussed with Pattama to help her selected the research design for conducting her Classroom Research project. Pattama recommended Pattra to employ the research design that was most available to conduct her Classroom Research project. Pattama wrote that

Pattra asked me to help her selected the research design for conducting her Classroom Research project. From her research question, I agreed with Pattra to employ the experimental research to study whether the students could gain more achievement score or not after the implementation of questioning technique in the classroom. I explained Pattra that the strength of the one group pretest-posttest design was it required the students only in one classroom to be the research participant. Pattra had to develop one series of lesson plan based on the questioning technique to implement with the students. Then she asked the students to do the pre-test before implementing the lesson plans and asked the students to do the post-test after implementing the lesson plans. But the weakness of this research design was it wasted the time for the students, who were the research participants, to do the test for two times. On the other hand, the strength of the static-group comparison design was the students in the control group and experimental group wasted only one time to do the test. But the weakness of this research design was Pattra should write two series of lesson plan. The first series was the normal lesson plan for teaching the students in the control group classroom. The second series was the lesson plan based on the questioning technique for using with the students in the experimental group. After I explained to her, Pattra decided to employ the one group pretest-posttest design in her study because she did not want to write the two series of lesson plan in the same time. She told that writing two series of lesson plan enhanced her workload (Pattama’s Journal #5: November 9th, 2009).

In the case of Juntima, Jakchai suggested her to schedule the time for developing the lesson plans and research instrument, collecting data, analyzing data, and writing the Classroom Research report. Jakchai introduced Juntima to see the example of a research plan in the SHCR and gave the worksheet number five in the SHCR to Juntima to help her write the research plan. Jakchai expressed that

In developing the research plan, I suggested Juntima to write about the research design of her study, the research participants, the research instrument for collecting data, the method for analyzing data, and the timeline for conducting the Classroom Research project. I agree with Juntima that she employed the one group pretest-posttest research design in her study because it corresponds with her research question. It can answer her research question by comparing the students' pre- and post-test scores before and after implementing the formative assessment method in her classroom. It is easy to conduct that was suitable with the time that Juntima has to conduct her Classroom Research project (Jakchai's Journal #4: November 2nd, 2009).

In Napa's case, Dara agreed with Napa in employing the one group pretest-posttest research design in her study because it provided the answer for her research question, as she said

“Napa told me that she preferred to employ the one group pretest-posttest research design in her study because she thought this research design was not difficult to conduct and was suitable with her research question. I agree with her idea. This research design is easy to conduct that is consistent with her time in conducting the Classroom Research project. Furthermore, it corresponds with her research question. She can use the students' pre- and post-test scores to answer her research question whether the students gain more achievement score after the implementation of mind map or not” (Dara's Interview #3: November 3rd, 2009).

The textbooks and teacher handbook are the resources for developing research instrument.

All three cooperating teachers recommended the pre-service teachers to use the science textbooks and the teacher handbook as the basis for developing their pre-tests and post-tests. They recommended the pre-service teachers to explore the learning outcomes in the teacher handbook and then construct the test items by modifying the questions in the science textbooks. The pre-service teachers sent the pre-tests and post-tests to cooperating teachers before implementing them in the classroom. The cooperating teachers checked for the content validity and the typing errors.

In the case of Pattra, she developed the pre- and post-test by modifying the test items which appeared in the science textbooks. The pre- and post-test comprised of 30 test items. Pattra was uncertain how she could develop the pre- and post-test. She did not know how many test items should be included in the pre- and post-test. Pattama stated that

Pattra had less experience in developing the test, so it was too difficult for her to construct the test items by herself. I recommend Pattra to modify the test items from the 9th grade science textbooks which are published by different publishers to use in her pre- and post-test. I remind Pattra to see the expected learning outcomes in the teacher handbook before constructing the test items. The test items should cover all of the learning outcomes. I provide her the opportunity to decide about the number and the format of test items that she preferred to use in her pre- and post-test. I just recommend Pattra that the number of test items should not be too many or too few. If there were too few test items, it may not assess the students' learning. If there are too many test items, Pattra may be difficult to find the time to arrange the tests (Pattama's Jornal #7: December 14th, 2009).

Pattra developed only one test for the students to do twice for the pre-test and post-test. Pattama did not agree with Pattra because it was nonsense for the students to do the same test for twice. The students may wonder why Pattra assigned them to do the same test twice, as Pattama expressed

“I do not agree with Pattra to use the same test for the students to do in the pre-test and post-test. The students may remember the test items in the pre-test and answer in the same manner in the post-test which may produce the inaccurate research finding. I prefer Pattra to develop two different tests. The first one uses for the pre-test and another one uses for the post-test. But her university supervisor did not think like me. Pattra told me that her university supervisor recommended her to develop one test for using in the pre-test. He recommended Pattra to rearrange the test items and the choices of each test item in the pre-test in new order for using in the post-test. I inevitably allow Pattra to develop the pre- and post-test following her university supervisor’s recommendation because I think the university supervisor has the first priority to recommend the pre-service science teachers during the internship period. Pattra sent the draft of her pre- and post-test to me. I check whether the test items covered all of the expected learning outcomes and proved for the typing errors” (Pattama’s Interview #4: December 28th, 2009).

In Juntima’s case, she developed one test for the students to do twice for the pre-test and post-test because she thought it was difficult to develop the two parallel tests for comparing the students’ achievement scores before and after implementing the formative assessment method in the classroom. Jakchai agreed with Juntima, but he suggested Juntima to make some changes in the pre-test before using in the post-test, as he stated

“I recommended Juntima to construct the test items by modifying from the questions in the 8th grade science textbooks, the teacher handbook, and the exercise sheets that she distributed to the students. I agree with Juntima in using the same test in the pre-test and post-test because she did not has much

experience in developing the test. It consumes a lot of time for developing two parallel tests that had equal difficulty level to compare the students' achievement score before and after implementing the formative assessment method. However, I recommend her to make something difference between the pre-test and post-test to prevent the problem that the students may remember the test items in the pre-test and answer in the same manner in the post-test which can lead to the error of research findings. I recommend Juntima to rearrange the sequence of the test items and the choices of each test item in the pre-test in new order before assigning the students to do in the post-test" (Jakchai's interview #4: December 3rd, 2009).

Juntima sent the draft of her pre- and post-test to Jakchai. Jakchai checked whether the test items covered all of the learning content that students learned or not. He gave suggestions about typing errors, as he wrote

Juntima performed well in developing the pre- and post-test. The test items covered all of the learning content that students learned. I suggested her about the typing. I found many errors typing such as liquid, gass, forc, and so on. I told Juntima to correct all of the error typing before implementing the tests in the classroom (Jakchai's Journal #6: December 17th, 2009).

In the case of Napa, she did not know how to develop the pre-test and post-test. Dara gave the teacher handbook which was developed by the staff of the St. Mary School network to Napa for guiding her in the construction of test items that she could include in her pre-test and post-test. Napa copied all of the test items from the teacher handbook for use in her pre-test and post-test. Dara was very disappointed with Napa's practice. Dara wrote

Napa told me that she did not know how to develop the pre-test and post-test because the instructor in the Classroom Research course did not teach her in depth for developing the tests. I gave the teacher handbook that I and other teachers of the St. Mary School network cooperatively developed to Napa. The

handbook had the example of test items for assessing the students' learning. I expected her to bring the idea from the teacher handbook to construct the test items by herself. Unfortunately, she developed the pre-test and post-test by copying all of the test items from the teacher handbook that I gave to her. I suggested her to develop the new pre-test and post-test by modifying the questions from the 7th grade science textbooks or from the exercise sheets that she distributed to the students. I also asked her to increase the number of test items from 20 to 30 test items. I thought 20 test items in the pre- and post-test were too few for assessing the students' learning. Napa did not follow my suggestion. She gave the reason that she will organize the pre-test in the next four days. She did not have time to develop the new tests. I was very disappointed with her practice because she did not show her ability in developing the test. She asked me to give suggestions to her tests. I did not know what I should suggest to her because she did not follow my suggestion in the thing that I would like her to do. I just checked the error typing for her (Dara's Journal #5: January 21st, 2010).

Descriptive statistics are used to analyze data.

The pre-service teachers did not know how to calculate the standard deviation, so all three cooperating teachers explained to them how to calculate the standard deviation. In the case of Pattra, she knew that she should use descriptive statistics to analyze the data because her collected data, the students' pre- and post-test scores, were the quantitative data. She constructed a table for comparing each student's pre- and post-test scores. Pattama recommended Pattra to calculate the standard deviation of the students' pre- and post-test scores. Pattama wrote that

Pattra sent the draft of her data analysis to me. She calculated the difference of each student's pre- and post-test scores and calculated the mean score of the students' pre- and post-test scores and filled in the table. I asked Pattra to calculate the standard deviation to show the reader about the distribution of the students' scores in the pre- and post-test, but she did not know how to

calculate the standard deviation. I explained how to calculate the standard deviation by showing the formula for calculating the standard deviation in the SHCR to Pattra and explained Pattra how to calculate the value of $\sum x^2$ and $(\sum x)^2$ which appeared in the formula for calculating the standard deviation.

Pattra understood that $\sum x^2$ and $(\sum x)^2$ were the same value (Pattama's Journal #10: March 3rd, 2010).

Pattra did not know how to write the conclusion and discussion. Pattama explained to Pattra how to write the conclusion by summarizing the trends that emerged from her data analysis. For the discussion, Pattama recommended Pattra to provide the reasons in term of how the research findings accepted or rejected with the research hypothesis. Pattama wrote that

I recommended Pattra to write the conclusion by summarizing briefly the main findings of her Classroom Research project for example how many students got the post-test score more than pre-test score, and how many students got the same score in the pre- and post-test. For the discussion, I recommended Pattra to critique about why the students got the post-test score more than pre-test score and why some students got the same score in the pre- and post-test, and then related the research findings to her research hypothesis to see whether the research findings accepted or rejected with the research hypothesis (Pattama's Journal #10: March 3rd, 2010).

In the case of Juntima, Jakchai suggested Juntima calculate the mean scores and the standard deviations of the students' pre- and post-test scores to show the overall picture of students pre-test and post-test scores and the distribution of the students' pre- and post-test scores, as Jakchai wrote

Due to Juntima employed the quantitative research method in her study, so she should calculate the mean score and the standard deviation for comparing the students' pre- and post-test scores. Juntima did not know how to calculate the

standard deviation, so I showed the formula for calculating the standard deviation in the SHCR to her. I taught her to use the Microsoft Excel program to calculate the mean score and the standard deviation because it was easy and used less time than calculating by calculator (Jakchai's Journal #7: March 1st, 2010).

In Napa's case, Dara suggested Napa to calculate the standard deviation of the students' pre- and post-test scores, as Dara wrote

Napa did not know how to calculate the standard deviation. She asked me why she should calculate the standard deviation. I explained to Napa that the mean score should be presented accompany with the standard deviation for helping the reader know about the distribution of the students' score in the pre- and post-tests. I introduced the formula for calculating the standard deviation to Napa and explained how to calculate the value of $\sum x^2$ and $(\sum x)^2$ because she did not understand the difference of $\sum x^2$ and $(\sum x)^2$. I suggested Napa to use the Microsoft Excel program for building the line graph to show the difference between the students' pre-test and post-test scores because it was easier for the readers to see the difference between the students' pre-test and post-test scores than presenting in the table form. Napa did not follow my suggestion because she did not know how to build the line graph and she had many works to clear before going back to the university (Dara's Journal #6: March 2nd, 2010).

Writes the Classroom Research report follows the thesis-typed format.

The Faculty of Education required the pre-service teachers to write the Classroom Research report in a five-chapter format, so all three cooperating teachers recommended the pre-service teachers to write the Classroom Research report followed the thesis-typed format. The five chapters included: chapter 1- introduction and background of the study; chapter 2- related literature; chapter 3- research

methodology; chapter 4- results of the study; and chapter 5- conclusion, discussion, and recommendations for further studies.

Pattra did not feel confident about the information that she should include in each chapter of her Classroom Research report. So Pattama explained the components of the Classroom Research report to Pattra. Pattama recommended Pattra to see the example of Research report writing from the theses that were stored in her university library. Pattama wrote

I recommended Pattra to write her Classroom Research report follows the thesis-typed format because it comprised of five chapters; which was the same format that the Faculty of Education required her to write. I recommended Pattra to use the same format for typing the reference because she typed many different formats of the reference throughout her Classroom Research report. Pattra did not write the name of the tables, so I suggested her to write the name of each table to tell the reader about what the information in the table mentioned about? Lastly, I checked the error typing and asked Pattra to correct all of the error typing in her Classroom Research report (Pattama's Journal #10: March 3rd, 2010).

