

CHAPTER 4

Research Results

The aims of the research study entitled “A Model of Developing Mentor Teachers’ Competencies to Enhance Mathematics Learning Provision in the 21st Century” were (1) to study the present condition of mathematics learning and supervision of mentor teachers and their needs with regard to developing their classroom performance in the 21st century, (2) to develop a model of developing mentor teachers’ performance and competencies to enhance mathematics learning in the 21st century (3) to study the results of using the developed model of developing mentor teachers’ performance and competencies to enhance mathematics learning in the 21st century. This research was presented in 4 steps according to the research timing as follows:

Part 1 The present condition of mathematics learning and mentor teachers’ needs for competencies development promoting mathematics learning and teaching management in the 21st century

Part 2 The result of the model of developing mentor teachers’ performance and competencies to enhance mathematics learning in the 21st century

Part 3 The result of attempting to use the model to enhance mentor teachers’ performances in creating mathematics learning lessons in the 21st century

Part 4 The result of the study of the use of the model that enhances mentor teachers’ performances in creating mathematics learning lessons in the 21st century

4.1 Part 1: The present condition of mathematics learning and mentor teachers' needs for competencies development promoting mathematics learning and teaching management in the 21st century

To study the present condition and needs in this research, the researcher synthesized the document, textbooks and related research papers on learning management competency and supervision in 21st century learning management and explored the conditions and requirements for developing competences in learning management, mathematics, and supervision that promotes the learning of mathematics in the 21st century. The tool used was a questionnaire which was divided into 2 parts as follows:

1. The results of synthesizing texts, textbooks, and related research on developing competencies in learning management in the 21st century

Based on the synthesis of papers and research related to learning management of mathematics in the 21st century, the researcher analyzed and synthesized the relevant research papers and materials on 21st century learning management. Then, the researcher summarized the performance of 21st century mathematics teachers as described by the educators, researchers, and academic professors in the 16 articles about the core competencies of mentors; 7 items on literacy competencies, 11 items about 21st century learning management skills, and 6 articles about attributes and attitudes. This synthesis was analyzed as a table classifying each core competency of mentor teachers and mathematics teachers separated by the details of mathematics management and supervision, which are knowledge competency, skill competency, and characteristics performance. Then, the researcher summarized the key ideas to identify frameworks for mentors to promote mathematics instruction classrooms in the 21st century and also to create the indicators assembled in the questionnaire in order to study the current condition and needs of mentors.

After synthesizing documents, texts, and related research, 16 items in total, the results suggested that there were 3 competencies in learning and supervising which promote the learning of mathematics in the 21st century, which are 19 knowledge competency indicators, 23 skill performance indicators, and 13 characteristics performance indicators as follows;

1.1 Knowledge Performance There were 19 indicators. 11 indicators classified as promoting 21st century learning management in mathematics, and 8 indicators

classified as helping supervising mentor teachers support 21st century mathematics as presented in Table 4.1

Table 4.1 Learning management competency indicators and supervision of knowledge performance

Indicators classified as promoting 21 st century learning management in mathematics	Indicators classified as helping supervising mentor teachers support 21 st century mathematics
1. Knowledge of mathematics content at the level taught	1. Knowledge, concepts, and principles of cooperation between mentor teachers and student-teachers in the following areas:
2. Knowledge of the principles and guiding principles of learning that foster 21 st century skills in the following areas:	1.1. Writing lesson plans that include the 21 st century skills
2.1. Critical Thinking Skills	1.2. Creating mathematics activities related to the 21 st century skills.
2.2. Problem-solving Skills	1.3. Reflection after the use of the lesson plan
2.3. Creativity & Innovation Skills	2. Knowledge about evaluating the student-teachers
2.4. Cross Cultural Understanding Skills	3. Knowledge about evaluating the classroom management of student-teachers
2.5. Collaboration skills	4. Knowledge about constructing a Professional Learning Community (PLC)
2.6. Communication & Technology Skills	5. Knowledge about the 21 st century classroom supervision process
2.7. Career & Learning skills	6. Knowledge about giving suggestions to the student-teacher to manage mathematics learning in the last century.
2.8. Child-centered classroom instruction (Teach Less, Learn More)	
3. Knowledge of assessment of learners' achievements in the 21 st century	
4. Knowledge of environmental learning management for learners' in the 21 st century	

1.2 Skills Performance There were 23 indicators that can be classified as 11 indicators for managing a mathematics classroom in the 21st century and 12 indicators for the supervision of student-teachers in the 21st century, as shown in table 4.2.

