CHAPTER 4
RESULTS OF DATA ANALYSES

This research implementation is entitled "Construction of a Model for Developing Instructional Competency Promoting Prathom Suksa 6 Students' Mathematical Process Skills through Knowledge Management and Action Research." The researcher presents the research findings into three main parts as the followings.

Part one is about the results of creating the model for Developing Instructional Competency Promoting Prathom Suksa 6 Students' Mathematical Process Skills through Knowledge Management and Action Research.

Part two reveals the results of studying the teachers' levels of instructional competency that promotes the mathematical process skills of Prathom Suksa students through Knowledge Management and Action Research.

Part three is about the results of study of target group teachers' opinions toward the model for developing the instructional competency that promotes the mathematical process skills of Prathom Suksa students through Knowledge Management and Action Research.

Part One: The Results of Creating a Model for Developing Instructional Competency Promoting Prathom Suksa 6 Students' Mathematical Process Skills through Knowledge Management and Action Research.

This part, the results of creating a model for developing instructional competency promoting Prathom Suksa 6 students' mathematical process skills through knowledge management and action research. To get a model for development is composed of development steps four implementation steps as the followings. (1) Identify the target of success of the model development of the Instructional Competency Promoting Mathematical Process Skills (2) Check of the Instructional Competency Promoting Mathematical Process Skills before the model development (3) Develop the Instructional Competency Promoting Mathematical Process Skills (4)

Evaluate and Reflect the results of development of the Instructional Competency Promoting Mathematical Process Skills (shown in Figure 15).

