CHAPTER 5
CONCLUSION, DISCUSSIONS AND SUGGESTIONS

The objectives of this research are to create a model to develop the instructional competency promoting mathematical process skills among the Prathom Suksa 6 students though knowledge management and action research, to study the instructional competency of the teachers promoting their students' mathematical process skills, and to study the teachers' opinions toward the model for developing the instructional competency that promotes the mathematical process skills. The research conduct is divided into four steps as the followings.

Step 1: the step to develop the conceptual framework to develop a model for the development of the instructional competency that promotes the students' mathematical process skills.

Step 2: the step to design the development of instructional competency that promotes the mathematical process skills.

Step 3: the step to implement to implement the set model for developing the instructional competency that promotes the mathematical process skills.

Step 4: the step of evaluation and the improvement of the model for developing the instructional competency that promotes the mathematical process skills.

The target groups of this research are the teachers in the content-areas of mathematics at Prathom Suksa 6 level under Office of Chiang Mai Education Service Area 2 in year 2007. The research selects eight teachers form eight schools in four districts, which are Mae Rim, San Sai, Prao, and Mae Taeng, and 185 Prathom Suksa 6 students who study with the target group teachers of this research in the second semester year 2007.

The tools used for this research are the record forms for the implementation relevant to the created model, the evaluation form on the instructional competency

that promotes the mathematical process skills, the record form of interviews with the target group teachers, the record form on the trace of checking students' exercises or tasks, the evaluation forms on the teaching plan, the record form on the data reflection after the teaching, the report form on the classroom implementation, the evaluation forms on the students mathematical process skills, and the questionnaires to ask the target group teachers' opinions toward the created development model. The analysis of data is done through induction methods and statistical methods, i.e., means and standard deviation.

Conclusions

The research on creation of a model for developing the instructional competency that promotes mathematical process skills of Prathom Suksa 6 students through knowledge management and action research can be summarized as the followings.

1. **Creation of the model for developing the instructional competency that promotes the mathematical process skills.** The research identifies the steps of implementation into four steps and each of the steps can be summarized as the followings.

Step 1: The step of developing the conceptual framework in developing the model to enhance the teachers' instructional competency that promotes mathematical process skills. The researcher applies the concept of knowledge management that is composed of knowledge identification, knowledge creation and acquisition, knowledge organization, knowledge codification and refinement, knowledge access, knowledge sharing, and learning. Furthermore the researcher also utilizes the concept of action research that is composed of development of action plan, implementation of the plan, observation and recording of the implementation results, and reflection of the implementation results that lead to new plan-making to be integrated within the process of the model to develop instruction competency created by the researcher.

Step 2: The step to design the development of the instructional competency that promotes the students' mathematical process skills. The model for

development of the instructional competency, which is the implementation cycles managed by the researcher and the target group teachers, is derived for this process. The implementation cycle undertaken by the researcher is the main cycle that is functioning as the conceptual framework of the action research. This main cycle is composed of seven implementation steps, i.e., Step 1 (identification of the success target of the development), Step 2 (measurement of the instructional competency level before the model undergoing development), Step 3 (plan for development of the instructional competency), Step 4 (development of the instructional competency), Step 5 (observation, check and reflection of the development), Step 6 (evaluation of the instructional competency), and Step 7 (summary of results of the development). For the implementation cycles managed by the teachers, the conceptual framework of the knowledge management acts as the main cycle that links the cycles of the teachers to the implementation cycle of the researcher in Steps 3 and 4 (identification of the success target of the tasks, identification of the main knowledge necessary for the implementation, acquisition of knowledge to use in the implementation, improvement through reviews, creation of knowledge and tools necessary for the implementation, application of knowledge in the implementation (these steps of implementation are done through the action research process), knowledge recording and exchange of the learning from the implementation of the teachers. These sub-steps are not clearly separated into definitive steps for their close interconnection.

Step 3: The step of implementation of the model to develop the instructional competency that promotes mathematical process skills. The researcher selects the samples among the mathematics teachers, students, and the target group schools by identifying the required characteristics of the sample, i.e., mathematics teachers for Prathom Suksa 6, voluntary participation in the research, open-minded, potentials for good relationship with others, acquisition of basic knowledge on the mathematics, duties in the accessible schools (not in isolated areas) in terms of communication, and stated cooperation from their school administrators. The students selected as the samples are Prathom Suksa 6 students who are studying under the selected target group teachers during the time of research. The researcher implements

with the use of the model for the instructional competency development from April 2007 until March 2008. The summary of the implement is given below.

Step 1 is done to identify the targets of the success of the development of the instructional competency. This is the step where the researcher creates awareness and develops the teachers' instructional competency that promotes the mathematical process skills in their students, gives additional knowledge for the target group teachers, and unites the target group teachers to identify the instructional competency in forms on its standards, indicators, and evaluation criteria. After the instructional competency is identified through 5 standards and 17 indicators, the implement to develop it reveals that the samples have achieved better scores in all standards than the scores recorded in the pre-implement evaluation (at least one level higher).