Table 4.2 Learning management competency indicators and supervision of skills performance

Indicators classified as promoting 21st century learning management in mathematics	Indicators classified as helping supervising mentor teachers support 21st century mathematics
1. Ability in planning lessons that encourage learners to acquire 21 st century learning skills	1. Collaboration with university professors in supervising the student-teacher
2. Ability in creating mathematics lessons that encourage learners to acquire 21 st century learning skills in the following areas:	2. Collaboration with student-teachers in the following areas:
2.1. Critical Thinking Skills	2.1. Writing a lesson plan for teaching mathematics based on 21 st century learning classroom management
2.2. Problem-solving Skills	2.2. Creating a classroom based on learning mathematics in the 21 st century
2.3. Creativity & Innovation Skills	2.3. Assessing learners' learning based on 21 st century mathematics learning management
2.4. Collaboration Skills	2.4. Creating or producing modern instructional teaching materials in the 21 st century with mentor teachers
2.5. Communication & Technology Skills	2.5. Applying technology to the class.
2.6. Career & Learning Skills	3. Friendly supervision process as follows:
2.7. Cross Cultural Understanding Skills	3.1. Building faith to gain acceptance
2.8. Facilitating Learning (Teach Less, Learn More)	3.2. Motivating learners
Evaluating student performance	3.3. Making them feel confident in using their knowledge
Ability in authentic assessment	3.4. Working and brainstorming ideas together
	3.5. Giving meaningful and beneficial feedback
	3.6. Allowing student-teachers to develop their best abilities

1.3 Characteristics performance There were 13 indicators that can be classified as 8 indicators for 21st century mathematics learning management and 5 indicators for the supervision of student-teachers, as shown in table 4.3.

Table 4.3 The indicators of learning management and supervision of characteristic performances

Indicators classified as promoting 21st century learning management in mathematics	Indicators classified as helping supervising mentor teachers support 21st century mathematics
1. Can make students have a positive attitude and realize the value of mathematics	1. The teachers have the willingness, pride, and happiness of being a mentor
2. Believes in the importance of mathematics for every career	2. The teachers are proud to be a role model for students to practice professional experience as a student-teacher
3. Strives for the development of learning management so that learners can complete the content according to the learning management plan	3. The teachers are determined and optimistic about developing a student-teacher
4. Has good relationships with students before leading to the content	4. The teachers believe that supervision is one of the tools that can improve the classroom instructional ability of student-teachers
5. Has a cheerful and friendly manner while teaching mathematics in the classroom	5. Teachers have confidence in creating a mathematics classroom in the 21 st century
6. Has the patience to wait and let the students figure out ways to find answers by themselves	
7. Believes that learners can develop their math skills for 21 st century learning	
8. Believes that 21 st century learning skills are essential to learning math	

2. The results of the study of the mathematical instruction management and supervision of the needs of student-teachers for enhancing their performance as a teacher in the 21st century

In this research, the researcher collected data from questionnaires and interviews. The results were as follows:

2.1 The needs for self-development of mentor teachers

2.2 The situation of mathematics learning management and the needs for teacher competency development that promotes the learning of mathematics in the 21st century.

2.3 The situation of supervision and the need to develop mentor teachers' competencies that promotes learning in the 21st century.

2.1 Mentor teachers' self-development needs

The researcher asked the mentors to comment about their self-development needs in various aspects and the model of mentor teachers' development, including timing and monitoring as presented in table 4.4.