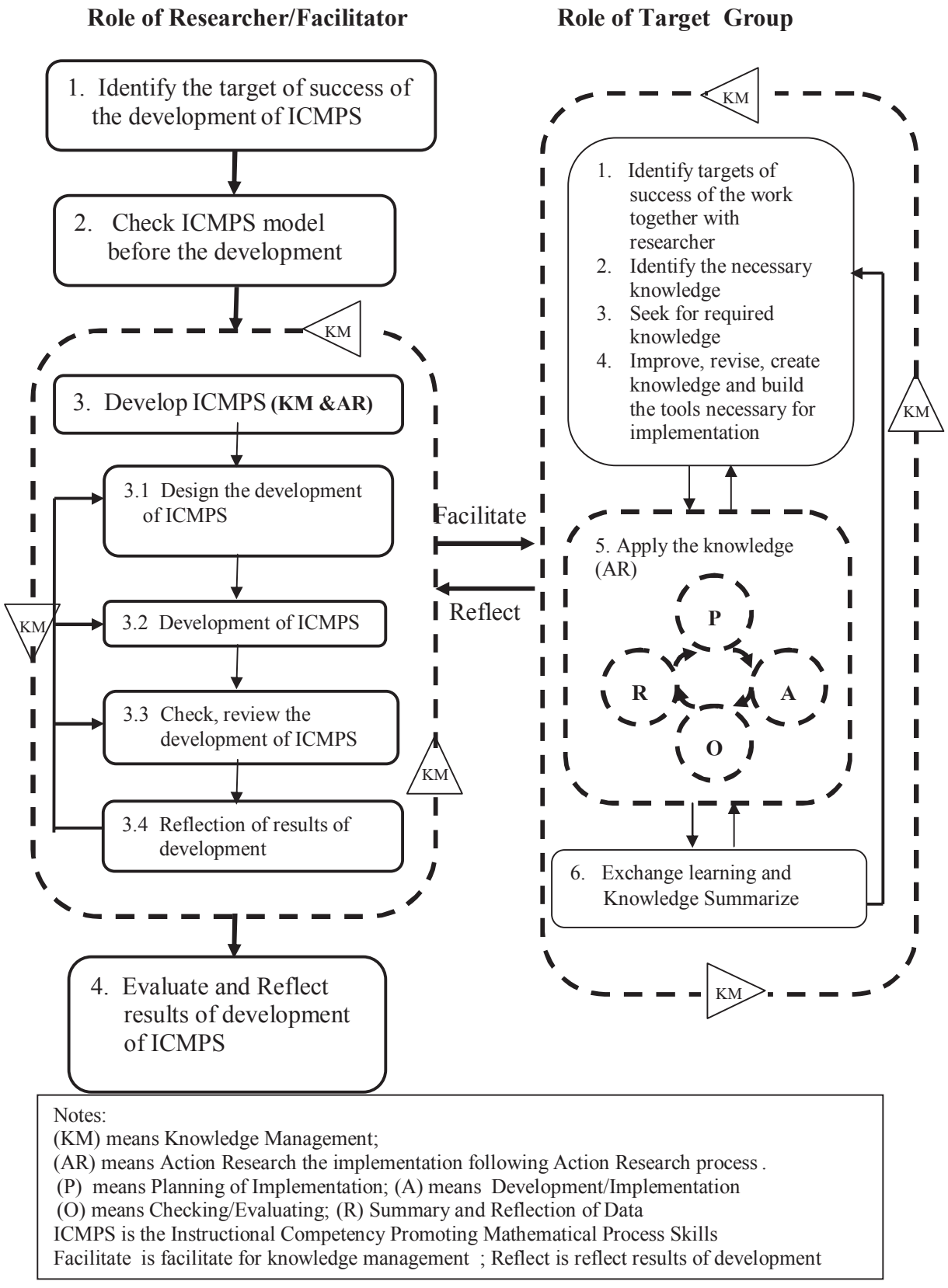

Figure 15 The Model for Developing Instructional Competency Promoting Mathematical Process Skills

The model for developing instructional competency promoting Prathom Suksa 6 students' mathematical process skills through knowledge management and action research (Shown in Figure 15) is identified further into four steps as the followings.

Step 1: The step to identify the target of success in the development of the instructional competency promoting the mathematical process skills. This step is active participation of the target group teachers and researcher according to the conditions of the targets of the implementation who willingly offer cooperation in the implementation that it may develop according to the targets' best interests.

Step 2: The step to check the existing levels of instructional competency promoting mathematical process skills before the development. This step is assign means and tools used for evaluation, creates and seeks for quality of the tools, and check the instructional competency that identify the target in Step 1 and the actual results according to used as the database for design and development in the next steps of the model development.

Step 3: The step to develop the teachers' instruction competency promoting mathematical process skills. This step classified into four steps and uses the concept of action research process as the followings.

Step 3.1: The step to design the instructional competency that promotes the mathematical process skills. This step utilize the results of analysis in Step 2 for design the development with the principles and concepts of knowledge management which is composed of identify targets of success of the work, identify the necessary knowledge, seek for required knowledge, Improve, revise, create knowledge and build the tools necessary for implementation, apply the knowledge, exchange learning and knowledge summarize and identifying the activities of development into three activities as the followings.

The first activity is a series of meetings to prepare the implementation plan in which the target group teachers consult or exchange knowledge and experience together and identify the direction or guidelines of developing the implementation of the group.

The second activity is a set of the activities to implement the planned development by the target group teachers or bringing the implementation guidelines from the plan to application in reality.

The third activity is a set of meetings to exchange the learning results as the knowledge and experience gathered from the implementation to consult or share among the teachers to create self-knowledge on their own to apply in further teaching.

Step 3.2: The step for the development of the instructional competency that promotes mathematical process skills. This step is implements the activities of development designed in Step 3.1.

Step 3.3: The step to check and review the development of the instructional competency that promotes the mathematical process skills. Here the researcher collects the data from the evaluation that design in Step 3.1. The checking or reviewing during the development is done to bring the derived data to improve the development of the process, the methods to increase its appropriateness to the situation and the readiness of the implementation among the target group teachers.

Step 3.4: The step to reflect the results of the development and to review the results acquired from the checking and reviewing in Step 3.3 to contemplate and reflect the results of the development to improve or development the process implementation, step and methods or instructional competency.