In Juntima's case, she asked Jakchai about the information that she should include in each chapter of her Classroom Research report. Jakchai recommended Juntima see the format and the information that she should write in each chapter of her Classroom Research report in the theses, as Jakchai wrote

I guided Juntima about writing the information in each chapter of the Classroom Research report for example, Chapter 1 she should mention about the significance of the study, the research participants, the research hypothesis, the variables of her study, and the definition of terms. Chapter 2 she should provide background information about the theoretical framework that were the foundation of her Classroom Research project and showed the evidence about what other researchers had found out that related to her research topic. Chapter

3 she should indicate about the research design, the process for developing the lesson plans, pre-test, and post-test, the process for collecting data, and the method for analyzing data. Chapter 4 she should use table or graph to show data and to describe how the data answer her research question. Chapter 5 she should provide a brief summary of the findings and recommendation for further studies (Jakchai's Journal #7: March 1st, 2010).

In the case of Napa, Dara suggested her about typing format. Dara wrote that

I suggested Napa to write her Classroom Research report followed the thesis-typed format because it comprised of five chapters which met the requirement of the Faculty of Education that preferred Napa to write the Classroom Research report in five-chapter format. Napa sent the draft of her Classroom Research report to me. I found that each of her paragraphs was very long. It was difficult to read. The arrangement of main topic and sub-topic throughout her Classroom Research report was not consistency. I suggested her to rearrange the main topic, sub-topic, and paragraphs and to correct about the error typing. Napa did not include all of the related literatures that she cited in each chapter of her Classroom Research report in the bibliography. I suggested her to read through her Classroom Research report again for checking the entire literatures that were cited in each chapter and to write a new bibliography that included all of the related literatures that she cited in her Classroom Research report (Dara's Journal #7: March 5th, 2010).

Supports From the University Supervisor in Conducting Classroom Research

Permpon did not supervise the Classroom Research to pre-service teachers, if the pre-service teachers did not request for his recommendation. Permpon supervised the Classroom Research to pre-service teachers in the following way.

University supervisor supervises about research design and research instrument.

In the case of Pattra, she consulted Permpon about the research design that she should employ in her study. She was not sure which research design was suitable with her research question between the one group pretest-posttest design and the static-group comparison design. Permpon recommended her to employ the research design that could provide the answer to her research question and she was confident to conduct, as he wrote

Pattra asked me about the research design for conducting her Classroom Research project. She thought there were two types of research design that could provide the answer to her research question; the one group pretest-posttest design and the static-group comparison design. I thought these two research designs were both suitable with her research question. I recommended Pattra to consider about the weakness and strength of each research design. I recommended her to employ the research design that she was confident to conduct (Permpon's Journal #1: November 11th, 2009).

Pattra also asked Permpon about developing the pre- and post-test. Her cooperating teacher wanted her to develop two different tests for use in the pre-test and the post-test, but Pattra did not have the time to develop two different tests. So, Permpon recommended her to rearrange the test items and the choices of each test item in the pre-test in a new order for use in the post-test. He wanted Pattra to pay attention to develop the learning activities for the students than to spend more time in developing the research instrument, as Permpon wrote

Pattra told me that her cooperating teacher would like her to develop two different tests for use in the pre-test and the post-test. Pattra did not want to develop two different tests because she did not have time. She spent a lot of time to develop the pre-test. I recommended her to rearrange the test items and the choices of each test item in the pre-test in new order for using in the post-test. I preferred Pattra to concentrate more on her teaching practice than

conducting the Classroom Research project because the practice of teaching was the main purpose of the internship period. The intention of conducting Classroom Research project during the internship period was to provide the opportunity for pre-service teachers to learn the process of Classroom Research project about how to generate the research question, how to review the literature, how to develop the research instrument, etc. Developing only one test for using in the pre-test and rearrange the sequence of test items and the choices of each test item in the pre-test for using in the post-test was enough for the pre-service teachers to learn about how they can develop the research instrument for conducting the Classroom Research project (Permpon's Journal #2: December 11th, 2009).

In the case of Napa, she had a different idea from her cooperating teacher about the number of test items that she should include in the pre- and post- tests. So, she asked Permpon to determine for her how many test items that she should include in the pre- and post- tests, as Permpon wrote

Napa would like to have 20 test items in the pre- and post- test, but her cooperating teacher would like to have 30 test items. To practice about conducting the Classroom Research project, I would like pre-service teachers independently pursue their idea as much as possible. I allowed her to have 20 test items in the pre- and post- test, although I thought it was too few for assessing the students learning (Permpon's Journal #4: January 19th, 2010).

Permpon provided more detail about the number of test items during the interview that

“In my opinion, the intention of the pre- and post- test of Napa's Classroom Research project was to provide the answer of her research question whether the students gained more achievement scores or not after she encouraged the students to construct the mind map for summarizing the lesson. I thought 20 test items in the pre- and post- test could lead the answer to her research

question. Although I think 20 test items is too few for assessing the students learning, but the pre-test and post- test are not the real assessment of students learning. The real assessment of students' learning occurred when the students took the final examination at the end of the semester. Napa can assess the student learning in the topic of 'plant mechanism' again in the final examination" (Permpon's Interview #3: January 22nd, 2010).

University supervisor supervises about developing the lesson plans.

In Juntima's case, Permpon did not quite supervise her Classroom Research project because she did not ask him about conducting the Classroom Research project. However, he recommended her to indicate the answer of each question into the lesson plans that she developed for use in her Classroom Research project in order to assess the correctness of the students answers. He persuaded Juntima to employ some instructional materials to drive her lessons for encouraging the students' attention to learn and for promoting the students' learning, as he stated

I did not supervise Juntima much about her Classroom Research project. She did not consult me in conducting the Classroom Research project. She told me that everything was going well for her Classroom Research project. She got many recommendations from her cooperating teacher in helping her to conduct the Classroom Research project. Two things that I recommended Juntima was writing the lesson plans and using the instructional material. First, Juntima wrote the questions that she asked the students in the lesson plans, but she did not indicate the answers of those questions. I recommended her to indicate the answer of each question into her lesson plans to assess the students' answers about how much of the correctness. Second, I persuaded Juntima to employ picture and slide presentation to drive her lessons for encouraging the students' attention to learn and for promoting the students' learning. The students may get bore if she only asked, talked, and assigned them to do the exercise sheets during the class period (Permpon's Journal #3: January 15th, 2010).

Discussions in Relation to the Third Research Question

A discussion of the supports about Classroom Research from the cooperating teachers and the university supervisor that the pre-service teachers received over the implementation of the initiative are provided below.

Classroom observation leads to the research question.

For Pattra and Juntima they misunderstood how to generate their research questions. They thought that they could continue on their previous Classroom Research title that they developed in the Classroom Research course. In the case of Napa, she did not know which problem in the classroom should be selected for generating the research question. She asked Dara to generate the research question for her. All three cooperating teachers recommended the pre-service teachers to observe and record the classroom situation for one and a half to two months in order to investigate the problems in the classroom. This finding agreed with Koshy (2005), Johnson (2008), and Srisukwattananun (2008) in that the research question could be generated by observing the situation in the classroom for a period of time. Classroom observation led the pre-service teachers to recognize the problems or things that could be improved in the classroom. The cooperating teachers guided the pre-service teachers in selecting the problems that most frequently occurred or affected many students in the classroom to generate as the research question. This finding was supported by Koshy (2005) in that if the Classroom Research project addressed an issue that affected many students in the classroom, the time spent in conducting the research was considered worthwhile.

Books, research articles, and theses are the resources for reviewing literature.

All three cooperating teachers recommended the pre-service teachers to search for the related literatures from books, theses, and research articles. First, they recommended the pre-service teachers to describe the details about the main concepts that they were used in conducting the Classroom Research project such as questioning

technique, formative assessment method, mind map, and achievement score for providing the theoretical framework of the study to the readers. Second, they recommended the pre-service teachers to report the findings from related research in order to see what other researchers had found out about the similar Research questions for getting ideas about how to collect data, how to analyze data, and how to write the research report. This finding corresponded with Price (2001), Landrum and Nelsen (2002), and Krabacher (2008) in that the mentor teachers recommended the pre-service teachers to review the literature from the research articles and theses for investigating what others had done before. The related literatures provided the examples of teaching technique, research questions, data collection methods, and data analysis techniques to the pre-service teachers. Koshy (2005), Mertler (2006), and Johnson (2008) mentioned that the literature review was an examination of research articles, online documents, theses, books, and other sources related to the Classroom Research project. The purpose of the literature review was to set the Classroom Research topic in a theoretical framework and to make a connection between the theory and classroom practice. The literature review also guided the ways for researchers to conduct the Classroom Research project.

Research design should provide answer to the research question.

According to all three pre-service teachers conducted their Classroom Research project for studying the improvement of students' achievement scores after they implemented new teaching techniques in the classroom. The data that they needed to answer the research question was the students' achievement scores. So the cooperating teachers and university supervisor agreed with the pre-service teachers to employ one group pretest-posttest research design in their study. They thought this research design could provide answer to the research question by comparing the students' pre-test and post-test scores before and after they implemented the new teaching technique in the classroom whether the students gain more achievement scores or not. This finding was consistent with Price (2001), Strickland, Corleys, and Jones (2001), and Smith and Sela (2005) in that the pre-service teachers did not know about the research design that should be employed in the Classroom Research project.

The university supervisors suggested the pre-service teachers to employ the research design that could provide the answer to the research question. Wiersma (2000) and Johnson (2008) supported that the research design was a plan for conducting the research. The research design depended on research question. The research design should provide the answer to the research question.

Descriptive statistics are used to analyze data.

The cooperating teachers recommended the pre-service teachers analyze their data by using descriptive statistics such as mean score and standard deviation. This finding corresponded with Price (2001) and Halim, Buang, and Meerah (2010) in that they recommended the pre-service teachers to use the descriptive statistics to analyze the students' achievement scores for evaluating the effectiveness of the research interventions that were employed in the pre-service teachers' Classroom Research projects. Wiersma (2000), Johnson (2008), and Thomas (2009) stated that the descriptive statistics were commonly used to analyze numerical data. There were three major types of descriptive statistics: (i) measure of central tendency such as mean score, mode, median; (ii) frequency distribution; and (iii) measures of variability such as range and standard deviation. To support this, Kerdtum (2002), Taber (2007), and Sanghiran (2010) pointed out that data analysis techniques depended on the type of data, which had been gathered. For quantitative data in small-scale Classroom Research, it was often sufficient to use descriptive statistics, e.g. percentage, mean score, and standard deviation to analyze and summarize the findings.

Writes the Classroom Research report follows a thesis-typed format.

All three cooperating teachers recommended the pre-service teachers to write the Classroom Research report following a thesis-typed format because it comprised of five chapters which was the format the Faculty of Education required the pre-service teachers to write their Classroom Research report. The five chapters included: chapter 1- introduction and background of the study; chapter 2- related literature;

chapter 3- research methodology; chapter 4- research finding; and chapter 5- conclusion, discussion, and recommendations. This finding in harmony with Price (2001), Rock and Levin (2002), Thathong (2002) that the cooperating teachers and university supervisors recommended the pre-service teachers to write the Classroom Research report in the five-chapter format which was the same format of thesis typing because the ideas were presented in a clearly manner so that the reader was able to gain a maximum amount of understanding.

Factors that Support the Pre-Service Science Teachers' Practice of Classroom Research

The pre-service teachers, the cooperating teachers and a university supervisor expressed their opinion about the factors that support the pre-service science teachers' practice of Classroom Research with the following details.

The close supervision from cooperating teachers enables the pre-service teachers to gain the understanding and the ability in conducting a Classroom Research project.

The close supervision from the cooperating teachers was the major factor that supports the pre-service teachers' practice of Classroom Research during the internship period. All three pre-service teachers commented on this. The supportive behavior of Pattara's cooperating teacher allowed her to talk and exchange the ideas with peace of mind, as she stated

“Pattama acts as she is my friend. She listens to my voice and shows her willingness to help me all the time. I am confident to discuss and ask her for recommendations. Pattama's recommendations and the worksheets that she assigns me to do are helpful for me in conducting the Classroom Research project in each step. I gain more understanding about conducting the Classroom Research project. Pattama permits me to try out my ideas in the Classroom Research project. She allows me to determine about the number

and the format of test items in the pre-test and post-test. The warm atmosphere between me and Pattama helps me to learn many things from the direct experiences in undertaking the Classroom Research project” (Pattra’s Interview #6: March 19th, 2010).

Napa stated that “Dara paid many attentions to my Classroom Research project. She always gives useful recommendation to me when I have trouble with my Classroom Research project” (Napa’s Interview #6: March 18th, 2010). Juntima was confident and enjoyed conducting the Classroom Research project with the support from Jakchai. Jakchai was flexible, supportive, and encouraging. He allowed Juntima to take risks in trying new ideas in her Classroom Research project. As a result, Juntima experienced meaningful learning that stimulated her to grow as a teacher, as she expressed

“Jakchai challenges me in implementing my ideas for conducting my Classroom Research project. I have the opportunity to implement new teaching technique that I learnt in the method course in my classroom. He always observes and gives valuable feedback to me. He helps me in shaping my research question and data collection plan. Conducting the Classroom Research project has the potential to improve my teaching practices and encourages me to think systematically in solving the problem in the classroom” (Juntima’s Interview #4: March 18th, 2010).