Table 4.4 The percentage of mentors' comments about their self-development needs areas

Areas of development	Total number	Percentage
1. Development in learning management competency that promotes the learning of mathematics in the 21 st century	207	96.7
2. The development of trainee teachers' teaching performance in promoting learning in the 21 st century	212	99.1
3. The need for cooperation between the supervision adviser from university and the mentor teachers from the schools that develop teachers' teaching experiences	213	99.5
4. Development of mentor teachers' teaching performances in promoting learning mathematics in the 21 st century	213	99.5
5. What should be the proper form of development?		
5.1) Curriculum about qualified mentor teachers should be available.	140	65.4
5.2) Mentor teachers should be developed during the time that the students are practicing or training to be teachers.	144	67.3

Table 4.4 (Continued)

Areas of development	Total number	Percentage
6. What is the proper duration of training the mentor teachers?		
6.1) Once a semester before sending the student-teachers	174	81.3
6.2) Once a month during the time that the student-teachers are practicing teaching experience and training	18	8.4
7. How many times should there be a follow-up?		
7.1) Once a semester	75	35.5
7.2) Twice a semester	98	45.8
7.3) Three times a semester	20	9.3
7.4) Four times a semester	3	5.6

From the table, we found that most teachers have a need for cooperation between supervisors and mentors in the development of the teachers' professional experience. Also, it is evident that the development of mentor teachers' performances to promote the learning of mathematics in the 21st century is the most important to teacher professional development which was 99.5%. About 63.7% of teachers agree to develop the mentor teachers while the student-teachers were practicing and experiencing their teacher's profession skills. The appropriate time of training should be once a semester before sending them to be trained, which was suggested by 81.3% of mentors. Finally, the follow-up duration should be twice a semester, which 45.8% agreed with.

2.2 The situation of mathematics learning instruction in the 21st century and the need for developing mentor teachers' competencies that promotes mathematics learning in the 21st Century

This research has been classified into 3 main competencies: knowledge competency, skill competency, and attributes competency by presenting the requirements of mathematics learning management in the 21st century at the present time. The researcher also classified the learning performance into 3 areas; knowledge competency, skill competency, and attributes competency and listed those competencies in table 4.5 to table 4.7.

Table 4.5 Mean and standard deviation of the level of opinion of the mentor teachers based on the knowledge competency.

	Knowledge competency	Present situation			Needs/ requirements		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
1	Knowledge of mathematics content at the level taught	4.09	0.73	high	3.95	1.10	high
2	Knowledge of the principles and guiding principles of learning that foster 21 st century skills in the following areas:						
	2.1 Critical Thinking Skills	3.52	0.72	high	4.18	0.88	high
	2.2 Problem-solving Skills	3.74	0.72	high	4.21	0.93	high
	2.3 Creativity & Innovation Skills	3.40	0.79	average	4.25	0.82	high
	2.4 Cross Cultural Understanding Skills	3.30	0.74	average	4.05	0.86	high
	2.5 Collaboration skills	3.68	0.72	high	4.05	0.98	high
	2.6 Communication & Technology Skills	3.58	0.71	high	4.13	0.88	high
	2.7 Career & Learning skills	3.52	0.75	high	4.06	0.95	high
	2.8 Child-centered classroom instruction (Teach Less, Learn More)	3.54	0.72	high	4.21	0.81	high
3	Knowledge of assessment of learners' achievements in the 21 st century	3.53	0.68	high	4.19	0.81	high
4	Knowledge of environmental learning management for learners' in the 21 st century	3.66	0.68	high	4.07	0.95	high
Total		3.67	0.52	high	4.16	0.83	high

From the table, the learning management status of the mentor teachers was at a high level. ($\bar{x} = 3.67$, $SD = 0.52$) The item with the lowest mean was knowledge of the principles and guiding principles of learning that foster 21st century skills in the cross cultural understanding area. The mean was 3.30, the standard deviation was 0.74. This item was followed by the creativity and innovation area, which was 3.40, and the standard deviation was 0.79. The demand for knowledge competency development was at a high level ($\bar{x} = 4.16$, $SD = 0.83$). The issue with the highest demand was knowledge of the principles and guiding principles of learning that foster 21st century skills in the creativity

and innovation skills area, which had an average of 4.25, and the standard deviation was 0.82. Facilitating learning with the “Teach less, Learn more” policy had a mean score of 4.21, and the standard deviation was 0.81. Problem-solving skills were 4.21 for the mean score, and the standard deviation was 0.93.