The implementation in the Step 3 is the implementation that requires action research process and knowledge management, which appear as a dynamic cycle in form of self-regulating spiraling steps with the aims to improve or develop the implementation by the researcher to achieve the set targets. This step will relate to the implementation by the target group teachers through the researcher's working as the knowledge management director that the target group teachers can implement the plan through knowledge management. The knowledge management is implemented accordingly to the steps in the identified model, which are (1) identifying the feasible targets of success, (2) identifying the main necessary knowledge for the development, (3) seeking for knowledge and exchanging of the learning with relevant people, (4) improving, adjusting, and creating of knowledge, (5) bringing the derived knowledge to develop the instructional competency, (6) recording of the knowledge, and (7) bringing the knowledge to exchange with others as part of the shared learning.

Step 4 is the step on the evaluation and reflection of the results of the development of the instruction competency promoting mathematical process skills. This evaluation step is done to check or evaluate and reflect the results after the development by comparing the progress of the development with the set targets as well as to summarize these results to use as the database for further development.

Part 2: The Results of Studying Instructional Competency that Promotes Mathematical Process Skills of Prathom Suksa 6 Students through Knowledge Management and Action Research.

The researcher analyzes the summary of data in each indicator in Standard 1 to Standard 5 from the evaluation of the teachers' instructional competency through the classroom visits and the tape recorded teaching sessions of the classroom as well as the interviews with the target group teachers and the scrutiny of related documents. For the Standard 5 to analyze and summarize the results of the evaluative tests for the students and show of the results of analysis in 3 sector as the followings.

1. Summary of the results of analyzes by Comparison of the Results of the Evaluation Before and After the Model Development (Shown in Table 3).
2. The Instructional Competency Promoting Mathematical Process Skills of Target Group Teachers after the Model Development/Trial classified in quality levels (Shown in Table 4).
3. Summary of the Suggestions Target Group in Developing Instructional Competency that Promotes Mathematical Process Skills of Researcher in Supervisor and Knowledge Facilitator During the Model Development.

Table 3 Comparison of the Results of Development of Instructional Competency that Promotes Mathematical Process Skills Before and After the Model Development, the Identification of Targets, and the Model Trial

Standards/Indicators	**Before Model Development**		**After Model Development**		**The Results of Development according to Targets**
	Mean and Standard Deviation	Quality Level	Mean and Standard Deviation	Quality Level	
Standard 1 Designing and planning the teaching and learning arrangement to promote students' mathematical process skills	**1.13** **(0.35)**	**Need Improvement**	**3.69** **(0.56)**	**Very Good**	**Targets Achieved**
Indicator 1.1 Check the students' mathematical process skills before designing the teaching and learning arrangement	1.00 (0)	Need Improvement	3.38 (0.61)	Good	Targets Achieved
Indicator 1.2 Plan the teaching and learning arrangement that promotes students' mathematical process skills	1.25 (0.50)	Need Improvement	4.00 (0)	Very Good	Targets Achieved
Standard 2 Arrange the teaching and learning arrangement that promotes the students' mathematical process skills	**1.77** **(0.78)**	**Moderate**	**3.06** **(0.78)**	Good	**Targets Achieved**
Indicator 2.1 Arrange the activities that promote abilities to solve mathematical problems	1.88 (0.61)	Moderate	2.88 (0.79)	Good	Targets Achieved
Indicator 2.2 Arrange the activities that promote abilities to think logically along with solving mathematical problems	1.38 (0.61)	Need Improvement	3.00 (0.87)	Good	Targets Achieved

Table 3 (Continued)

Standards/Indicators	Before Model Development		After Model Development		The Results of Development according to Targets
	Mean and Standard Deviation	Quality Level	Mean and Standard Deviation	Quality Level	
Indicator 2.3 Arrange the activities that promote abilities to communicate with mathematical symbols or communications	2.63 (1.00)	Moderate	3.75 (0.50)	Very Good	Targets Achieved
Indicator 2.4 Arrange the activities that promote abilities to make linkage with mathematical knowledge	2.13 (0.79)	Moderate	2.88 (0.61)	Good	Targets Achieved
Indicator 2.5 Arrange the activities that promote abilities to think creatively on mathematical problems	1.25 (0.50)	Need Improvement	3.00 (0.71)	Good	Targets Achieved
Indicator 2.6 Use media or learning sources that promote mathematical process skills	1.38 (0.61)	Need Improvement	2.88 (0.79)	Good	Targets Achieved
Standard 3 Measure and evaluate the mathematical process skills along with the learning contents	**1.00 (0)**	**Need Improvement**	**3.81 (0.35)**	**Very Good**	**Targets Achieved**
Indicator 3.1 Measure the students on the knowledge and mathematical process skills continuously and periodically	1.00 (0)	Need Improvement	3.63 (0.35)	Very Good	Targets Achieved
Indicator 3.2 Use the methods of measurement and evaluation to reflect the students' knowledge and mathematical process skills in several methods	1.00 (0)	Need Improvement	4.00 (0)	Very Good	Targets Achieved