Step 2 is undertaken to check and measure the levels of existing instructional competency among the teachers. The researcher provides knowledge to measure and evaluate the instructional competency, creates the tools to check it, improves the quality of the tools, applies the tools to check the instructional competency before the model development, and analyzes the information for a conclusion. The summary confirms that the target group teachers have already shown certain level of the instructional competency to promote the mathematical process skills before the development of the model. The average score for all standards registered by the target group teachers stands in "Need Improvement" level with one standard falls in "Moderate" level (Standard 2: arrange the teaching and learning arrangement that promotes the students' mathematical process skills). Three indicators stand in "Moderate" level: Indicator 2.1 (arrange the activities that promote abilities to solve mathematical problems), Indicator 2.3 (arrange the activities that promote abilities to communicate with mathematical symbols or communications), and Indicator 2.4 (arrange the activities that promote abilities to make linkage of mathematical knowledge). All of the target group teachers have shown a rather similar level of instructional competency that promotes mathematical process skills before the model development.

Step 3 is needed to make plan to develop the teachers' instructional competency. The researcher studies the results of measurement of the level of

instructional competency of the target group teachers before the model development and prepares a plan, which is composed of three activities, for the activity arrangement to develop the target group teachers by using the concept of knowledge management and action research. Activity 1 is the preparatory meeting and plan-making for teaching arrangement. Activity 2 is related to the implementation of the plan. Activity 3 holds the teachers' meetings to exchange the learning and to set the implementation timeline for the researcher and the target group teachers.

Step 4 is the development of the instructional competency of the teachers according to the plan through implementation according to the activity arrangement for developing the teachers in three sub-activities. These sub-activities are divided further as the followings. The sub-activities by the target group teachers identify the targets of success in each teaching unit, produce the teaching guidelines, analyze and self-evaluate the knowledge the teachers have already had and still lack in the implementation, and exchange and share the knowledge and learning among themselves. The target group teachers apply the knowledge according to the action research process, which are preparing the teaching plan, arranging the teaching and learning according to the plan, checking and reviewing the teaching and learning arrangement, summarizing records and reflecting the teaching results, exchanging the knowledge from the implementation with other teachers and the summarizing and preparing the next teaching and learning sessions. This process appears as the spiraling implementation cycles that move continuously around for improvement through the knowledge management in all steps of the action research process.

Step 5 is related to observation, check and reflection of the development of the created model. The researcher observes and checks two main issues which are the results of the development for the instructional competency and the techniques or methods to develop it that the researcher uses in this development. Then the researcher reflects the data on the development results to the target group teachers to apply in improving themselves and reflects the implementation of the researcher to improve the process including the techniques and implementation methods. The check and review during the model development show that the target group teachers have increased their levels of development in instructional competency. In the earlier

period of the model development they perform rather awkwardly because they are not familiar with one another in the exchange of the learning to gain insightful knowledge to share with others. The researcher is responsible as the coordinator or facilitator of the learning for all target group teachers to allow them to freely show opinions and present the knowledge from their own experience. The researcher's creating a friendly atmosphere in exchanging the learning turns the learning climate into an informal, relaxed situation. The main problems and obstacles of the implementation are the plethora of school-related duties of the target group teachers, the limited time to set a meeting in convenience time for everyone, the troubles in setting appointments during the office working days; the meetings for sharing and reflecting the learning are thus arranged during holidays or weekends.

Step 6 is the step to evaluate the instructional competency. The researcher uses the Triangulation method to evaluate the teaching behavior of the target group teacher. The triangulation method gain its data from the classroom observation and tape recorded sessions of teaching, interviews with the target group teachers, study on related documents, and tests on the students' mathematical process skills. It can be concluded that the target group teachers have improved their level of existing instructional competency that promotes the mathematical process skills after the development and trial of the created development model. The average score of all measured standards are in "good" level after the implementation of the model. In two standards the teachers score averagely in "very good" level: Standard 1 (designing and planning the teaching and learning arrangement to promote students' mathematical skills) and Standard 3 (measure and evaluate the mathematical process skills along with the learning contents). There are two standards that fall into "good" level, which are Standard 2 (arrange the teaching and learning arrangement that promotes the students' mathematical process skills) and Standard 4 (analyze the process on teaching and learning results and bring them to promote the development of mathematical process skills efficiently). One standard that stands in "moderate" level is Standard 5 (development of student's mathematical process skills). The indicators in which the teachers achieve the highest score are Indicator 1.2 (plan the teaching and learning arrangement that promote students' mathematical process skill) and Indicator

3.2 (use the methods of measurement and evaluation in to reflect the students' knowledge and mathematical process skills in several methods). The indicator in which the teachers gain the lowest score level is Indicator 5.5 (abilities to develop the process skills in the creative thinking of the students). All target group teachers share a similar level of instructional competency that promotes mathematical skill after the development and trial of the model.