Two cooperating teachers, Pattama and Jakchai, mentioned that the open-mindedness of pre-service teachers encouraged them to give close supervision of Classroom Research to the pre-service teachers. For example, Pattama stated “Pattra is enthusiastic to ask for recommendations. She listens to all recommendation, thinks, and applies the recommendations that she thinks they are useful in her Classroom Research project” (Pattama’s Interview# 5: March 19th, 2010).

A university supervisor, Permpon, also expressed his opinion in a similar manner that the pre-service teachers got well support from their cooperating teacher in supervising their Classroom Research projects. He expressed

“I have many responsibilities in this academic year. I do not have much time when I go to supervise pre-service teachers in the school. I mostly supervise the pre-service teachers about their teaching practice rather than supervise them to conduct the Classroom Research project. I think the practice of teaching is the most important job for pre-service teachers during the internship period. If the pre-service teachers do not ask me the suggestions about the Classroom Research project, I do not discuss about the Classroom Research project with them. All of the pre-service teachers told me that their cooperating teacher advised many things to them in conducting the Classroom Research project. The close supervision from the cooperating teachers largely benefit the pre-service teachers in conducting the Classroom Research projects because the cooperating teachers spend most of the time with the pre-service teachers in the school. The cooperating teachers can give recommendations immediately when the pre-service teachers have trouble with their Classroom Research project” (Permpon’s Interview# 4: March 19th, 2010).

The Supervision Handbook of Classroom Research guides the ideas for cooperating teachers in supervising Classroom Research to the pre-service teachers.

All three cooperating teachers noted the usefulness of the Supervision Handbook of Classroom Research. The handbook enhanced their understanding of conducting Classroom Research. The information, examples, and worksheets in the handbook guided them in supervising each step of conducting the Classroom Research for the pre-service teachers, for example Dara stated

“The Supervision Handbook of Classroom Research is very helpful for me to get the idea for supervising Classroom Research to Napa. It explains the

details for conducting the Classroom Research project in each step. I introduce the examples and worksheets in the Handbook to Napa to help her generate the research question, search and report the related literatures, plan the Classroom Research project, determine the research instrument, analyze the data, and write the Classroom Research report. I think I learnt the concept of Classroom Research with Napa through this Handbook” (Dara’s Interview# 4: March 18th, 2010).

Jakchai mentioned that “It is very easy for me to use the explanations, examples, and worksheets in the Supervision Handbook of Classroom Research to supervise Juntima’s Classroom Research project” (Jakchai’s Interview# 5: March 18th, 2010). He thought that he learned a great deal about conducting the Classroom Research project together with Juntima while he was supervising her. He understood better of how to conduct each step of the Classroom Research project.

The pupils’ attention gives pre-service teachers the encouragement to conduct the Classroom Research project.

The pupils’ attention to learn gave the moral support to the pre-service teachers in conducting their Classroom Research project. Two pre-service teachers, Pattra and Napa, mentioned in this aspect. Pattra mentioned

“I conducted my Classroom Research project in the topic of ‘Developing the 9th grade students’ achievement score in science subject (SC 33101) by using teacher questioning technique’. The students gave good collaboration for me to undertake my Classroom Research project. They were eager to answer the question and tried to share their opinions in the classroom. Each student did the exercise by himself/herself. They did not copy their friends’ answer just liked they did before I conducted my Classroom Research project. If there were some students talked to each other, other students will warn them. The students’ generosity supports me a lot in conducting my Classroom Research

project. I feel safe and try to do my best in the Classroom Research project for promoting the students' learning" (Pattra's Interview #6: March 19th, 2010).

In the same manner, Napa stated when she organized the learning activities in the classroom and pupils showed their interest in the lesson, she was proud. The pupils' positive responses motivated her to pursue the Classroom Research project, as she expressed

"The students paid attention in my teaching while I was conducting my Classroom Research project. They wrote many concepts that they learned in the mind maps. They could do more exercises when comparing with the time before I conducted my Classroom Research project. These results assure that my Classroom Research project benefits to the students. It gives me the big encouragement in conducting my Classroom Research project" (Napa's Interview #6: March 18th, 2010).

The school's facilities benefit pre-service teachers in searching for information to conduct the Classroom Research project.

One pre-service teacher, Juntima, expressed that the computer and high speed internet in the school helped her get into the information for conducting her Classroom Research project. Juntima mentioned

"The facilities in the school are beneficial for me in conducting the Classroom Research project. I always use the school's high speed internet to search for the related literature to write the second chapter of my Classroom Research report and to search for the information for developing the exercise sheets and information sheets to distribute to the students while I was conducting my Classroom Research project. The school library is quiet. It is a good place for me to use the computer in the library to design and to type the exercise sheets and the information sheets, to analyze the data, and to type my Classroom Research report" (Juntima's Interview #4: March 18th, 2010).

Factors that Hinder the Pre-Service Science Teachers' Practice of Classroom Research

The pre-service teachers, the cooperating teachers and a university supervisor expressed their opinions about the factors that hindered the pre-service science teachers' practice of Classroom Research with the following details.

The limitation of time affects the pre-service science teachers' Classroom Research project.

All of the three pre-service teachers and two cooperating teachers, Pattama and Jakchai, thought that the school activities hindered the pre-service teachers' practice of Classroom Research. The duration of the second semester when the pre-service teachers carried out their Classroom Research project was short. In addition, there were many additional activities that were not originally scheduled in the school plan in the second semester that interrupted the pre-service teachers' practice of Classroom Research. They could not teach the lesson plans that they developed as the intervention in their Classroom Research project. For instance, Juntima could not teach followed the lesson plans based on the formative assessment method, which she developed for using in her Classroom Research project because the school's activities reduce her teaching time. Juntima stated

“In the sub-topic ‘energy and melting’, I plan to teach for two periods, but actually I have time to teach this sub-topic only one period because the school's activities which did not appear in the school long range plan decreased my teaching time. It always had the activities for preparing the school to assess by the Royal School Award assessment committee. The students needed to practice the performance and the teachers were asked to prepare the documents to present to the Royal School Award assessment committee. In the overall picture, I plan to teach the topic of ‘matter and properties of matter’ based on the formative assessment method for 13 periods, but indeed I have only 10 periods to teach this topic. I lose my

teaching time with the school activities for 3 periods. I cannot ask every question that I wrote in the lesson plans to the students due to I do not have enough time. I lecture to the students instead of asking them the questions. I do not have time for the students to discuss their answers together. When their answers are right, I tell them 'It is right' and then I continue to ask them the other questions" (Juntima's Interview #4: March 18th, 2010).

The limitation of time affected the reliability of Pattra's Classroom Research project. Pattra thought that her study would have greater reliability if she implemented the questioning technique in two learning topics and compared the students' pre-test and post-test scores in those topics instead of implementing the questioning technique in only one topic as she did. She expressed as the following

"This is the first time for me in conducting the Classroom Research project. I spend a lot of time in generating the research question, reviewing the literature, and developing the lesson plans, pre-test, and post-test. In my opinion, the time for conducting the Classroom Research project is too short. Teaching and researching are my new experiences. I cannot develop the lesson plans based on questioning technique, the pre-test, and the post-test in the two learning topics within the limitation of time that I have. Comparing the students' pre- and post-test scores in only one learning topic liked I did in my study is quite not reliable. The students may be interested in and have strong basic knowledge in the topic of universe and galaxy, so they can get the post-test score more than the pre-test score. Comparing the students' pre-test and post-test score in at least two learning topics is the thing that I must do to build more reliability of my Classroom Research project. If the students get the post-test scores more than the pre-test scores in both two learning topics, it surely concludes that the students' higher achievement scores results from the questioning technique that I employed for conducting my Classroom Research project" (Pattra's Interview #6: March 19th, 2010).

Jakchai stated in the same manner about the school activities that hindered the pre-service teachers' practice of Classroom Research. The additional school activities affected Juntima's Classroom Research project. Juntima could not teach follow the lesson plans in the topic of 'matter and properties of matter' that she developed for use in her Classroom Research project. Jakchai said

"In the sub-topic 'energy and chemical reaction' she mainly summarized the content to the students by lecturing and assigning the students to do the exercise sheets as their homework. She did not have time to ask all of the questions that she wrote in her lesson plans to the students. She could not provide the time for the students to do the exercise sheets and discuss the answer with their friends during the teaching periods because the additional school activities reduced her teaching time for many periods" (Jakchai's Interview# 5: March 18th, 2010).

The pre-service teachers could not implement their preferred ideas in the Classroom Research project because of the insufficient school support.

The pre-service teachers developed the information sheets, exercise sheets, a pre-test, and a post-test for conducting their Classroom Research projects which they never developed these things before they conducted the Classroom Research project. Before conducting the Classroom Research project, the pre-service teachers did not organize the pre-test and post-test for the students in each learning topic. They only organized the test for the students for the mid-term and final examination. In addition, they read the information to the students and asked the students to jot down in their notebooks instead of distributing the information sheets to the students. The insufficient school support in developing the information sheets, exercise sheets, a pre-test, and a post-test hindered them in conducting the Classroom Research projects in the way that they wanted. Furthermore, the school could not provide the instructional materials for the pre-service teachers to use in organizing the learning activities during their Classroom Research projects. All three pre-service teachers, one cooperating teacher and one university supervisor stated this problem. For example,

Pattra and Juntima wanted to distribute the exercise sheets and the information sheets to all students in the classroom in every period, but they could not do so because they did not have money to pay for the cost of photocopying. Juntima mentioned

“There are many expenses for conducting the Classroom Research project especially the expenditure about photocopying the exercise sheets, the information sheets, a pre-test, and a post-test to distribute to 30 students in the classroom. I want to distribute the exercise sheets and the information sheets to all students in my classroom in every period, but I cannot do it in every period because I do not have money to pay for the cost of photocopying. Some periods I write the questions on the blackboard and ask the students to jot down the questions in their notebooks instead of distributing the exercise sheets to them to save my money in photocopying. I think, it wastes the time with this technique. It is better if the school allows me to use the school photocopy machine or provides some money for me to pay for the cost of photocopying of the exercise sheets, the information sheets, a pre-test, and a post-test” (Juntima’s Interview #4: March 18th, 2010).

Pattra noted the insufficient school support in term of school resources. She mentioned

“I prefer to use the visualizer to show the pictures of the planet to the students, but I cannot do. The school has limited computer and visualizer. It is a complicated process for booking the multimedia room to use the computer and visualizer. The school gives the priority to the in-service teacher more than the pre-service teacher in using the multimedia room. I solve this problem by printing the pictures and showed the pictures to the students in the classroom, but I was blamed from my university supervisor about the tiny size pictures. He told me that the students at the back of the room could not see the pictures clearly. I do not know how to deal with this problem due to I cannot use the visualizer and enlarging the color photocopy is expensive. I would like the school to support me in using the multimedia room when I need to show the

slide presentations or pictures to the students” (Pattra’s Interview #6: March 19th, 2010).

From the perspective of cooperating teacher, Pattama thought that Pattra had many interesting ideas in organizing the learning activities during her undertaking of Classroom Research project, but she could not implement her ideas because the school could not provide her the resources that she needed. Pattama said

“Pattra would like to show the solar system model to the students. I think it is a good idea to employ the instructional materials in the classroom for motivating the students’ learning. I find the solar system model in the science laboratory for her, but unfortunately, it is broken. In another situation, Pattra wanted to use the visualizer to show the pictures of the planet to the student, but the multimedia room is booked for a long queue. The insufficient school resources obstruct Pattra to conduct her Classroom Research project. I think Pattra can better conduct her Classroom Research project, if the school can provide her the resources that she prefers to use to promote the students’ learning during her implementation of the questioning technique in the classroom” (Pattama’s Interview #4: March 19th, 2010).

From the perspective of university supervisor, Permpon thought that every research project required money for the researchers to carry out the studies. The insufficient support from the school was a factor that hindered the pre-service teachers in conducting their Classroom Research project. He mentioned

“The pre-service teachers told me that they had problem in distributing the exercise sheets and instructional sheets. They could not distribute the exercise sheets and instructional sheets to the students in every period because it consumed a lot of money for photocopying. They solved this problem by asking the students to jot down the questions in their notebooks instead. They thought this technique was not good because it wasted their teaching times. Furthermore, they paid a lot of money for photocopying the pre-test and the

post-test for collecting data in their Classroom Research project. I think, the school should provide support for the pre-service teachers by allowing them to use the school photocopier machine to photocopy the exercise sheets, instructional sheets, the pre-test, and the post-test for distributing to the students” (Permpoon’s Interview# 4: March 19th, 2010).

The inadequate support from the university produces the obstacles in supervising Classroom Research to the pre-service teachers and diminishes the opportunity for pre-service teachers in sharing opinions and experiences about conducting the Classroom Research project.