Table 3 (Continued)

Standards/Indicators	Before Model Development		After Model Development		The Results of Development according to Targets
	Mean and Standard Deviation	Quality Level	Mean and Standard Deviation	Quality Level	
Standard 4 Analyze the process of teaching and learning results and bring them to promote the development of mathematical process skills efficiently	**1.00** **(0)**	**Need Improvement**	**3.44** **(0.66)**	Good	**Targets Achieved**
Indicator 4.1 Analyze the process result of teaching and learning arrangement that promotes students mathematical process skills	1.00 (0)	Need Improvement	3.50 (0.71)	**Very Good**	Targets Achieved
Indicator 4.2 Bring the data from the analysis of Indicator 4.1 to solve the problems or develop students' mathematical process skills	1.00 (0)	Need Improvement	3.38 (0.61)	Good	Targets Achieved
Standard 5 Development of students' mathematical process skills	**1.33** **(0)**	**Need Improvement**	**2.58** **0.76)**	**Moderate**	**Targets Achieved**
Indicator 5.1 Abilities to develop the mathematical process skills in solving problems of the students	1.50 (0.12)	Need Improvement	2.88 (0.61)	Good	Targets Achieved
Indicator 5.2 Abilities to develop process skills in reasoning of the students	1.13 (0.35)	Need Improvement	2.63 (0.61)	**Moderate**	Targets Achieved
Indicator 5.3 Abilities to develop the process skills in communication, interpret mathematical meaning and presentation of the students	1.25 (0.87)	Need Improvement	2.63 (0.79)	Moderate	Targets Achieved

Table 3 (Continued)

Standards/Indicators	Before Model Development		After Model Development		The Results of Development according to Targets
	Mean and Standard Deviation	Quality Level	Mean and Standard Deviation	Quality Level	
Indicator 5.4 Abilities to develop process skills in making linkage of the students	1.63 (1.06)	Need Improvement	2.50 (0.87)	Moderate	Targets Achieved
Indicator 5.5 Abilities to develop the process skills in creative thinking of the students	1.13 (0.35)	Need Improvement	2.25 (0.50)	Moderate	Targets Achieved
Total Average of All Standards/Indicators	**1.25**	**Need Improvement**	**3.32**	Good	**Targets Achieved**

Table 3 compares the levels of the teachers' instructional competency that promotes the mathematical process skills before and after the development and trial of the created model. The table shows that all evaluated standards and indicators have increased from the pre-model development evaluation to post-model development and trial. Comparing the identified targets of teaching plan and the actual results, the table shows that the actual achievement in term of targets of success in all standards is higher from the planned targets before the model trial with at least one level.

The results of evaluations of target group teachers' instructional competency promoting mathematical process skills after development through the implementation of model classified in quality levels are presented in Table 4.

Table 4 The Instructional Competency Promoting Mathematical Process Skills of Target Group Teachers after the Model Development/Trial The number of teachers was classified in quality levels.