Step 7 is the step to summary and improve the instructional competency development model. The researcher brings result of evaluate in Step 6 comparing the results of the model development against the identified targets, this research shows that the actual results of the development accomplish the identified targets in which all standards have shown an increasing trend of improvement at least one level

Step 4: The step of evaluation and improvement and development of the model to develop the teachers' level of instructional competency. The researcher utilizes the data from the implement in Step 3 to adjust the model for developing the instructional competency, which is the implementation cycle undertaken by the researcher. The implementation cycle undertaken by the researcher is composed of four implementation steps, i.e., step 1 (identifying the target of success of development), step 2 (checking the instructional competency before the development), step 3 (development of instructional competency) (this cycle classifies the sub-cycle which is composed of designing of instructional competency development, developing instructional competency, checking and reviewing the instructional competency and reflecting of the result of developing the instructional competency), step 4 (evaluating and reflecting the development results).

2. Results of study on the teachers' instructional competency that promotes mathematic process skills. It can be concluded that the instructional competency has already existed among the target group teachers before the model development. These teachers score averagely in the "need improvement" level in all measured standards and the level of instructional competency of the target group teachers after the model development stands in "good" level. When comparing the results of the model development against the identified targets, this research shows

that the actual results of the development accomplish the identified targets in which all standards have shown an increasing trend of improvement at least one level (comparison of the evaluation result before and after the model development). However the development of the target group teachers in each standard has shown some differences, i.e., the target group teachers have developed the instructional competency level according to Standard 1 (design and plan the teaching and learning arrangement to promote students' mathematical process skills), Standard 3 (measure and evaluate the mathematical process skills along with the learning contents) and Standard 4 (analyze the process of teaching and learning results and bring them to promote the development of mathematical process skills efficiently) with the level of "good" or higher. For Standard 2 (arrange the teaching and learning arrangement that promotes the students' mathematical process skills) and Standard 5 (develop the students' mathematical process skills), the target group teachers show the development results reaching the level of "moderate" or higher.

3. Teachers' opinion toward the model of developing instructional competency promoting mathematical process skills. It can be concluded that most of the target group teachers perceive the benefits gained from participating in the process of developing the instructional competency in terms of increasing knowledge and experience. This means that they understand and see the necessity of developing the mathematical process skills and the classroom research process, exchanging the learning together, and thus stimulating their self-development. In terms of applying these increased knowledge and experience to develop the teaching and learning plan and to arrange the learning activity consistent with the contents, the teachers have gained better capacities, i.e., response to teaching outcomes after juxtaposed to planned objectives, management of problems and obstacles in activity arrangement, provision of suggestions to use in additional teaching, launch of classroom-based research, and planning for the learning activity for the next sessions. These teachers can apply knowledge to create tools for evaluation purposes that cover all aspects of the learning behaviors especially on the mathematic process skills. There is the self-evaluation to discover flaws or weaknesses of the model improvement and correct

then adjust the teaching and learning arrangement in the next sessions. They can also use the research process in the classroom to improve the learning quality and to solve the problems occurring in the teaching sessions by using the data from the results of self-evaluation. Having experienced such benefits, the target group teachers see that the students gain better mathematical process skills in response to the development according to each student's capability levels or potentials. The students also begin to display positive opinions toward mathematical subjects.

The main problem appearing in the model development process is that the students can only learn slowly because they are not familiar with the learning method that emphasizes on the mathematical process skills. Besides, the basics on the mathematical process skills of the students are still limited and there are natural differences in the students' ability levels. These drawbacks slow down the model implementation to achieve the expected targets. The target group teachers also suffer from limitation on time to fully participate in the activities together. For example, they have duties assigned by the schools that they can not participate in all activities. Neither do they have enough time to write up the reports at the end of the sessions or to join the activities together.

Suggesting about the steps and the processes according to the model to developing the instructional competency, the target group teachers believe that there should be activities to build teaching and learning media to promote the mathematical process skills continuously and arrange the activities to develop the teachers' ability on technology that they apply to produce learning media.

Discussions

This research is about creation of the model for developing the teachers' instructional competency that promotes the mathematical process skills for Prathom Suksa students through the knowledge management and action research. There researcher discusses the results according to the research objectives as what follows.

1. Creation of the model to develop the teachers' instructional competency promoting mathematical process skills.

The researcher creates a development model by using the concept based on the learning result of an implementation with the target group teachers because the researcher believes that everyone has the need to develop and improve their performance. They have needs to improve their own implementation for the inner stimulation, which is important for successful model development. Learning theoretician Marquardt (2006: 69) studied through research and found that people learned the best when they were motivated to achieve something. Therefore the learning that is based on Performance–Based Learning, which is consistently linking the performance to certain objectives, tends to be more successful than the learning in form of "abstract learning." Furthermore, learning is more likely to achieve the best results when it is related fully to the performers in terms of psychological and emotional values.