All three cooperating teachers, a university supervisor, and a pre-service teacher mentioned the inadequate university support. Cooperating teachers and university supervisor thought that there were many problems which displeased them in supervising Classroom Research to the pre-service teachers. First, the university did not clarify definitely role and responsibility of the cooperating teachers. Second, the university supervisor did not come to the school often and did not build enough rapport with the cooperating teachers. The university supervisor did not provide the time for cooperating teachers to talk with when he came to observe the pre-service teachers in the school. Third, the university distributed the assessment forms for the pre-service teachers Classroom Research project to the cooperating teachers late of the internship period. Before getting the assessment form, the cooperating teachers were not sure about the topics of Classroom Research that the university required them to assess for the pre-service teachers. The assessment of pre-service teachers’ practice of Classroom Research was not authentic, as Pattama expressed

“The university gave the assessment form of pre-service teachers Classroom Research project to me in the last two weeks of the internship period. I must recall how good Pattra’s practice in each topic that appears in the assessment form and assign the score for her. I think if the university gives the assessment form to me at the beginning of the internship period, the assessment is more authentic because I can assign the score to Pattra immediately at the time she

performs her practice of researching. Furthermore, I can supervise Pattra exactly in the topic that the university specified in the assessment form” (Pattama’s Interview# 5: March 19th, 2010).

Jakchai and Dara thought in a similar way in that the university supervisor came to school only two times during the semester. They did not have much opportunity to talk with the university supervisor because the university supervisor did not make an appointment before he came to the school. For instance, Jakchai stated

“The times the university supervisor comes, I do not stay in the classroom with Juntima because the school principal asked me to work for the school audiovisual section in the meeting hall. In my opinion, to enhance the pre-service teacher’s practice of Classroom Research effectively, the university supervisor should come to school often and work more collaboratively with the cooperating teacher. The university should arrange the meeting between the university supervisor and cooperating teacher to discuss about the problems and the role of each person in supervising Classroom Research to pre-service teacher” (Jakchai’s Interview# 5: March 18th, 2010).

Furthermore, the university did not provide the opportunity for the pre-service teachers to share their ideas and experiences in conducting the Classroom Research project with peers and the university faculties. Napa and Permporn mentioned about this. They thought that the absence of the seminars throughout the internship period hindered the pre-service teachers’ ability in conducting the Classroom Research project. Napa expected to share and get the ideas for developing the pre-test and post-test from the perspectives of her peers and university faculties during the seminar, but she could not. The university did not arrange any seminars throughout the internship period, even though it was specified in the internship manual. Napa expressed

“In the internship manual, the Faculty of Education scheduled to arrange the seminar for the pre-service teachers to share the ideas and to report the

progression of Classroom Research project every five weeks throughout the internship period. In practice, the Faculty of Education did not arrange the seminar during the internship period. I am very disappointed because I hope to get the idea about developing the pre-test and post-test from my friends and my university supervisor in the seminar. I feel the university leaves me to practice of Classroom Research alone in the school” (Napa’s Interview #6: March 18th, 2010).

For Permpon, he had many responsibilities. He did not have much time to talk with pre-service teachers when he supervised them in the school. He mainly supervised the pre-service teachers’ teaching practice. He intended to supervise the Classroom Research to the pre-service teachers in the seminars at the university which the Faculty of Education scheduled to arrange throughout the internship period. The absence of the seminars impacted Permpon as he did not have much chance to give suggestions about Classroom Research to the pre-service teachers, as he expressed

“The change of the administrative team of the Faculty of Education before the beginning of the academic year affects the management of the internship for the pre-service teachers because there is no specific person who is responsible for managing the internship. The management of the internship in this academic year has many weaknesses. In the former years the management of the internship courses was well plan. The Faculty of Education invited the cooperating teachers to attend the meeting at the university for describing the role of the cooperating teachers. The cooperating teachers received the assessment forms at the beginning of the internship period in supervising the pre-service teachers. Throughout the internship period, there were the seminars for the pre-service teachers and the university supervisors to exchange the idea together. The university supervisor could see the progression of the pre-service teachers’ Classroom Research project and give advice to the pre-service teachers. In this year, the Faculty of Education arranged the seminar only one time for clarifying the role and responsibilities of the pre-service teachers during the internship before they go to the school.

The Faculty of Education did not arrange any other seminars throughout the internship period even though it was specified in the internship manual. The pre-service teachers did not have the opportunity to discuss and exchange the ideas together about conducting the Classroom Research project. In addition, my intention to give advices about Classroom Research to the pre-service teachers during the seminars was disappear. I discuss these problems with the faculties from the Faculty of Education, but there is no response. The management of the internship course in this academic year is very unsystematically, which is not much effective in supporting the pre-service teachers' practice of Classroom Research" (Permpon's Interview# 4: March 19th, 2010).

The insufficient knowledge and experience in conducting the Classroom Research leads the pre-service teachers to conduct the Classroom Research project with anxiety.

All three pre-service teachers expressed their opinions that the Classroom Research course that the university provided was not enough preparation them to conduct the Classroom Research project during the internship period. The pre-service teachers were stressful and struggled with the problems for developing the research instruments, analyzing the data, and writing the Classroom Research reports because the instructor of the Classroom Research course did not teach these topics in-depth. They were assigned to read the course material and to gain an understanding of these topics by themselves. Juntima did not know which statistics method she should use for analyzing her data, as she expressed

“At the initial, I am very nervous in analyzing the data because the instructor in the Classroom Research course assigned us to read the course material in the topic of data analysis and research report writing by ourselves. I am not sure which methods I should employ for analyzing the data. I do not understand clearly about the statistics that I will use for analyzing my data. There are many statistics appeared in the course material of Classroom

Research course. Jakchai helps me a lot in analyzing the data. He suggests me to calculate the mean and standard deviation of the students' pre-test and post-test scores to show the readers about the difference of the students' achievement scores before and after the employment of formative assessment method in my classroom. He teaches me how to use the Microsoft Excel program to calculate the mean and standard deviation too" (Juntima's Interview #4: March 18th, 2010).

Napa also struggled with problem in developing the pre-test and post-test. She did not know how to develop the pre-test and post-test, as she told

"I confuse in developing the tests. I am uncertainty about how many test items are proper for the students to do. I think if there are too many test items, the students may get bore and do not pay much attention to do the test. On the other hand, if there are too few test items, it may be difficult to assess the students' learning. Besides, I do not know how to develop the test. I develop the pre-test and post-test by copying the test items from the teacher handbook. The insufficient knowledge in this aspect leads me to have little conflict with Dara because we have different idea about the number of the test items that should include in the pre- and post-test. In addition, she disagreed with me that I develop the pre-test and post-test by copying the test items from the teacher handbook. She would like me to construct the test items by myself" (Napa's Interview #6: March 18th, 2010).

To support this, Dara who was Napa's cooperating teacher stated that Napa's weak knowledge about Classroom Research and the lack of attention to conduct her Classroom Research project were the factors that hindered Napa's practice of Classroom Research. Although Napa scheduled the time when she would generate the research question, review the literature, develop the research instrument, collect data, analyze data, and write the Classroom Research report, she could not finish her works on time. Dara mentioned

“I use a lot of efforts in supervising Napa to conduct her Classroom Research project. I think she is quite not ready to conduct the Classroom Research project. She does not have enough knowledge about Classroom Research. She cannot answer my questions when I ask her about how she can generate the research question, develop the test, and analyze the data. Sometimes I feel very exhaust in supervising the Classroom Research to Napa because she does not follow my suggestion. I really disagree that she develops the pre-test and post-test by copying the test items from the teacher handbooks. She does not show her ability and effort in developing the tests. I suggest her to construct the test items by herself, but she does not do it. She does not put her mind in conducting the Classroom Research project. She lacks of enthusiasm to acquire knowledge. She always chats with her friends in her free time instead of trying to read the book about Classroom Research to help her in conducting the Classroom Research project” (Dara’s Interview# 4: March 18th, 2010).

The pupils’ lack of responsibility builds tension in collecting data.

Although the pupils’ behavior was the factor that support Pattra in conducting the Classroom Research project, the pupils’ behavior was also the factor that hindered her in collecting data for her Classroom Research project, as Pattra mentioned

“There are three students absent for doing the pre-test on the appointment date. I use a lot of endeavor to pursue them to do the pre-test. I am stressful with these students. They lack of responsibility. They always say they do not have time. They are the member of school football team. They devote most of their time to be trained and attend the competition. At that time, I feel very stress that my Classroom Research project will be worthless, if I cannot collect the completed data. I am afraid it may affect to my internship score” (Pattra’s Interview #6: March 19th, 2010).

Lack of concentration in conducting Classroom Research due to too much teaching responsibility.

Only Pattra thought she could not concentrate on her Classroom Research project as much as she wanted because she had nine periods a week to teach the students. It was too much workload for her, as she said

“I confuse with my role during the internship period. I act three main roles including student, teacher, and researcher. I do not know which role I should focus the most. My teaching responsibility, nine periods per week, is too much for me. I do not have much time to concentrate on my Classroom Research project. It is unfair that my friends in other schools have teaching responsibility only six periods a week. They have more time than me to concentrate on their Classroom Research projects. The Faculty of Education should collaborate with the professional development schools to assign the teaching responsibility to the pre-service science teachers in the same manner. If I have only six periods a week for teaching, I think I can perform better for reviewing the literature, developing the pre-test and post-test, and writing the research report” (Pattra’s Interview #6: March 19th, 2010).

The inadequate proficiency in using computer hinders in typing the Classroom Research report.

Only Napa mentioned about the inadequate computer skill that hindered her in typing the Classroom Research report. She worried that she could not follow her cooperating teacher’s recommendation to build the line graph to show the difference of the students’ pre-test and post-test scores, as she said

“Dara told me to use the Microsoft Excel program for building the line graph to show the difference between the students’ pre-test and post-test scores in my Classroom Research report. She told that the line graph allowed the readers to see the difference between the students’ pre-test and post-test scores better than the table. I cannot follow her recommendation because I do not know how to build the line graph. I am not sure whether she think I am an irresponsible person or not. I am not ready to learn new thing at that time. I am

very busy in the last two weeks of my internship period for clearing all of my work at the school before I go back to the university. I want to finish my Classroom Research project as soon as possible because I also have other tasks to finish such as collecting all of my lesson plans, and typing the special project report” (Napa’s Interview #6: March 18th, 2010).

Napa faced another problem about using the computer. Her USB flash drive was infected by a computer virus and she could not open the files. She did not know how to recover the infected file. She wasted the time retyping the chapter 1 to chapter 3 of her Classroom Research report again. Napa said.

“I cannot access the files which I save in my USB flash drive because it is attacked by the computer virus. I must type all of the data in the chapter 1 to chapter 3 of my Classroom Research report again. It wastes a lot of my time due to my typing skill is very poor” (Napa’s Interview #6: March 18th, 2010).

University supervisor does not have much time to supervise Classroom Research to pre-service science teachers due to too much work load of the university supervisor.

Permpon, university supervisor, expressed that he could not supervise the pre-service science teachers in the school quite often because he had many responsibilities. He was the head of Physics department and he was assigned to a committee to develop the curriculum for the Westernthani University Laboratory School which will operate in the next academic year. He could not stay in the school for a long time when he went to supervise the pre-service science teachers in the school. He mainly supervised the pre-service science teachers about their teaching practice. He did not have time to supervise or discuss their practice of Classroom Research. He stated

“I have many responsibilities in this academic year. The university laboratory school will operate next year. The dean of the Faculty of Science appointed

me to be the member of committee for developing the Westernthani University Laboratory School's science curriculum. The Faculty of Education assigned me to supervise six pre-service science teachers who devoted their internship period in four difference schools. Two schools situated 40 kilometers from the university. It is very difficult for me to find the time to go to supervise each pre-service science teacher in the school. I do not have much time to talk with the cooperating teachers and the pre-service science teachers when I go to the school. I mostly supervise the pre-service science teachers about their teaching practice. If the pre-service science teachers do not ask me the advices about the Classroom Research project, I do not discuss about the Classroom Research project to them. This may lead the pre-service science teachers not to concentrate too much in conducting their Classroom Research project because they may think I do not emphasize about their practice of Classroom Research" (Permpon's Interview# 4: March 19th, 2010).

Discussions in Relation to the Fourth Research Question

The discussions of the factors that support and hinder the pre-service teachers' practice of Classroom Research are provided below.

Factors That Support Pre-Service Science Teachers' Practice of Classroom Research

The close supervision from cooperating teachers raises the pre-service teachers' ability to conduct Classroom Research.

The research findings revealed that the pre-service teachers experienced meaningful learning and conducted their Classroom Research projects confidently through the close supervision from their cooperating teachers. The cooperating teachers provided the opportunities for the pre-service teachers to share their ideas in conducting their Classroom Research projects and gave recommendations to them in each stage of conducting the Classroom Research project. Supporting this, Price

(2001) and Rock and Levin (2002) pointed out that a safe and nurturing supervision by the mentor teacher were tremendous support pre-service teachers in conducting the Classroom Research project. The discussions with the mentor teachers emerged things that pre-service teachers did not notice or think about before. Landrum and Nelsen (2002), Lancy (2003), Levin and Rock (2003), and Carboni, *et al.* (2007) responded in a similar fashion that when pre-service teachers engaged in the Classroom Research, they formed partnerships with the mentor teachers who opened up their practices of teaching and researching for dialogued and critiqued. The establishment of partnership and openness produced the feeling of joint learning between the mentor teachers and the pre-service teachers and raised the pre-service teachers' ability in researching. Additional perspectives, supports, and feedbacks from the mentor teachers helped the pre-service teachers to gain and improve an understanding of themselves as teachers and researchers, of their pupils and of their roles and responsibilities as teachers.