Standards/Indicators	Quality Level				Mean
	Need improvement (person)	**Moderate** (person)	**Good** (person)	**Very good** (person)	
Standard 1 Designing and planning the teaching and learning arrangement to promote students' mathematical process skills					**3.69**
Indicator 1.1 Check the students' mathematical process skills before designing the teaching and learning arrangement	0	0	5	3	3.38
Indicator 1.2 Plan the teaching and learning arrangement that promotes students' mathematical process skills	0	0	0	8	4.00
Standard 2 Arrange the teaching and learning arrangement that promotes the students' mathematical process skills					**3.06**
Indicator 2.1 Arrange the activities that promote abilities to solve mathematical problems	0	3	3	2	2.88
Indicator 2.2 Arrange the activities that promote abilities to think logically along with solving mathematical problems	0	3	2	3	3.00
Indicator 2.3 Arrange the activities that promote abilities to communicate with mathematical symbols or communications	0	0	2	6	3.75
Indicator 2.4 Arrange the activities that promote abilities to make linkage with mathematical knowledge	0	2	5	1	2.88
Indicator 2.5 Arrange the activities that promote abilities to think creatively on mathematical problems	0	2	4	2	3.00

Table 4 (Continued)

Standards/Indicators	Quality Level				Mean
	Need improvement (person)	**Moderate** (person)	**Good** (person)	**Very good** (person)	
Indicator 2.6 Use media or learning sources that promote mathematical process skills	0	3	3	2	2.88
Standard 3 Measure and evaluate the mathematical process skills along with the learning contents					**3.81**
Indicator 3.1 Measure the students on the knowledge and mathematical process skills continuously and periodically	0	0	1	7	3.63
Indicator 3.2 Use the methods of measurement and evaluation to reflect the students' knowledge and mathematical process skills in several methods	0	0	0	8	4.00
Standard 4 Analyze the process of teaching and learning results and bring them to promote the development of mathematical process skills efficiently					**3.48**
Indicator 4.1 Analyze the process result of teaching and learning arrangement that promotes students mathematical process skills	0	0	4	4	3.50
Indicator 4.2 Bring the data from the analysis of Indicator 4.1 to solve the problems or develop students' mathematical process skills	0	0	5	3	3.38
Standard 5 Development of students' mathematical process skills					**2.58**
Indicator 5.1 Abilities to develop the mathematical process skills in solving problems of the students	0	2	5	1	2.88
Indicator 5.2 Abilities to develop process skills in reasoning of the students	0	3	5	0	2.62

Table 4 (Continued)

Standards/Indicators	Quality Level				Mean
	Need improvement (person)	**Moderate** (person)	**Good** (person)	**Very good** (person)	
Indicator 5.3 Abilities to develop the process skills in communication, interpret mathematical meaning and presentation of the students	0	4	3	1	2.62
Indicator 5.4 Abilities to develop process skills in making linkage of the students	0	5	2	1	2.50
Indicator 5.5 Abilities to develop the process skills in creative thinking of the students	0	6	2	0	2.25
Total Average of All Standards/Indicators					**3.32**

Table 4 reveals that although the table 3 showed that the teachers could improve their performance qualities higher in average, it was found that the target group teachers developed the performance differently for example most teachers were evaluated at the excellent level in standard 3, and were at the good level in standard 1 and 4, they at the moderate level in standard 2 and 5. The indicators that the target group teachers were evaluated in moderate level consisted of indicator 2.1 (3 persons), indicator 2.2 (3 persons) Indicator 2.4 (2 persons), indicator 2.5 (2 persons), indicator 2.6 (3 persons), indicator 5.1 (2 persons), Indicator 5.2; Abilities to develop process/skills in reasoning of the students (3 persons), indicator 5.3 (4 persons), indicator 5.4(5 persons), and indicator 5.5 was the indicator that most number of teachers were rated at the moderate level (6 persons).

Summary of the Evaluation Results and Suggestions in Developing Instructional Competency that Promotes Mathematical Process Skills

During the development of the target group teachers' instructional competency that promotes mathematical process skills, the researcher evaluates and suggests in summary as the followings.

1. Preparation

1.1 The objectives of the teaching and learning arrangement in each learning unit should cover the learning behavior of the students on three aspects, which are (1) on the knowledge in the learning contents, (2) on the mathematical process skills, and (3) on the desired characters. However the plan in teaching and learning arrangement may not cover the behaviors on these three aspects. This drawback can be compensated by careful consideration by the practitioners about the appropriateness of time, kinds of activities and the learning contents in each plan.