The concept of efficient model development using the performance-based learning has been accepted among practitioners and educational sectors or organizations. For example, related to the action research and the knowledge management, Ministry of Education (2003: 14) promulgated that the educational institutions promote the teachers to be able to launch research to develop the teaching and learning in Section 30 of National Education Act. At present the Ministry of Education supports all sectors under the Ministry to use the learning arrangement in their units or organizations that they become the "learning organizations." It can be observed there has been a wave of promotion on producing websites about knowledge management in the organizations. Besides, senior administrators such as Kasama Voravarn na Ayutthaya (2007: Online) emphasized that the organizations under the Office of Basic Education Commission must use the knowledge management to develop the quality of educational implementation. The Office of the Basic Education Commission also stated further that the implementation of the research project and development to increase the efficiency of the organizations must be done through knowledge management. The Office even launches some activities together with the Knowledge Management Institute to mobilize the Offices of Education Service Areas under the Office of the Basic Education Commission to be aware about the knowledge management in several educational areas.

The researcher applies the concept of knowledge management and action research integrated together and builds a new development cycle that is classified into two implementation cycles: one cycle managed by the researcher and the other one by the target group teachers. Despite this distinction, the two cycles of implementation process are basically similar. This similarity is becoming distinctively different when the implementation targets for each part measure the likely changes to appear as planned or to happen naturally. The implementation to achieve such targets requires the analysis for the necessary knowledge and abilities, the availability of such knowledge and abilities within the practitioners, the results the practitioners aim, the clear plan to improve themselves, and the proper planning to achieve such targets. They then implement the prepared plans into practice during which they must use supportive implementation methods. There are also the measurement, evaluation, summary of the implementation, and the summary of implementation results. Such processes are the main builders of the process of action research (Kemmis and McTaggart, 1995: 13–28). They are consistent with the main process of knowledge management according Carla O'Dell's concept of knowledge management (Thailand Productivity Institute, 2005: 35-36) which is the process to move on for changes composed of four main steps, i.e., creating the knowledge, structuring the knowledge, implementing the knowledge, and measuring and evolving the knowledge.

From the application of the model to develop the instructional competency, to achieve success its practitioner must consider the important emphases on the model for developing instructional competency, i.e., identifying the target, setting targets of tasks, learning from the implementation, exchanging the learning, and developing continuously in cycles. Because the development according to this model emphasizes on its achievements, the model always compares the actual outcomes with the planned targets. This fact can be observed from the identification of the targets in developing instructional competency that promotes mathematical process skills. This time the similar process has been identified to be the standards, indicators and criteria, which is in response to the policy of the Office of the National Education Commission to use recently the Standard-Based Implementation. And the most important part of this process is the standards that will show the achievements of such implementation.

There are the indicators for recognizing the important sub-behaviors that reflect the achievement of the implementation in more concrete forms. There are the evaluation criteria which are also the guidelines for making decisions on giving scores or setting quality levels for the implementation or for the results of such implementation. Identifying the standards, indicators, and criteria of the implementation can take considerably extended time because it requires the process of identification throughout several steps, for instance, creating the knowledge, standards, indicators, and criteria with the target group teachers that they can identify clear targets. The study of known standards, indicators and criteria of the nationally-acknowledged central organizations and relevant organizations and the consultation with the experts to adjust the format and language can make these standards, indicators, and criteria to be more directly, accurately, and flexibly convey the intended meanings appropriately. Although these procedures may require a lot of time but they are important because identification of clear targets allows the practitioners to foresee the development direction. Guskey's comments (2000: 16), for example, about occupational development stated that such process must be accompanied by identification of clear objectives, targets, intended values, as well as proper standards, indicators and criteria for its fair evaluation. The researcher allows the target group teachers to participate in consideration on the model appropriateness vis-à-vis the potentials of the teachers and students. The identification of the standards, indicators and criteria as parts of the model development is thus becoming a challenge for the target group teachers to achieve success under the conditions and limitations of each of teachers. The teachers also build a kind of moral support in the implementation of the model development to reach successfully the development targets. Whenever the target group teachers achieve success according to the set standards and indicators, the researcher would adjust the difficulty level of the list of implementation or the conduct of implementation behavior in forms of standards and indicators.

The development methods used as the methods for the target group teachers are the arrangement of the actual teaching and learning activities. The results of this teaching and learning arrangement in terms of problems, obstacles, and ideas are discussed together in meetings to exchange ideas among the target group teachers.