The cooperating teachers have the knowledge to supervise the pre-service teachers to conduct the Classroom Research project.

The cooperating teachers gained knowledge about conducting the Classroom Research project from the information that appeared in the SHCR. This knowledge facilitated the cooperating teachers in giving close-up supervision of conducting the Classroom Research project to the pre-service teachers. The handbook guided them in supervising each stage of Classroom Research to the pre-service teachers. This finding did not agree with Strickland, *et al.* (2001) and Zambo and Zambo (2006), which found that the pre-service teachers did not get much assistance from the cooperating teachers in conducting the Classroom Research project because the cooperating teachers had limited knowledge of Classroom Research. The cooperating teachers did not know how they could supervise the pre-service teachers to conduct the Classroom Research project. The university supervisors played the important role in supervising the pre-service teachers to conduct the Classroom Research project.

Factors That Hinder Pre-Service Science Teachers' Practice of Classroom Research

The time constrain affects the pre-service science teachers' practice of Classroom Research.

The research findings revealed that the pre-service science teachers struggled with the time for conducting their Classroom Research project. The school's activities affected the pre-service teachers in following the lesson plans that they developed for using in the Classroom Research project. The duration of the second semester when the pre-service teachers carried out their Classroom Research project was short. The pre-service teachers had limited time in conducting each stage of their Classroom Research project for example reviewing the literature, developing the research instrument, and analyzing the data. This finding agreed with the studies of Price (2001) and Srisuantang *et al.* (2009) that one of the greatest challenge the pre-service teachers faced was finding time for their practicing of Classroom Research. The pre-service teachers spent much of their time preparing their teaching rather than conducting the Classroom Research project. Along these same lines, Ross (1987), Strickland, *et al.* (2001), Smith and Sela (2005), and Zambo and Zambo (2006) noted that the demands on pre-service teachers' time during the internship were great, but the time available was not optimal. The time available for the Classroom Research project was a major concern for pre-service teachers. The amount of work that pre-service teachers had during the internship did not allow them to devote much time on their Classroom Research projects.

The insufficient school support obstructs the pre-service teachers to implement their preferred ideas in the Classroom Research project.

The insufficient support from the school resulted the pre-service teachers could not implement their prefer ideas in the Classroom Research projects. The school could not provide the instructional materials and equipment that the pre-service teachers would like to use for organizing the learning activities while they were

conducting their Classroom Research projects. The pre-service teachers would like the school and/or university to support them more to assist them directly in undertaking the Classroom Research project. This finding was congruent with Katkin (2003), Randall, Wilbur, and Burkholder (2004), and Krabacher (2008) who found that the pre-service teachers who benefited from support by the school and university performed well in their Classroom Research projects. They used the resources in the school and university to organize the learning activities while they conducted the Classroom Research projects in order to improve their instruction and to promote the students' learning. The support from the school and university increased the pre-service teachers' enthusiasm to pursue Classroom Research work and enhanced their practical and conceptual research skills.

The lack of university seminar hinders the pre-service teachers to share their opinions and experiences in conducting the Classroom Research projects to each other.

The findings from the studies of Smith and Sela (2005), Carboni, *et al.* (2007), and Srisuantang, *et al.* (2009) revealed that the organization of seminars for pre-service teachers when the pre-service teachers were conducting the Classroom Research project provided the opportunity for them to exchange their opinions and experiences in conducting the Classroom Research project. The seminars gave the pre-service teachers the opportunity to share their personal learning process which emerged during the Classroom Research project. The meaningful learning of the pre-service teachers occurred when the Classroom Research process was shared with colleagues. Srisuantang, *et al.* (2009) stated that the seminars largely affected to the progression of pre-service teachers' Classroom Research project. The pre-service teachers were motivated to conduct the Classroom Research project from the encouragement of the university faculties during the seminars. Degago (2007) responded in a similar way that the pre-service teachers valued the collaboration with their peers during the seminars. The seminars allowed them to report their Classroom Research progress and to provide the chance to get comments and suggestions for improving their practice of Classroom Research project from the colleagues'

perspectives. In contrast with this study that there was no seminar offered to the pre-service teachers when they conducted their Classroom Research project. The pre-service teachers did not have the opportunity to exchange their opinions and experiences in conducting the Classroom Research project with peers and the university faculties. They had insufficient knowledge in developing the research instruments, analyzing the data, and writing the Classroom Research report. They expected to get the idea for conducting their Classroom Research projects from the discussion with their peers and the university faculties in the seminars. But the university did not arrange any seminars throughout the internship period, even though it was specified in the internship manual. The pre-service teachers felt the university left them to practice of Classroom Research alone in the school.

The insufficient collaboration between the university and the school leads to the unsatisfied processes in supervising Classroom Research to the pre-service teachers.

The three cooperating teachers noted that the university did not prepare them for supervising Classroom Research to the pre-service teachers during the internship period. The university did not clarify the role and responsibility of the cooperating teachers. The university supervisor did not have time to talk with cooperating teachers about the pre-service teachers' practice of Classroom Research when the university supervisor came to observe the pre-service teachers in the school. This finding aligned with Strickland, *et al.* (2001) and Smith and Sela (2005) who found that the university supervisors faced difficulty to find the time to work collaboratively with the pre-service teachers and the cooperating teachers in the school. Supporting this, Krabacher (2008) and Srisuantang, *et al.* (2009) noted that the lack of collaboration between the cooperating teachers and the university supervisors produced anxiety in the pre-service teachers to conduct to the Classroom Research projects. The pre-service teachers were uncertain whose recommendation they should rely on. They sometimes confused aspects that the cooperating teachers and the university supervisors gave to them differently such as the development of research intervention and research instruments for use in the Classroom Research project. The pre-service

teachers would like the cooperating teachers and the university supervisors to meet and talk together more often.

The pre-service teachers conduct the Classroom Research project with anxiety because of the insufficient knowledge and experience in conducting the Classroom Research.

The pre-service teachers conducted their Classroom Research project with anxiety because it was the first time for them to conduct the Classroom Research project in a real classroom atmosphere. The Classroom Research course could not provide sufficient knowledge in conducting the Classroom Research project especially in the topic of developing the research instruments, analyzing the data, and writing the Classroom Research report because the instructor assigned the pre-service teachers to read the course materials and to gain an understanding of these topics by themselves. This finding was congruence with the studies of Strickland, *et al.* (2001), Smith and Sela (2005) and Srisuantang, *et al.* (2009) that the pre-service teachers were less experienced in research and academic writing skills. They were very confused about Classroom Research. They did not really understand what the meaning of Classroom Research was and did not know how to work with the literature. The word 'research' frightened to the pre-service teachers. They saw the Classroom Research project as a difficult task because it required a lot of knowledge, experience and thinking skills. The limitation of the pre-service teachers' maturity and readiness in conducting the Classroom Research resulted in the slow progression of their Classroom Research projects.

CHAPTER VII

CONCLUSIONS AND IMPLICATIONS

Overview of the Chapter

This chapter aims to provide the conclusions and implications of the research study. First, a summary of the study is described. Then, it is followed by the conclusions of the research results. Third, implications of the study are provided. At the end of this chapter, some suggestions for future research are presented.

Research Summary

Research Objectives

The present study is designed to study about pre-service science teachers' understanding and practice of Classroom Research, the cooperating teachers and university supervisor supervision of Classroom Research to pre-service teachers, and the factors that support or hinder the pre-service teachers' practice of Classroom Research project during the implementation of the initiative that was developed by the researcher.

Research Questions

The study is shaped by the following research questions:

1. What are the pre-service science teachers' understandings of Classroom Research before engaging in the initiative?
2. How do the pre-service science teachers' understanding and practice of Classroom Research evolve over the implementation of the initiative?

3. What supports about Classroom Research do pre-service science teachers receive from the cooperating teachers and university supervisor over the implementation of the initiative?

4. What factors support or hinder the pre-service science teachers' practice of Classroom Research?

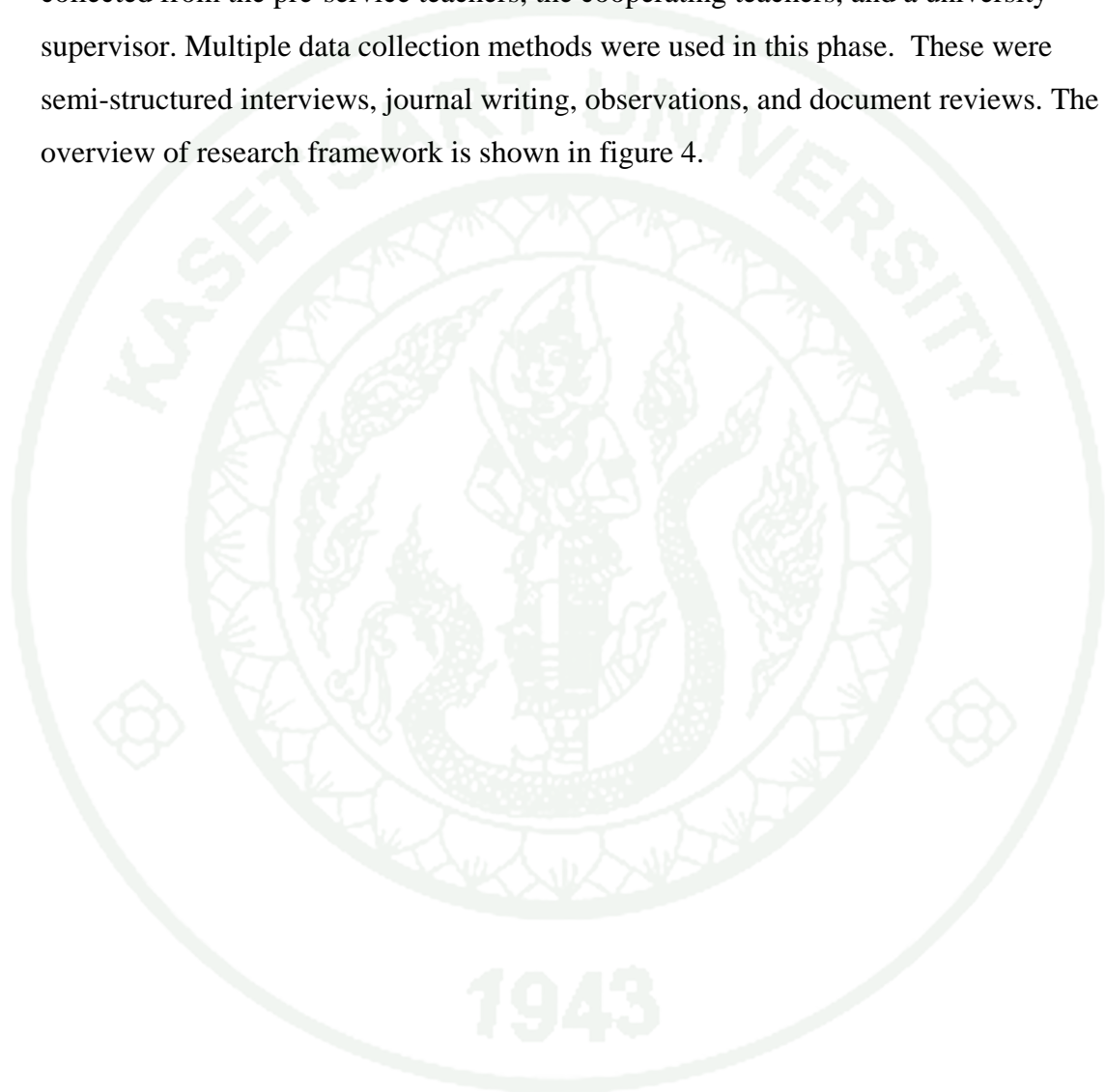
Review of the Research Framework

There were three phases of the study. The first phase was conducted for exploring the pre-service science teachers' understanding of Classroom Research before engaging in the initiative. The data collection methods employed in this phase were questionnaire and semi-structured interviews.

In the second phase, the initiative was developed based on the collected data in the first phase about the pre-service science teachers' understanding of Classroom Research before engaging in the initiative accompany with the cooperating teachers' and university supervisor's background information about the understanding of Classroom Research, the experiences in conducting Classroom Research, the experiences in supervising Classroom Research to the pre-service science teachers, and the supports that they preferred to receive for helping them to supervise Classroom Research to the pre-service science teachers. The researcher developed the SHCR and set up the workshop for enhancing the cooperating teachers and university supervisor understanding of Classroom Research and for guiding them how to supervise Classroom Research to the pre-service science teachers. The workshop discussed the seven topics that appeared in the SHCR: general concepts of Classroom Research, generating the research question; reviewing the related literature; developing the research plan and research instrument; collecting data; analyzing data; and writing the research report.