1.2 The development of the behaviors related to the mathematical process skills should have set the objectives that emphasize the students to create the learning in all aspects, i.e., solving problems, reasoning with mathematical language and symbols, linking the kinds of knowledge, and training creative thinking in every learning unit. The Institute for the Promotion of Teaching Science and Technology (2003a: 85) has suggested the arrangement of mathematical process skill training activities through the learning contents on Number and Operation, Measurement, Geometry and Algebra, Data Analysis, and Probability. In fact these are the learning contents that the students must learn at Prathom Suksa 6 level.

2. The teaching and learning activity arrangement that promotes the mathematical process skills

2.1 The important activities that promote the students' mathematical process skills should use the learning media in concrete forms or allow the students to learn from the learning sources and to use questions in order to promote mathematical process skills such as the questions "Why" "How", "Why So", "If … so …"

2.2 The teachers should give sufficient time for the students to think properly for answers instead of hurriedly demanding answers or asking other questions. The teachers must stimulate and reinforce the teaching firmly and regularly. Besides, the teachers should give equal chances for all the students.

2.3 The teachers should present the methods to solve the problems encountered from real situation or identify a variety of methods for the students to understand that solving mathematical problems have several methods. This method does not only train the students to use mathematical process skills but also trains them to think with various methods.

2.4 The teachers should train the students to link the mathematical knowledge with other learning and content-areas as well as to use mathematical knowledge to their daily life. This kind of training allows the students to see the importance, benefits, and values of mathematics. It also stimulates the students to learn more about mathematics.

2.5 The activity arrangement that promotes mathematical process skills may take longer time to apply than the arrangement of teaching and learning that emphasize only on the mathematical conceptualization. Therefore the teachers must be patient, open minded, attentive to opinions of the students, and encouraging to every student to learn further on the mathematical process skills.

2.6 The teachers should evaluate their students by using open-ended questions to regularly check, review, and analyze the mathematical process skills of each student. The measurement during the study is the valuable evaluation because it helps promoting the students to achieve the objectives of teaching and learning sessions.

3. Summary and reflection of the results of the teaching and learning:

3.1 The reflection data after each teaching session will be useful for the improvement of the teachers' teaching methods and students' learning development. The reflection data should also reflect the list of necessarily needed data form in all evaluated items. Such data are brought afterward to use in developing the teaching and learning in the next teaching plans.

3.2 The classroom implementation report is the summary of the representative results of the teaching and learning as the whole picture or the whole learning units. This kind of report also uses reflection data to improve the teaching and learning plans in the next learning units.

These suggestion were given through meeting for exchange and learning activities, visits the classroom and advise, consult during implementation to the target

group teacher all the times that they implemented the development of instructional competency model. Results of the suggestion enable them to develop instructional competency to targets achieved. The samples of their products were presented in Appendix F on page 202.

Part 3: The Study Results on the Target Group Teachers' Opinions towards the Development Model on Instructional Competency that Promotes the Mathematical Process Skills of Prathom Suksa 6 Students through Knowledge Management and Action Research.

The researchers analyzes the opinions collected through the questionnaires of the target group teachers about the benefits gained from participating in the process of development of instructional competency, the problems or obstacles occurring in their participation in the process, and the suggestions for improving the development of the instructional competency. The eight target group teachers provide the complete data in all items inquired by the questionnaires. The results of data analysis can be summarized as the followings.

1. Benefits Gained from Participating in the Development Process of Instructional Competency

1.1 On increasing the knowledge and experience of the target group teachers.

1) The teachers understand and perceive the necessity of the mathematical process skills and the classroom-based action research process. Due to the use of various methods by the researcher such as study of the secondary data, lecturing, workshop meetings, exchanging the learning, etc. (The key informants are eight persons).

2) The teachers are able to exchange the learning with one another, to stimulate their own self-development through study of the principles, concepts and new teaching methods, and to promote the mathematical process skills (key informants eight persons).

3) The teachers are able to develop themselves on the communication skills in terms of speaking method, voice tones and question- asking, including the

development in the teaching activities, e.g., leading to lessons, learning activities, summarizing the lessons, and reflecting data from the tape-recorded sessions of their own teaching (three out of eight key informants).