The researcher is responsible to act as a supervisor who advises on the teaching and learning planning in a manner similar to that of the supervisors for on-the-job trainings. This is the technique that can link the learning results from the classrooms to the improved application in actual work performance. This method potentially increases the skills or the competency in the work (Sisson, 2002: 15. The interviews and discussions with the target group teachers show that the target group teachers are satisfied with the development of instructional competency with this model because they can learn the techniques, methods, experience and knowledge that are consistent with actual problems and they can bring these new gains to implement for solutions for the problems in time. It is similar to procuring reflection data from the real implementation. This fact stimulates reinforcement in willful learning and adjustment of action or implementation on the teachers' own. This is consistent with Chuchai Smithikrai's statement (2001: 101) that giving feedback data is very important in learning and the motivation of the learners. The feedback data about the results of action, whether they take forms in commentary words, scores of tests, or reports of the evaluation forms of the implementation, will play three important roles in promoting the learning and motivation of the persons getting the enhancement (Locke & Latham, 1990 cited in Chuchai Smithikrai, 2005: 101). The first role is to stimulate the learners to realize whether the implementation is proper or improper. This realization helps them to adjust and change action whenever necessity arises. The second role is to raise the level of learners' interests to the learning process. The third role is to stimulate the willingness to achieve the set targets and to improve the manner of implementation of the development. When applying the created model into implement, the researcher practices the suggestions to develop the efficiency suggested by Yont Chumchit (1992 : 137-138) as the guideline for development, i.e., acceptance that the learning process occurs all the time. The personal learning of each person should be adjusted to the demands or needs of the learning persons themselves. Compulsory learning may produce the opposite results from the expected achievements. The prosperity of the teachers will be promoted when they exchange opinions, assumptions and results of tests and when they are allowed judge or

consider their own students and other learning conditions. Continuously practiced, these factors will certainly help the creation of proper learning process.

The concepts of knowledge management and action research are utilized by the researcher to settle the development process. These concepts are consistent and well integrated, which means the action research process is composed of plan, implementation of plan, observation of implementation, and reflection of data for improvement in further process. The researcher practices knowledge management especially the knowledge management process that has been used in the development of the implementation cycle of the target group teachers (Thailand Productivity Institute, 2005: 54-59), which is composed of knowledge identification, knowledge creation and acquisition, knowledge organization, knowledge codification and refinement, knowledge awareness, knowledge sharing, and learning. The analysis for the knowledge-creation process would occur naturally in every step of the action research process and in the model development model but this research emphasizes clearly in the steps of development on the instructional competency and on the model of the development on the implementation cycle of the target group teachers. The action research process usually stands as the sub-process of the learning process of the teachers but in the implementation cycle of the target group teachers the action research stands as the main process and has the knowledge management as the sub-process. This shows that these two processes share similar characteristics, i.e., they stand in the continuous implementation cycle as processes and methods that support each other, and both influence the success of the process implementation. In fact, Kittiporn Punyapinyophol (1997), Boonyaporn Chimploy (2001), Urai Thieng-u (2001), Parinya Upala (2002), and Sumitra suwan (2003) have shown the successful results of using the action research in developing the quality of the tasks. The examples for the organizations that can bring the knowledge management to successful use are Siriraj Hospital, Spansion (Thailand) Co. Ltd., TRUE Corp (PLC), (Thailand Productivity Institute, 2005: 66-130), Ban Tak Hospital, Department of Agricultural Extension, C.P. Seven Eleven Public Company, and Network of Natural Agriculture in Phichit Province: Network of Clean Rice (Vicharn Panich, 2005 : 239-268).

2. Study of the development of the teachers' instructional competency that promotes the mathematical process skills.

The target group teachers have shown some levels of instructional competency that promotes the mathematical process skills before the development of the model (with the average score of all standards at 1.25 or "need improvement"). The target group teachers have similar level of instructional competency that promotes the mathematical process skills before the model development. Most of these teachers, however, typically emphasize on the students' understanding of the contents as the main conceptualization. The summary of the Office of Mathematics and Computer of the Institute for the Promotion of Teaching Science and Technology (2004: 4) stated that in the past the mathematics teaching and learning arrangement was most often emphasized on what the teachers want their students to learn more than on the building the process skills. The teachers' other emphasis on the learning methods to learn the contents created the values and meanings in what the students had learned. The students who studied mathematics well in the past were therefore the learners with good knowledge on the contents. However in the present, the changing social economic conditions have forged different characteristics on the demands of the use of mathematics from the past. The informal interviews with the teachers while the researcher evaluates their teaching and learning methods as the supervisor reveal that more than 80 percent of mathematics teachers fail to recognize the mathematical process skills according to the curriculum of B.E. 2544 (2001) in the contents areas of mathematics. Moreover the researcher observes that the number of research and available theses about the mathematical process skills are very limited. The majority of theses are discussing the solutions for mathematical problems, which has been thus considered to be the main principle of teaching and learning of mathematics. These facts are consistent with the findings showing that the target group teachers score only with "moderate" level in three indicators for the instructional competency: Indicator 2.1 (arrange the activities that promote ability to solve mathematical problems, means or M=1.88), Indicator 2.3 (arrange the activities that promote abilities to communicate with mathematical symbols or communications, M=2.63), and Indicator 2.4 (arrange the activities that promote abilities to make linkage with mathematical knowledge,