The results of interviewing the mentor teachers showed that teachers had little knowledge of mathematics management in the 21st century. One teacher asked, *“How should we teach mathematics in the 21st century? Do we need technology in teaching?”* And another one said, *“Learning mathematics the 21st century requires many types of activities, and we do not need a computer, right?”* The other one asked, *“What are the skills of the 21st century, and how do we teach mathematics in the 21st century?”*

Table 4.6 Mean and standard deviation of mentor’s attitude levels based on competency skill

	Competency Skills	Present situation			Needs/ requirements		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
1.	Ability in planning lessons that encourage learners to acquire 21 st century learning skills	3.59	0.72	high	4.18	0.87	high
2.	Ability in creating mathematics lessons that encourage learners to acquire 21 st century learning skills in the following areas:						
	2.1 Critical Thinking Skills	3.41	0.75	average	4.15	0.85	high
	2.2 Problem-solving Skills	3.60	0.74	high	4.09	0.95	high
	2.3 Creativity & Innovation Skills	3.41	0.75	average	4.16	0.93	high
	2.4 Collaboration Skills	3.59	0.73	high	4.06	0.96	high
	2.5 Communication & Technology Skills	3.40	0.68	average	4.08	0.91	high
	2.6 Career & Learning Skills	3.46	0.78	average	4.07	0.90	high
	2.7 Cross Cultural Understanding Skills	3.31	0.73	average	4.04	0.87	high
	2.8. Facilitating Learning (Teach Less, Learn More)	3.39	0.74	average	4.14	0.93	high
3.	Evaluating student performance	3.52	0.74	high	4.19	0.91	high
4.	Ability in authentic assessment	3.67	0.75	high	4.16	0.95	high
	Total	3.48	0.60	average	4.16	0.76	high

The table showed that the learning achievement of the mentors' competency skills was at an average level ($\bar{x} = 3.48$, $SD = 0.60$). The lowest mean scores were the ability to manage mathematics that encourages learners to acquire learning skills in the 21st century in terms of cross cultural understanding skills. The mean was 3.31 and the standard deviation was 0.73. As for facilitating learning that focuses more on learning than teaching (Teach Less, Learn More), the mean was 3.39 and standard deviation was 0.73, 0.74. The need for professional development was at a high level. ($\bar{x} = 4.16$, $SD = 0.76$). Evaluating student performance skill had the highest mean which was 4.19, and the standard deviation was 0.91. This was followed by the need to improve ability in planning lessons that encourage learners to acquire 21st century learning skills, which had the mean of 4.18, and the standard deviation was 0.87.

The results of interviewing mentors on skill competencies found that most mentors did not learn to focus on problem-solving and finding a variety of ways of thinking. As one teacher said, *"The teacher usually explains the lesson and lets the students do the exercises,"* and *"Teachers organize activities for students to work in groups and present in front of the classroom, but most of them are homework assignments"* and *"Teachers do not use computers, but it is a good idea to visualize the lesson."* Lastly, the teacher thinks that it is impossible to teach students to think since they cannot understand even the basic knowledge. One teacher said, *"No matter how hard I try to explain the lesson to the students, they cannot understand what I have been talking about. There is no way to teach them problem-solving skills."*

Table 4.7 Mean and standard deviation of the mentor teachers' level of achievement with regard to the attributes

	Attributes	Present situation			Needs/requirements		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
1	Can make students have a positive attitude and realize the value of mathematics	3.90	0.73	high	4.04	1.04	high
2	Believes in the importance of mathematics for every career	4.13	0.81	high	4.01	1.11	high

Table 4.7 (Continued)

	Attributes	Present situation			Needs/requirements		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
3	Strives for the development of learning management so that learners can complete the content according to the learning management plan	4.10	0.78	high	4.03	1.10	high
4	Has good relationships with students before leading to the content	3.98	0.76	high	4.00	1.06	high
5	Has a cheerful and friendly manner while teaching mathematics in the classroom	4.10	0.76	high	3.98	1.12	high
6	Has the patience to wait and let the students figure out ways to find answers by themselves	3.94	0.74	high	3.94	1.14	high
7	Believes that learners can develop their math skills for 21 st century learning	3.94	0.74	high	3.99	1.04	high
8	Believes that 21 st century learning skills are essential to learning math	4.02	0.80	high	4.02	1.03	high
Total		4.01	0.67	high	4.00	1.01	high

The results found from the table were (1) The situation of creating learning in the classroom is at high level ($\bar{x} = 4.01$, $SD = 0.67$). The highest mean was 3.90, which referred to the ability to encourage students to have a positive attitude and realize the value of mathematics, and the standard deviation was 0.73. (2) The second-highest ranking was having the patience to wait and let the students figure out ways to find the answer by themselves, which had a 0.94 mean and standard deviation of 0.74. The overall needs with regard to attributes improvement was at a high level. ($\bar{x} = 4.00$, $SD = 1.01$) The highest mean was building a positive attitude towards mathematics; its mean was 4.04 and the standard deviation was 1.04. The second-highest ranking was striving for the development of learning management so that the learner can complete the content according to the learning plan. The mean was 4.03 and the standard deviation was 1.10.