1.2 On utilizing knowledge and experience to develop the teaching and learning plan.

1) The teachers can develop the plan to arrange the learning activities consistently to the learning contents such as the activity arrangement that emphasize the use of questions, learning by doing, training to think for creative answers, etc. Included in this development are recording the post-teaching reflective data to check consistency between the planned and the actual results, analyzing problems and obstacles encountered during the activity arrangement (and suggestions for solutions), utilizing the classroom research, and preparing plans to arrange the learning activity in the next sessions and plans for curriculum development (eight out of eight key informants).

2) The teachers can think creatively for creating games, songs and mimicked situations, as well as preparing exercises, evaluation forms for mathematical process skills development consistently with learning objectives, and implementation steps adhering to the academic principles. The media is appropriately and more frequently used to arrange the learning activity (three out of eight key informants).

3) The teachers can employ the knowledge to create the tools for evaluation purposes that cover the learning behavior in all aspects, especially on the mathematical process skills (6 out of 8 key informants).

4) The teachers begin to perceive the importance of the evaluation before studying and summary of the record after the end of study sessions for certain learning contents (5 out of 8 key informants).

5) The teachers are able to launch self-evaluation in order to find the weaknesses for improvement and revision for more improved arrangement of teaching and learning arrangement (7 out of 8 key informants).

6) The teachers can use the classroom research process to develop learning quality and to solve problems occurring in the teaching process by using the

data from the results of self-evaluation to implement effectively (7 out of 8 key informants).

With such benefits as explained above, the target group teachers agree that they influence their students to acquire better mathematical process skills as a response to the development attempt to increase their abilities or potential of each student. These benefits also induce their students to build positive opinion towards mathematics generally.

2. Problems and Obstacles in Teachers' Participating in the Development Process of the Model

2.1 Students

1) The students learn slowly because they are not familiar with the learning methods emphasizing the development of their mathematical process skills. Besides the mathematics background of the students is rather limited and the variances in the levels of ability among the students are high. As the result, the implementation planned to achieve the targets is slower than the expected time, e.g., in the training for the students to find various answers through open-ended questions requires a lot of time because the students' unfamiliarity with this method (7 out of 8 key informants).

2) From the causes in previous item (1), proper solutions to this drawback or to develop the students into similar levels of knowledge are not available quickly in the classroom or altogether difficult in case of high number of students. This problem offers a challenge for the teachers to think about the methods to solve (2 out of 8 key informants).

2.2 The Target Group Teachers

1) Time constraint suffered by the target group teachers to be able to fully participate in the research-related activities, i.e., teaching assignments, school's duties, limits them to write properly the summary of post-class report, to practice certain activities, etc (8 out of 8 key informants).

2) Positive assertiveness in the teachers' action, especially at the early period of activity to exchange the learning with their peers, is lacking because

they are not familiar and acquainted with one another well enough to speak and show their opinions openly (4 out of 8 key informants).

3. Suggestions for the Steps and Processes according to the Model for Developing the Instructional Competency

1) There should be some activities to arrange the teaching and learning media that promote the students' mathematical process skills continuously and arrange the activities to develop the teachers on the technology continuously for them to apply it in producing learning media (5 out of 8 key informants).

2) The target group teacher should be exchanging and learning before arrangement teaching plan because each of the teachers has different teaching experience and faces different problems in teaching and learning arrangement. Therefore the exchanging of learning before the arrangement of the teaching will help having ideas to solve the problems and preparing more various teaching and learning methods (2 out of 8 key informants).

3) In the implementation of the developed model to increase the instructional competency, especially in the step of training on mathematical process skills, the students should be divided into groups based on their respective potentials to smoothen the process of learning for the students with natural differences in abilities and potentials. The students who still show weaknesses in learning mathematics will inevitably work and learn in slower rates than their faster peers. If not addressed properly, this natural discrepancy in student's potentials would affect the learning in other content-areas (1 out of 8 key informants).

4) The practitioners should have developed the development techniques for mathematical process skills that have linkages to the subjects related to local knowledge (1 out of 8 key informants).