In the third phase, the researcher followed through the implementation of the initiative to study the effect of the initiative on pre-service teachers' practice of

Classroom Research, the cooperating teachers' and university supervisor's supervision of Classroom Research to pre-service teachers, the development of pre-service teachers' understanding of Classroom Research, and the factors that support or hinder the pre-service teachers' practice of Classroom Research. The data was collected from the pre-service teachers, the cooperating teachers, and a university supervisor. Multiple data collection methods were used in this phase. These were semi-structured interviews, journal writing, observations, and document reviews. The overview of research framework is shown in figure 4.



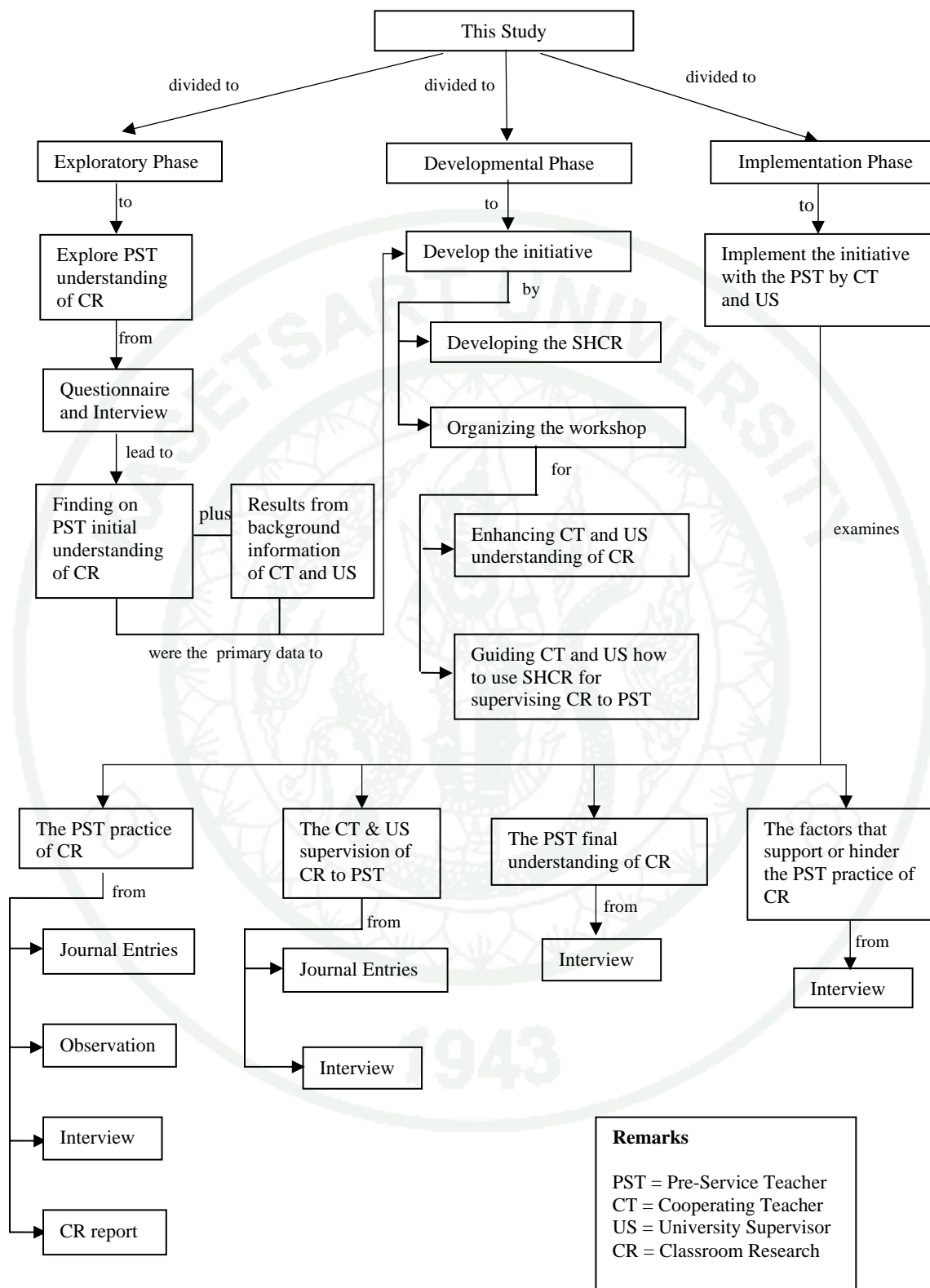


Figure 4 Research Framework

Conclusions of the Study

This section presents the conclusions of the research study, which are divided into four parts according to the four research questions:

Conclusions in Relation to the First Research Question

The pre-service science teachers' understanding of Classroom Research before engaging in the initiative

The findings indicated that, the pre-service science teachers mostly understood Classroom Research. For the Classroom Research concept, two-thirds of pre-service teachers understood Classroom Research as a process that the teachers implemented new teaching techniques in the classroom for promoting the students' learning. One-third of pre-service teacher understood Classroom Research as a step-by-step problem-solving process conducted by experienced teachers to solve the problems in their day-to-day teaching and to formulate new theories in education.

For generating the research question, one-third of pre-service teacher understood that the research question did not come from the classroom situation, but came from reviewing literature and selecting a question that was interested from the literature. One-third of pre-service teacher understood that the research question came from the recommendation of university supervisor and cooperating teacher. And one-third of pre-service teacher understood that there were variety of techniques for generating the research question such as analyzing students' achievement scores, observing the students' behavior, and checking the students' exercise books.

For reviewing literature, two-third of pre-service teachers understood that reviewing literature provided the theoretical framework to the Classroom Research project by linking the research topic with the educational theories found in books, theses, and research articles. Furthermore, reviewing literature gave a chance for them to find out about research methodologies that could be employed in conducting the

Classroom Research project. One-third of pre-service teacher understood that reviewing literature was a way to find the ideas to generate the research topic and research question.

Two-third of pre-service teachers understood that data could be collected by research instruments. The research instruments should be verified and approved by experienced person and tried out before being used to collect data in order to make sure the research instruments provided valid data for answering the research question. One-third of pre-service teacher did not understand how to develop the research instruments. She thought that research innovations such as lesson plans and learning materials were the research instruments. She understood that the development of research instruments could be carried on by studying various formats of instructional materials or learning activities employed in previous research and then would choose one learning activity or instructional material that she was interested in applying in her classroom.

For analyzing data, two-third of pre-service teachers understood that data could be analyzed by using descriptive statistics such as frequency, percentage, mean, standard deviation, and t-test. One-third of pre-service teacher understood that data could be analyzed by employing the questionnaire, interviews, observations, and tests with the students in the classroom to get the information from them.

For writing Classroom Research report all pre-service teachers understood that the Classroom Research report comprised of five chapters included: chapter 1- introduction and background of the study; chapter 2- related literature; chapter 3- research methodology; chapter 4- results of the study; and chapter 5- conclusion, discussion, and recommendations for further studies.

Conclusions in Relation to the Second Research Question

The pre-service science teachers' practice of Classroom Research over the implementation of the initiative.

Although the pre-service teachers, for the most part, showed their understanding in each stage of conducting a Classroom Research project before engaging in the initiative, their practice of Classroom Research was not consistent with their understanding. In generating the research question, one-third of pre-service teacher did not review literature for generating her research question, but she wanted to continue on her previous research topic that she used to generate in the Classroom Research course. One-third of pre-service teacher did not analyze the students' achievement scores, observe the students' behavior, and/or check the students' exercise books in order to generate the research question as mentioned in the initial understanding, but asked the cooperating teacher to generate the research question for her. One-third of pre-service teacher did not know how to generate the research question. She wanted to continue on her previous research topic that she used to generate in the Classroom Research course. However, the discussion with the cooperating teachers during the implementation of the initiative led to the development of pre-service teachers' practice regarding generating their research questions. All pre-service teachers realized that the research question should be ground in the realities of their workplace. They observed and recorded the classroom situation for one and a half to two months, and then they selected a problem in the classroom to generate their research question.

For reviewing literature, all pre-service teachers identified the keywords from the research hypothesis and used the keywords to search for the related literature from various sources including books, theses, research articles, and the former Classroom Research reports in order to provide the theoretical framework for their study and to guide the idea for data collection and data analysis in their study.

All pre-service teachers employed the one group pretest-posttest research design to conduct their Classroom Research project because it corresponded with their research question which sought to compare the students' achievement scores after the implementation of research intervention in the classroom, and it was easy to conduct. They were familiar with this research design.

For developing the research instruments, the pre-service teachers developed the pre-test and post-test as their research instruments for collecting data in their Classroom Research project. They used the science textbooks and teacher handbook as the resources for developing the pre-test and post-test. They sent the test draft to the cooperating teacher and the staff of the school academic section for approving the test format and providing the validity of the tests. Two-third of pre-service teachers tried out the test before using to collect data.

All pre-service teachers used the descriptive statistics to analyze their data. They calculated the mean score and the standard deviation of the students' pre- and post-test scores. They compared the students' pre-test scores and post-test scores to see whether the students gained higher scores after the implementation of the research intervention or not.

In writing the Classroom Research report, all pre-service teachers wrote their Classroom Research report in the five-chapter format because it was a requirement of the university. Their Classroom Research report consisted of the abstract, the preface, the table of content, chapter 1, chapter 2, chapter 3, chapter 4, chapter 5, bibliography, and appendix.

The evolvement of pre-service science teachers' understanding of Classroom Research over the implementation of the initiative.

After engaging in the initiative, the pre-service teachers understood more about Classroom Research. All pre-service teachers understood Classroom Research as a form of inquiry with the intention of improving the quality of teacher's teaching practice for promoting the student's learning. All pre-service teachers understood that the research question could be generated by selecting from a problem that occurred in the classroom.

All pre-service teachers understood that reviewing literature meant linking their research topic with the educational theories found in books, theses, and research

articles for providing the theoretical framework to the Classroom Research project and informing their ideas to undertake the Classroom Research project by seeing the examples of research intervention and methods of data collection and data analysis used by other researchers.

All pre-service teachers understood that the appropriate research instruments for their research were pre-test and post-test. The research instruments should be verified and approved by experienced person and tried out before being used to collect data in order to provide the validity to the research instruments.

All pre-service teachers understood that data could be analyzed by using descriptive statistics such as frequency, percentage, mean, and standard deviation.

All pre-service teachers understanding of writing Classroom Research report were consistent with their initial understanding before engaging in the initiative that the Classroom Research report comprised of five chapters.

Conclusions in Relation to the Third Research Question

The findings revealed that all cooperating teachers gave support of Classroom Research to the pre-service teachers more than the university supervisor. The cooperating teachers supervised pre-service teachers in every stage in conducting the Classroom Research project. The university supervisor rarely supervised pre-service teachers in conducting the Classroom Research project because he did not have much time to supervise the pre-service teachers in the school.

In generating the research question, all cooperating teachers recommended the pre-service teachers to observe and record the classroom situation for investigating the problems in the classroom. They guided the pre-service teachers to select the problem that most frequently occurred or affected many students in the classroom to generate the research question.

In reviewing literature, all cooperating teachers recommended the pre-service teachers to identify the keywords from the research hypothesis and used the keywords to search the related literature from books, theses, and research articles for providing the theoretical framework of the study to the readers by describing the theories in education that they used to drive their Classroom Research project and for providing the chance to the pre-service teachers to gain insight about the ways of conducting their Classroom Research project.

In developing the research plan and the research instruments, all cooperating teachers recommended the pre-service teachers to employ the research design that could provide answer to the research question and was suitable with the pre-service teachers' time to collect and analyze data. They recommended the pre-service teachers to use the science textbooks and the teacher handbook as the basis for developing the pre-test and post-test. They recommended the pre-service teachers to explore the learning outcomes in the teacher handbook and then construct the test items by modifying from the questions in the science textbooks.

Developing the research plan and the research instruments was the only aspect that the university supervisor gave recommendation to two-thirds of pre-service teachers in conducting the Classroom Research project. First, he recommended one pre-service teacher to employ the research design that could provide the answer to her research question and she was confident to conduct. Second, he recommended two pre-service teachers to develop the pre- and post-tests by rearranging the test items and the choices of each test item in the pre-test in a new order for using in the post-test. Third, he recommended one pre-service teacher about the number of test items that she should include in the pre- and post- tests.

In analyzing data, all cooperating teachers recommended the pre-service teachers to present the standard deviation accompanied with the mean score for helping the reader know about the distribution of the students' scores in the pre- and post-tests. They taught the pre-service teachers to calculate the standard deviation because the pre-service teachers did not know how to calculate the standard deviation.

The Faculty of Education required all pre-service teachers to write the Classroom Research report in five-chapter format, so all cooperating teachers recommended the pre-service teachers to write the Classroom Research report followed the thesis-typed format which comprised of five chapters.

Conclusions in Relation to the Fourth Research Question

Factors that support the pre-service science teachers' practice of Classroom Research

From the perspective of pre-service teachers and university supervisor, they thought the factor that largely supports pre-service teachers' practice of Classroom Research was the close supervision from the cooperating teachers. The cooperating teachers spent most of the time with the pre-service teachers in the school. The cooperating teachers gave recommendations immediately when the pre-service teachers had trouble with their Classroom Research project. Other factors that supported the pre-service teachers were the pupils' attention, and the school's facilities for searching the information that was necessary to conduct the Classroom Research project.