One teacher said, “*The teacher always tries to teach the content clearly and make the students understand; however, if the students are still confused, the content explanation*

needs to be done again and again.” Another one said, “ Teaching mathematics is a very difficult task, since the students always complain that it is a very difficult subject that they don’t want to learn.” Another teacher said, “The objective of the lesson is to finish the lesson according to the set plan. It’s ok if some but not all students understand.”

2.3 The situation of supervision and the need for competency development to master 21st century mathematics lessons

The researcher identified the supervisory competency and the needs for development of mentors’ competency in three competencies: knowledge competency, skills competency, and attribute competency as shown in Tables 4.8 to 4.10.

Table 4.8 Mean and standard deviation of the level of opinion of the mentors based on knowledge competency

	Knowledge competency	Present situation			Needs/ requirements		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
1	Knowledge, concepts, and principles of cooperation between mentor teachers and student-teachers in the following areas: 1.1 Writing lesson plans that include the 21 st century skills 1.2 Creating mathematics activities related to the 21 st century skills. 1.3 Reflection after the use of the lesson plan	3.54	0.72	high	4.13	0.91	high
2	Knowledge about evaluating the student-teachers	3.67	0.70	high	4.11	0.96	high
3	Knowledge about evaluating the classroom management of student-teachers	3.65	0.65	high	4.09	0.92	high
4	Knowledge about constructing a Professional Learning Community (PLC)	3.35	0.72	average	4.12	0.89	high
5	Knowledge about the 21 st century classroom supervision process	3.48	0.70	average	4.17	0.91	high

Table 4.8 (Continued)

	Knowledge competency	Present situation			Needs/ requirements		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
6	Knowledge about giving suggestions to the student-teacher to manage mathematics learning in the last century.	3.49	0.76	average	4.18	0.88	high
Total		3.54	0.61	high	4.14	0.84	high

The tables show that (1) The current teachers had overall knowledge performance at a high level ($\bar{x} = 3.54$, $SD = 0.61$). The lowest mean was knowledge about constructing a Professional Learning Community (PLC), which was 3.35, and standard deviation was 0.72. This was followed by the knowledge of supervision that promotes the learning of mathematics in the 21st century, which had a 3.48 mean score, and the standard deviation was 0.70. (2) Overall needs in professional development was at a high level ($\bar{x} = 4.14$, $SD = 0.84$). The highest mean was about knowledge about counseling that encourages students to learn mathematics in the 21st century with an average of 4.18 and standard deviation of 0.88. The second ranking was the knowledge to supervise or give results from classroom observation of mathematics learning in the 21st century. The mean was 4.17, and the standard deviation was 0.88.

From the interview, most mentor teachers did not have knowledge about supervision or classroom observation that will improve teaching activities in the 21st century. One mentor said, “*Teachers never have an opportunity to write a lesson plan with the mentor teachers; the only job is to evaluate.*” “*It is an interesting issue to have teachers and student-teachers plan lessons together.*” “*The teacher had no idea about teaching in the 21st century, and it would be better if the professors from the university visit. This way the student-teachers will plan their lessons very well with teaching materials that they not have used in class at all.*”

Table 4.9 Mean and standard deviation of the opinion level of the mentoring teacher with regard to skill competency