M=2.13). The rather high scores in the teachers' abilities in communication and in knowledge linking may have correlation with the present situation that allows the teachers to produce more academic works or paper works to promote their professional status. Furthermore in the past, supervisors who checked the teachers' work emphasized the importance of using symbols, using mathematical principles correctly, including emphasizing the application of mathematics to the learning of other learning content-areas, and linking mathematics to the situation in daily life. Although solving problems is related to the main topics of the teaching and leaning mathematics, it requires the knowledge process in both the contents and the mathematical process skills. In addition there are many other factors that affect the students such as their basic knowledge, perception as well as the factors related to their teachers, i.e., knowledge level, abilities, time allowance, other duties or missions, etc.

The research findings related to the instructional competency that promotes the mathematical process skills after the model development show that the target group teachers reach the average score of 3.32 ("good" level) in instructional competency for all standards. All the target group teachers share a rather similar level of instructional competency after the model development similar. These target group teachers have gained knowledge, understanding and awareness about the emphasis of the teaching and learning of mathematics according to the Basic Education Curriculum of BE 2544. The teaching and learning of the mathematical process skills along with the learning contents are encouraged by the Office of Mathematics and Computer under the Institute for Promotion of Teaching Science and Technology (2004: 6). This encouragement reinforces the target group teachers' attempts to increase the levels of their objectives in the teaching and learning of mathematics, to increase the extent of teaching and learning activity arrangement, and to incessantly evaluate the learning achievements every time. These facts are correlated to the high scores ("very good" level) in the evaluation results on the instructional competency of the target groups in Standard 1 (designing and planning the teaching and learning arrangement to promote students mathematical process skills) and Standard 3 (measure and evaluate the mathematical process skills along with the learning

contents). The teachers also score quite highly ("good" level) Standard 2 (arrange the teaching and learning arrangement that promotes students' mathematical process skills) or they are quite competent to apply the plan to arrange the teaching and learning into practice. Nevertheless this skill is considered a new arrival among the target group teachers. The researcher observes the activity arrangement and the discussions to exchange the learning among the target group teachers. This observation shows that thinking about the activities to develop the process skills in the earlier period of the development on instructional competency is not sufficient enough. This is consistent with the problem on the developing the development of the mathematical process skills along with the learning contents stated by the Office of Mathematics and Computer under the Institute for the Promotion of Teaching Science and Technology (2547: 5) that teachers have problems in developing each of the skills through certain learning contents and in deciding the proper characters of learning activities to the skill development. Moreover the students are not familiar with the learning that enhances the mathematical process skills as the learning methods. They must spend some considerably long time for the learning of each of the contents. The group target teachers are therefore growingly worried that they will not be able to teach the whole contents tested in the national tests at the end of semester especially the samples group of students in this research Prathom Suksa 6 students. These students must prepare to take the national tests while they are undergoing the implementation with the model.

There is one standard in which the teachers score in "moderate" during the post-trial of the developed model, which is Standard 5 (development of students' mathematical process skills, M=2.58). This standard represents the outcomes of the teachers' teaching and learning arrangement. It is the standard that is influenced by many variables such as the differences among the students' background or basic knowledge in mathematics, the different levels of existing mathematical process skills, the characteristics and opinions of the students toward the teaching and learning mathematics, the techniques or methods used for arranging the activities of each of the teachers, the teachers' amount of responsibilities, and the available time to arrange the teaching and learning activities. The results of collection of opinions

among the target group teachers have identified the problems and obstacles in this stage of development. These results are consistent with the research findings of Somwong Plangprasopchok et.al. (2003 : Online) who studied the problems on teaching and learning mathematics from the mathematics teachers in the Northeast Region who attended the training on the mathematics project at Maha Sarakham University between 23 and 24 October 2003. The main problems in teaching and learning of mathematics among these mathematics teachers arise from the students' poor background on mathematics. The students do not like to think or avoid independent exercises by themselves. Furthermore the learning contents are too much without sufficient number of teachers for mathematics provided. Heavy teaching burdens for the teachers and little time to prepare the teaching and activities add these problems. Besides, the development of mathematical process skills of the students require many basic pre-requisite skills especially on the basic of thinking as suggested by the Office of Mathematics and Computer of the Institute for the Promotion of Teaching Science and Technology (2004: 17), which stated that the teachers should start this development on the five mathematical process skills. The students should acquire the development on necessary thinking skills such as analytical thinking, synthesizing thinking, reflective thinking, and critical thinking because these are the important basic thinking of the process skills for the students. Consideration on the average score of the teachers in this standard (Standard 5) shows that the score is very close to "good" level (M=2.75). The evaluation of the indicators under the standard shows that the indicator with the lowest score is the Indicator 5.5 (abilities to develop the process skills in creative thinking of the students, M=2.25). The development of creative thinking is related to the characteristics of the students, i.e., self-confidence, enthusiasm and assertiveness, and requires multiplicity of development attempts. Torrance (1963 cited in Aree Panmanee, 2002: 16) found that the learning methods of the persons who have creative thinking are characterized by their predilection to learn through questioning, discussion, and implementation to seek for truth or answers by themselves.