From the perspective of cooperating teachers, they stated the usefulness of the SHCR as an important support. The SHCR improved their understanding of conducting the Classroom Research project. This understanding facilitated the cooperating teachers in giving close-up supervision of conducting the Classroom Research project to the pre-service teachers. The SHCR guided them the ways for supervising each stage of conducting the Classroom Research to the pre-service teachers.

Factors that hinder the pre-service science teachers' practice of Classroom Research

The pre-service teachers, the cooperating teachers and a university supervisor expressed various factors that hinder the pre-service teachers' practice of Classroom Research included: (i) the school activities that were not scheduled in the school plan affected the pre-service teachers. They could not follow the lesson plans that they developed as the research intervention in their Classroom Research project; (ii) the insufficient school support hindered pre-service teachers in developing the information sheets, exercise sheets, a pre-test, and a post-test for using in their Classroom Research project. Furthermore, the school could not provide the instructional materials and equipment for the pre-service teachers for organizing the learning activities in the way that they wanted during their Classroom Research project; (iii) the university supervisor did not come to the school often and did not build enough rapport with the cooperating teachers. The university supervisor did not provide the time for cooperating teachers to talk about the pre-service teachers' practice of Classroom Research when he came to observe the pre-service teachers in the school; (iv) the university did not organize seminars to provide the opportunity for pre-service teachers to share ideas and experiences in conducting the Classroom Research project with peers and the university faculties, and (v) the insufficient knowledge and experience in conducting the Classroom Research leads the pre-service teachers to conduct the Classroom Research project with anxiety. The Classroom Research course that the university provided to pre-service teachers emphasized on the content rather than practiced the pre-service teachers to conduct Classroom Research in each stage. The pre-service teachers struggled with the problems about developing the research instruments, analyzing data, and writing the Classroom Research report.

Implications of the Study

The results of this study provide several suggestions for teacher education institutes to promote the pre-service teachers' understanding and practice of Classroom Research project:

1) The cooperating teachers and university supervisor should understand how to conduct a Classroom Research project and supervise a Classroom Research to pre-service teachers step by step. The teacher education institute should organize workshop for enhancing the cooperating teachers and university supervisor understanding of Classroom Research and should distribute the handbook about the guideline for supervising Classroom Research to the cooperating teachers and university supervisor in order to provide ideas to them about how they could supervise the Classroom Research to the pre-service teachers. Based on the results of this study, even though the pre-service teachers struggled with some obstacles in conducting Classroom Research project, they got many suggestions from the cooperating teachers, who understood about Classroom Research and knew how to supervise each stage of Classroom Research to the pre-service teachers from the SHCR.

2) The Classroom Research course that the teacher education institute organizes for the pre-service teachers should provide the profound knowledge and skills necessary in conducting a Classroom Research project. If possible, the university should give pre-service teachers prior experience in conducting a Classroom Research project in every stage with supports from the university instructors before they were required to complete a Classroom Research project in the internship setting by themselves. The results of this study showed that the Classroom Research course that the university provided to pre-service teachers was not enough preparation the pre-service teachers to conduct the Classroom Research project because the instructor of the Classroom Research course did not teach them in-depth in every stage of conducting Classroom Research project which resulted pre-service teachers facing the problems in developing the research instruments, analyzing data,

and writing the Classroom Research report. In addition, the Classroom Research course should provide the opportunity for the pre-service teachers to practice all stages of conducting Classroom Research project rather than only teaching them the content of Classroom Research. The findings of this study revealed that although the pre-service teachers expressed that they had initial understanding of Classroom Research before engaging in the initiative, their practice of Classroom Research was not consistent with their initial understanding. Without support from the cooperating teachers, they could not generate the research question. They did not know how to write the result of their literature review and they did not know how to calculate the standard deviation.

3) The teacher education institute should organize the seminars for pre-service teachers, cooperating teachers, and university supervisors to share the progression and experiences in conducting Classroom Research project collaboratively throughout the internship period. The results of this study revealed that the lack of a university seminar hindered the pre-service teachers in sharing their opinions and experiences in conducting a Classroom Research with peers and the university faculties. They had insufficient knowledge in developing the research instrument, analyzing the data, and writing the Classroom Research report. They expected to get the idea for conducting their Classroom Research projects from the discussions with their peers and the university faculties in the seminars. But the university did not arrange any seminars throughout the internship period. Furthermore, the cooperating teachers expressed that the university supervisor did not have time to talk with them about the pre-service teachers' practice of Classroom Research when the university supervisor came to observe the pre-service teachers in the school. The cooperating teacher preferred the university to arrange the seminar between the university supervisor and cooperating teachers to discuss about the pre-service teachers' practice of Classroom Research, the problems and the role of each person in supervising Classroom Research to pre-service teacher.

4) The university supervisors should manage the time to supervise the pre-service teachers in the school. The university supervisors should have time to read the

lesson plan before observing the pre-service teachers teaching. After observing the pre-service teachers teaching, the university supervisors and cooperating teachers should collaboratively give feedback to the pre-service teachers.

5) The university supervisors should understand that Classroom Research is a component of teaching that benefited and improved the pre-service teachers' teaching practice. In this study, the university supervisor understood that conducting Classroom Research project was an addition workload for the pre-service teachers that resulted the university supervisor to pay attention in supervising about teaching more than supervising about conducting a Classroom Research project.

6) For readers and researchers who are interested in doing similar studies, it is important to remember that this study was conducted with a group of three pre-service science teachers in a specific context of Westernthani University and its partner schools which signed a contact with the Westernthani University to serve as the professional development school for the pre-service teachers to practice their teaching during the internship period. There is no intention in this study to generalize its results to pre-service science teachers in a larger group. Rather, the study attempts to learn more about pre-service teachers' understanding and practice of Classroom Research, the cooperating teachers and university supervisor supervision of Classroom Research to pre-service teachers, and the factors that support or hinder the pre-service teachers in conducting the Classroom Research project through the implementation of the initiative which was developed by the researcher. Nevertheless, the description of how the initiative was implemented and the context surrounding the use of initiative may be useful to others who decide to apply the initiative in their own context.

Recommendations for Further Studies

The researcher offers the following suggestions for further studies:

- 1) There is the need for future studies to investigate how pre-service science teachers can sustain their understandings and practices of Classroom Research in the first few years when they start their career as science teachers.
- 2) It is recommended to encourage the pre-service science teachers to conduct Classroom Action Research for studying the process (the development of their teaching practice) rather than the product (the students' achievement scores).
- 3) Should promote the university supervisors, cooperating teachers, and pre-service science teachers to understand that Classroom Research is beneficial to the improvement of pre-service science teachers' teaching practice. Classroom Research is not the additional workload for the pre-service science teachers during the internship period.

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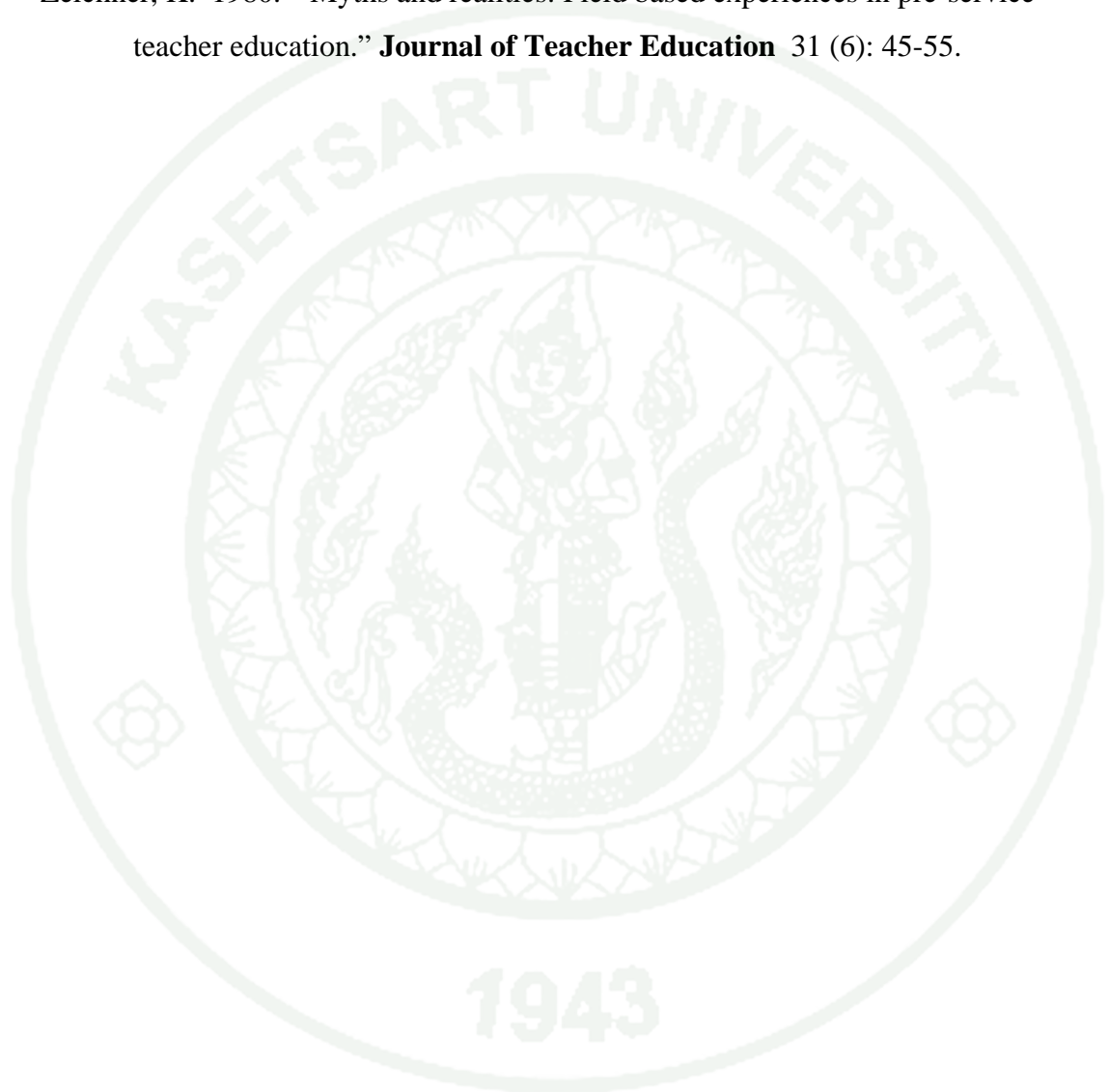
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APPENDICES



Appendix A

The Understanding of Classroom Research Questionnaire

The Understanding of Classroom Research Questionnaire

The aim of this questionnaire is to explore the pre-service teachers' understanding of Classroom Research. There were three parts in the questionnaire which asked about the demographics of the pre-service teachers, understanding about Classroom Research, and the willingness to engage in the initiative for enhancing the pre-service science teachers' understanding and practice of Classroom Research.

Part 1: The demographics

Instruction Please tick (✓) in the box () and fill the answer that corresponds to your information in the blank area. If the item options do not fit with yours, please add your specific information under “ other ...”

- | | | | |
|---|---------------|-------------|------------------------------|
| 1. Gender | Male | Female | |
| 2. Age | 20 – 21 years | 22-23 years | More than 24 years |
| 3. Your cumulative GPA before starting the internship course..... | | | |
| 4. Major Field of the study | | | |
| | Physics | Chemistry | Biology General Science |

Part 2: Understanding about Classroom Research

Instruction Please answer the following questions by writing the answer in the blank area.

1. What is Classroom Research?

.....

.....
.....

2. How can you generate the research question?

.....
.....
.....

3. What are the purposes of reviewing literature?

.....
.....
.....

4. How can you collect the data for your Classroom Research project?

.....
.....
.....

5. How can you develop the research instruments?

.....
.....
.....

6. How can you analyze data for your Classroom Research project?

.....
.....
.....

7. How can you write the Classroom Research report?

.....

.....

.....

Part 3: The willingness to engage in the initiative

Instruction Please indicate your willingness to engage in the initiative for enhancing the pre-service science teachers' understanding and practice of Classroom Research below.

Are you interested to participate in the initiative for enhancing pre-service science teachers' understanding and practice of Classroom Research

Yes, because.....

No, because.....

If you are interested to participate in the initiative, please provide your information for further contact

Name.....Surname.....

Telephone number.....

E-mail.....

For more information, you can contact the researcher at ekgaoak@hotmail.com



Appendix B

Interview Protocols

Pre-service teachers interview about understanding of Classroom Research before engaging in the initiative

1. What are the objectives of Classroom Research?
2. What are the criteria in generating the research question?
3. How can you review the literature?
4. What are the research instruments that can be used to collect data in the Classroom Research project?
5. What are the criteria for selecting the data collection methods to employ in the Classroom Research project?
6. What are the purposes of data analysis?
7. What are the components of Classroom Research report?
8. What are the topics that should be included in your Classroom Research report?