The results of comparison between the levels of development of instructional competency after the model development and the planned targets show the

achievement of the planned targets. The identification of the targets is undertaken from the participation of the target group teachers who are the practitioners who know the real conditions, limitations, and the feasibilities of the model development to create achievable targets. It is the identification of the targets that create the motivation for the practitioners to keep trials, attempts, and have moral support to achieve success according to the targets. This phenomenon is similar with the learning principle of Marquardt (2006 : 80) who states that the learning of a team would proceed fully if the team gets incentives or reinforcements for their participation, and the learning-by-doing methods is one of the most efficient methods of the learning of a team. However the results of the evaluation show that in some of the indicators in Standard 2 (before the development and trial of the model) and Standard 5 (after the development and trial of the model), some of the target group teachers have achieved the evaluation results standing in "moderate" level. Standard 2 (arrange the teaching and learning arrangement that promotes the students' mathematical process skills) is the standard about the implementation techniques through which the target group teachers must select the process techniques responsive to the learning factors and the environment. Some of the teachers show apparent lack of the skills and experiences in this topic that they should be developed further. Since Standard 5 (develop the students' mathematical process skills) is the standard on productivity, the standards on the students' mathematical process skills in each area is the main variable that produces different evaluation results for this standard. Among the target group teachers who have the evaluation results in "moderate" level for this Standard 5, most have shown the level of score for their competency to build students' mathematical process skills (before the model development and trial) as in "need improvement" level. Nevertheless the techniques on teaching and learning arrangement of the teachers according to the Standard 2 and its indicators play important roles in developing the instructional competency according to Standard 5 as well.

3. The study on the opinions or opinions of the target group teachers toward the created development model shows that the created model for the developing the instructional competency is appropriate.

The target group teachers report about gains of many benefits. All the target group teachers agree that exchanging the learning with peers can stimulate their self-development to study deeper about the principles, concepts, teaching techniques and the extra activities to create the students' mathematical process skills. The researcher arranges the activity for the target group teachers to exchange their learning every month. However the exchange of learning in the earlier period of this research was not successful because most of the target group teachers preferred to be listeners when the researcher or other teachers spoke. These teachers dare not speak or show opinion or exchange learning. Only after the researcher creates familiarity among the target group teachers by creating informal climate (such as using the house of the researcher as the meeting place, launching discussion about many other things outside the academic talks, and stimulating all the target group teachers to show opinion) that each of the teachers openly exchanges knowledge to one another. These attempts produce the target achievements in the meetings to exchange the learning and the benefits among the target group teachers. The roles of the researcher in the exchange of learning in the earlier period are very important because the researcher will be the one who ignites the thoughts and facilitates the learning and many other skills. This is similar to Vicharn Panich's assertion (2005: 12-13) that "Khun Amnuay" (facilitator) in the knowledge management should have the skills to ignite the thoughts, create enthusiasm, act as the trainer in the process of exchange of the learning or knowledge, know and able to access learning sources, have skills to create friendly climate or atmosphere, determined to success, have admirable qualities, ready to share, have directions to achieve targets, and build skills in learning and exchange the learning in many forms.

After bringing the knowledge and experience from the model development in the development of teaching and learning plan, all the teachers agree that the development of plan for learning activities arrangement must be done consistently with the learning contents. For example, the activities arrangement that emphasize on the questioning or training from actual practicing, training to think for multiple answers, recording the sessions after the teaching must be consistently compared to the planned results according to the learning objectives. Also necessary is the record

of problems and obstacles faced during the activity arrangement and suggestions to apply in the further teaching. The classroom-based research and plan production for the learning in further learning activities are important in development of curriculum. Before the development of the model, only two out of eight target group teachers give importance on the students' mathematical process skills. Therefore their teaching plans and activity arrangements are focused on trying to mainly understand the learning contents. When the researcher holds the meeting to identify the understanding with the target group teachers before the development of the model, the target group teachers also develop the teaching plans, develop the teaching and learning activities, prepare the evaluation forms and the recording methods for after-teaching sessions, and then bring the results of each teaching lesson to discuss and exchange with the other teachers continuously. As the result everyone has shown clear positive changes on these aspects, which is consistent with the "very good" results of evaluation after the model development and trial as shown in Standard 1 (designing and planning the teaching and learning arrangement to promote students' mathematical process skills) and Standard 3 (measure and evaluate the mathematical process skills along with the learning contents).

The main problem and obstacle in participating in the process of model development is the students' slow learning because of their unfamiliarity with the learning that emphasizes on the students' mathematical process skills. Besides, their background in mathematical process skills is very low and their levels of abilities are showing a high level of difference. The implementation thus achieves its targets slower than the previous expectation. The Office of Mathematics and Computer under the Institute for the Promotion of Teaching Science and Technology (2004: 5) suggested that if educators wanted to develop students to have the knowledge, the mathematical process skills, and the desired characters at the same time, the mathematics teachers should consider the learning contents' feasibility to the available time for learning. There should be reduction of unnecessary parts in the learning to allow sufficient time for the more essential learning subjects. The limitation of time for the target group teachers to join the activities appears because they have many other duties(Somwong Plangprasopchok et al.,2003 : Online).

Nevertheless the researcher tries to solve the problems by using the technology for communication such as emails and mobile phones although these methods can not fully replace the learning exchange through face-to-face group discussion.

Suggestions

The results of this research produce the following suggestions.

1. Suggestions for the application of the results of this research:

1.1 Having created a model to develop the instructional competency that promotes the mathematical process skills, the researcher implements it by following the four steps, which are developing the conceptual framework of the model development, designing its development, implementing the use of the model for development, and evaluating and improving the model. It can lead to the process to create the model for development to use in creating the model of development on other issues or subjects appropriately.

1.2 In applying the model for developing the instructional competency that promotes mathematical process skills to use in developing the teachers there should be the study on the principles, concepts, and the development process of each of the implementation cycles. The implementation follows such process continuously to move it in cycles that connect to others.

1.3 The development processes of the standards, indicators, and evaluation criteria for the instructional competency can be applied appropriately. The practitioners, however, still require the analyses on the current conditions or problems, readiness factors, the background of knowledge and the experience of the teachers, students potentials, including studying the target or the needs of the curriculum before the application, and most importantly the teachers should participate in identifying the steps of development process, settle the standards, indicators and evaluation criteria.

1.4 There should be decent preparation for the teachers and students before the model development. Especially needed is the training on necessary skills such as training to use ICT Media to facilitate communication and exchange of the learning. Faster and convenient communication and exchange of learning would

reduce the communication problems because the teachers already suffered multiple teaching burdens to be able to discuss and meet each other in face-to- face discussions, the training on using questions and answers (open-ended questions), and create shared learning media to be used in the implementation together.

1.5 The friendly climate of trusting and accepting each other among the teachers who participate in the model development activities should also be created. There should be the relaxed and friendly climate to enable open exchanging and sharing of the learning effectively.

1.6 In developing the students' mathematical process skills the teachers should divide the students into groups according to their abilities in each aspect to increase the efficiency of arranging the teaching and learning activities to achieve the targets within the identified timeline.

1.7 There should be a check and review on the development continuously and regularly. The time for checking and reviewing for each learning topic should be identified clearly. There should be the record of results after the checking and reviewing every time and the utilization of the results from the record to use in exchanging the learning and as a database for continual checking the progress of the model development.

1.8 The development proceeding of this model may consume a lot of time in development especially in creating the relaxed learning climate among the teachers. This requires the learning facilitators who can be patient, determined, having appropriate skills and character in combining the learning results to bring success to the development of this model.

1.9 The researcher should try the created development model to develop the teachers' instructional competency in teaching mathematics. This implementation should be done among the target group teachers continuously to study the efficiency and competency of the model in longer term.

2. Suggestions for further research

2.1 There should be a study about the necessary levels of instructional competency for the mathematics teachers or other subjects in order to be use as the database to promote development of the teachers to have decent knowledge and abilities in developing the quality of the students.

2.2 There should be a study on creating a model for developing the instructional competency on others aspects of mathematics subjects or other subjects which are related to the necessary competency in developing the teaching and learning in the topics. This kind of study may be useful to increase the efficiency and competency in the teaching and learning arrangement for subjects with each own unique characteristics.

2.3 Researchers should apply the principles and concepts about knowledge management and/or action research to use in the processes of research on developing the teaching of mathematics and other subjects in order to create a learning community or learning organization.

2.4 Researchers should bring the principles and concepts of the knowledge management and/or the action research to use in the research process to develop the learning of mathematics or other subjects that the students can learn together and become the systematic developers of the learning.

2.5 There should be a study on creation of the network of knowledge management practitioners on developing the teaching and learning of mathematics or other subjects to enhance the cooperation in developing the teaching and learning of personnel inside and outside of the organization.

2.6 There should be a study on using media, situation, and questions related to daily life to develop the learning achievement and the students' mathematical process skills.

2.7 There should be a research on techniques or methods of teaching and learning arrangement that promotes the students' development on both the learning contents and mathematical process skills side by side.

2.8 There should be a study on the efficiency of learning mathematics as the result from the development of students' mathematical process skills on both the learning and its useful application for daily life.

2.9 There should be a further research on the trial of the model to be used in developing the teachers in the whole school (sample) by emphasizing on encouragement for the school administrators to be responsible as knowledge management directors.