Cooperating teachers and university supervisor interview about the supervision of Classroom Research to pre-service teachers

1. How do you supervise the pre-service teacher to generate the research question?
2. How do you supervise the pre-service teacher to review literature?
3. How do you supervise the pre-service teacher to develop the research plan and research instruments?
4. How do you supervise the pre-service teacher to collect data?
5. How do you supervise the pre-service teacher to analyze data?
6. How do you supervise the pre-service teacher to write a research report?

Pre-service teachers interview about understanding of Classroom Research after engaging in the initiative

1. What is Classroom Research?
2. What are the objectives of Classroom Research?

3. What are the criteria in generating the research question?
4. How do you generate the research question?
5. How do you review the literature?
6. What are the research instruments that you employed to collect data in your Classroom Research project?
7. What are the criteria for selecting the research instruments to employ in your Classroom Research project?
8. How do you develop the research instruments?
9. What are the purposes of data analysis?
10. How do you analyze data for your Classroom Research project?
11. What are the components of Classroom Research report?
12. How do you write the Classroom Research report?

Interview about factors that support or hinder the pre-service teachers' practice of Classroom Research

1. What do you think are the factors that support the pre-service science teachers' practice of Classroom Research?
2. What do you think are the factors that hinder the pre-service science teachers' practice of Classroom Research?



Appendix C

Pre-Service Teacher Journal Form About the Practice of Classroom Research

Pre-Service Teacher Journal About Practice of Classroom Research

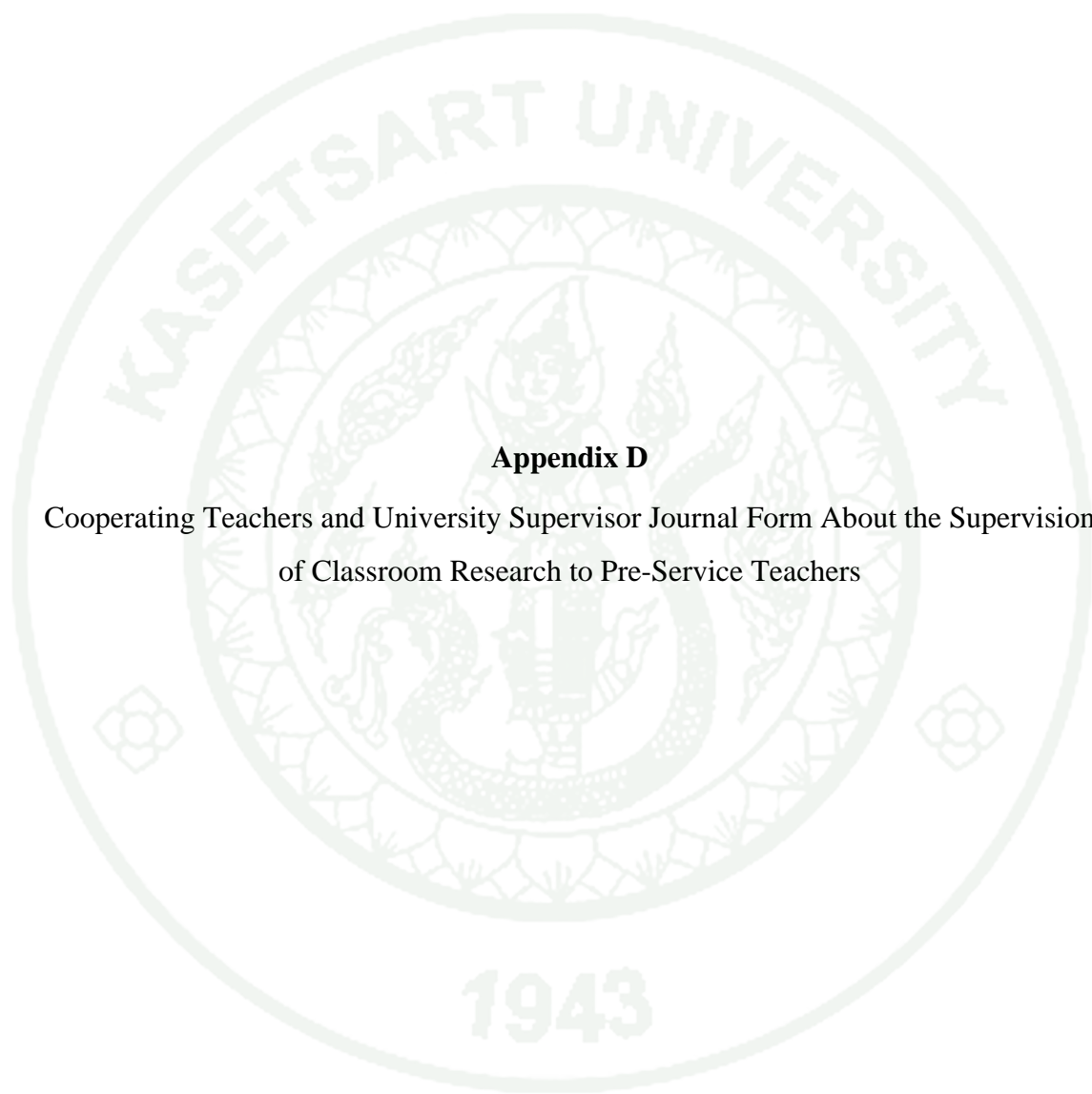
Date: _____

Time: _____

Pre-service teacher Name: _____

Instruction Please describe about your practice of Classroom Research with the following aspects.

1. How do you generate the research question? and What supports do you receive from your cooperating teacher and university supervisor?
2. How do you review literature? and What supports do you receive from your cooperating teacher and university supervisor?
3. How do you develop the research plan and research instruments? and What supports do you receive from your cooperating teacher and university supervisor?
4. How do you collect data? and What supports do you receive from your cooperating teacher and university supervisor?
5. How do you analyze data? and What supports do you receive from your cooperating teacher and university supervisor?
6. How do you write the Classroom Research report? and What supports do you receive from your cooperating teacher and university supervisor?



Appendix D

Cooperating Teachers and University Supervisor Journal Form About the Supervision
of Classroom Research to Pre-Service Teachers

**Cooperating Teachers and University Supervisor Journal Form About the
Supervision of Classroom Research to Pre-Service Teachers**

Date: _____

Time: _____

Supervisor Name: _____ Supervisee Name: _____

Instruction Please describe about your supervision of Classroom Research to the pre-service teacher with the following aspects.

1. How do you supervise pre-service teacher to generate the research question?
2. How do you supervise pre-service teacher to review literature?
3. How do you supervise pre-service teacher to develop the research plan and research instruments?
4. How do you supervise pre-service teacher to collect data?
5. How do you supervise pre-service teacher to analyze data?
6. How do you supervise pre-service teacher to write the Classroom Research report?



Appendix E

Worksheets in the Supervision Handbook of Classroom Research

Worksheet # 1
Teaching Journal

Date: _____ Teacher name: _____ Class: _____

Time: _____ Topic: _____

Direction: After your teaching, write a response to each of the following questions:

1. What went well in the classroom?

2. What went poorly in the classroom?

3. What surprised you during your teaching?

4. What questions did you end today with?

Worksheet # 2**The Summary of Situation in the Classroom**

Direction: Read through your teaching journal entries, and then group the information into 4 themes: what went well in your class, what went poorly, what surprised you, what questions did emerge in your mind? If the same situation occurred in the other days, put the check mark (✓) in front of that situation on your list to see the frequency of that situation.

What went well in your class?

What went poorly?

What surprised you?

What questions did emerge in your mind?

Worksheet # 3
Generating the Research Question

Direction: Use the data from the worksheet number two to generate the research question by answering the following questions:

1. What is the situation/problem in your classroom that most interest you to explore, learn more about, or understand better?
2. Why you are interested in this situation/problem?
3. Why do you think this situation/problem is important to study?
4. Who will be involved in this situation/problem?

Generating the Research Question (Cont'd)

5. To whom will the outcome of your study benefit?

6. What are the possible solutions that could be taken to solve this situation/problem?
(Write as many as possible)

7. Consider something 'new' and compare it to what you have been doing for the last two months. What is the 'new thing' that you would like to try?

8. What are the expected outcomes of the study?

9. How much time will be used for conducting the Classroom Research project?

Worksheet # 4
Conducting the Literature Review

Direction: Review the area you have selected as the focus of your Classroom Research project and the expected outcomes you hope to impact through your work. Then answer the following questions:

1. Consider your research question and write your research hypothesis

2. Identify key words from your research hypothesis

3. Find the related information from an internet search or book, academic journal, thesis, or dissertation in the library following these steps:
 - a. Place the keywords in order of importance
 - b. Do a search using all of your key words
 - c. Repeat the process until you feel you have acquired enough information to conduct your Classroom Research project

Worksheet # 5**Research Planning and Developing the Research Instruments**

Direction: Answer these questions to guide you in developing your Classroom Research plan.

1. What specific actions need to be taken in your Classroom Research project? (For example, writing lesson plans, organizing Problem Based Learning activities, organizing Cooperative Learning activities)

2. Who are your research participants?

3. What are the required data that you need for answering the research question?

4. What is the research design will you employ in your study?

Research Planning and Developing the Research Instruments
(Cont'd)

5. What data should be collected for answering your research question(s)?

6. How can you collect the data?

7. How can you analyze the data?

8. When will you develop the research intervention, collect data, analyze data, and write the research report?

Research Planning and Developing the Research Instruments
(Cont'd)

Direction: Use this table to clarify the timeline for developing the research instruments in each step.

Steps for developing the research instruments	Target date for completion (D/M/Y)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Worksheet # 6
A Data Collection Schedule

Direction: Use this item as a monitor to complete each data collection activity of your Classroom Research project

Activity to be completed	Target date for completion (D/M/Y)	Task completed? (☑) (D/M/Y)
1. Implement the strategy/intervention		<input type="checkbox"/>
2. Classroom observations		<input type="checkbox"/>
3. Interview the students		<input type="checkbox"/>
4. Organize the pre-test		<input type="checkbox"/>
5. Organize the post-test		<input type="checkbox"/>
6.		<input type="checkbox"/>
7.		<input type="checkbox"/>
8.		<input type="checkbox"/>
9.		<input type="checkbox"/>
10.		<input type="checkbox"/>

Worksheet # 7
Data Analysis Form

Direction: Read through your gathered data (the observation field notes, interview transcriptions, reflective journals, tests, and other documents) then jot down the information that you can use to answer your research question into this table for determining themes/categories.

Themes/categories	Evidence from the information source			
	Observations	Interviews	Journals	Tests
1.				
2.				
3.				

Worksheet # 8
Reflection on Classroom Research Process

Direction: Use the following questions to help you reflect on your Classroom Research project.

1. Do you collect the information as planned? Do the collected data provide the information you needed?

2. Does the research intervention employed in your Classroom Research project produce the outcomes in the manner that you expected? How?

3. Does the data that you collected sufficient for answering your research question? If so, are there additional sources of data that you might want to include next time?

Reflection on Classroom Research Process (Cont'd)

4. What problems do you have in conducting Classroom Research project? How will you do it better?

5. Are there any unintended outcomes that occurred in your study? If so, what are the unintended outcomes?

6. Are there other activities that should have occurred to promote the success of your study?

7. Are there other findings that should be added up from your expected outcomes? If so, what are those findings?

Worksheet # 9
Classroom Research Report Planning

Direction: Use the following table; review each of the stages you took in conducting your Classroom Research project, the activities you engaged in, and the documents you produced. Decide which documents you want to share and which activities you want to describe to others.

Stage or Process of Classroom Research	Documents, Events	What will you share?
Identify research question and select the expected outcomes		
Literature review		
Develop the research plan and research instruments		

Classroom Research Report Planning (Cont'd)

Stage or Process of Classroom Research	Documents, Events	What will you share?
Collecting data		
Analyzing data		
Your reflection toward your Classroom Research project		

Classroom Research Report Planning (Cont'd)

Use the data in the right hand column from the previous table to make a determination on both the details you would like to describe and the presentation techniques you will use for presenting the information you have decided to share.

Thing to be shared (from the previous table)	Detail needed (e.g. summarize whole idea or with specific event/activity)	Method for sharing (table, graphs, description, photos, poster)

BIOGRAPHICAL DATA

NAME:	Mr. Ekgapoom Jantarakantee
DATE OF BIRTH:	August 14, 1982
PLACE OF BIRTH:	Phetchaburi, Thailand
GRADUATION:	B.Sc. (Physics), Kasetsart University since 2005 Grad.Dip. (Teaching Science Profession), Kasetsart University since 2006
SCHOLARSHIPS:	- The scholarships to pursue High School, B.Sc. (Physics), Grad.Dip. (Teaching Science Profession), and Ph.D. (Science Education) under the Project for the Production of Science and Mathematics Talented Teachers (PSMT) which is conducted by the Institute for the Promotion of Teaching Science and Technology (IPST), Thailand. - The scholarships for research funding from the Graduate School, Kasetsart University, Thailand.