	Skill competency	Present situation			Needs/ requirement		
		\bar{x}	SD	Interpreta tion	\bar{x}	SD	Interpreta tion
1	Collaboration with university professors in supervising the student-teacher	3.55	0.85	high	4.05	0.97	high
2	Collaboration with student-teachers in the following areas:						
	2.1. Writing a lesson plan for teaching mathematics based on 21 st century learning classroom management	3.60	0.78	high	4.11	0.91	high
	2.2. Creating a classroom based on learning mathematics in the 21 st century	3.57	0.78	high	4.08	0.96	high
	2.3. Assessing learners' learning based on 21 st century mathematics learning management	3.54	0.74	high	4.11	0.91	high
	2.4. Creating or producing modern instructional teaching materials in the 21 st century with mentor teachers	3.38	0.75	average	4.28	0.88	high
	2.5. Applying technology to the class.	3.55	0.75	high	4.26	0.92	high
3	Friendly supervision process as follows:						
	3.1. Building faith to gain acceptance	4.01	0.74	high	4.06	1.10	high
	3.2. Motivating learners	4.00	0.75	high	4.09	1.09	high
	3.3. Making them feel confident in using their knowledge	4.01	0.80	high	4.11	1.13	high
	3.4. Working and brainstorming ideas together	4.04	0.75	high	4.06	1.12	high
	3.5. Giving meaningful and beneficial feedback	3.98	0.83	high	4.07	1.11	high
	3.6. Allowing student-teachers to develop their best abilities	4.19	0.76	high	4.10	1.12	high
Total		3.79	0.64	high	4.13	0.93	high

It was found from the above table that (1) Mentor teachers had a level of overall skill competency at a high level ($\bar{x} = 3.79$, $SD = 0.64$). The lower mean score was in producing modern instructional teaching materials in the 21st century with student-teachers,

which was 3.38, and the standard deviation of 0.75. (2) The demand for skills development was at a high level ($\bar{x} = 4.13$, $SD = 0.93$). The highest mean was with regard to cooperating with students in a professional experience by creating or producing modern instructional teaching materials in the 21st century with a mean of 4.28 and standard deviation of 0.88. Following this was the implementation of technology in mathematics learning management with a mean of 4.26 and a standard deviation of 0.92.

The interview revealed that most of the teachers did not cooperate with faculty advisors from the university to jointly develop students, and there is no collaboration in creating a learning community. Moreover, they had never met to write lesson plans together nor to reflect on the learning outcomes of the class. One of the teachers said, *“The teacher never observed teaching students together with their supervisors nor made a plan with the student-teachers. When the final lesson plan was evaluated, some students submitted a plan that did not match with the real class. Sometimes, the school had a lot of activities, so the student-teachers could not teach all of the content.”* *“Students did not have time to create nor plan for the teaching materials to encourage students to understand more content of the lesson.”*

Table 4.10 The mean and standard deviation of the mentor teacher's level of performance on the attributes

	Attributes competency	Present situation			Needs/ requirement		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
1	The teachers have the willingness, pride, and happiness of being a mentor	4.34	0.73	high	3.91	1.24	high
2	The teachers are proud to be a role model for students to practice professional experience as a student-teacher	4.38	0.72	high	3.93	1.21	high
3	The teachers are determined and optimistic about developing a student-teacher	4.39	0.72	high	3.95	1.25	high

Table 4.10 (Continued)

	Attributes competency	Present situation			Needs/ requirement		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
4	The teachers believe that supervision is one of the tools that can improve the classroom instructional ability of student-teachers	4.36	0.72	high	3.96	1.22	high
5	Teachers have confidence in creating a mathematics classroom in the 21 st century	4.25	0.73	high	3.99	1.20	high
Total		4.34	0.67	high	3.94	1.20	high

The tables show that (1) teachers' overall performance is at a high level ($\bar{x} = 4.34$, $SD = 0.67$). The lower mean scores included being confident in observing the classroom or supervising the student-teachers correctly with regard to developing important competencies in the 21st century. The mean score was 4.25 and the standard deviation was 0.73. The teachers with the willingness, pride, and happiness of being a mentor had an average of 4.34 and the standard deviation was 0.73. The mean score of the teachers who have the willingness, pride, and happiness of being a mentor was 34 and the deviation was 0.73. (2) There was a demand for a high level of development ($\bar{x} = 3.94$, $SD = 1.20$). The highest mean score was 3.99 and the standard deviation was 1.20 for having confidence in the ability to supervise student-teachers appropriately, considering the needs of performance development in the 21st century, followed having the belief that supervision could enhance the classroom management of the student-teachers who practice their profession at school. The mean was 3.96 and the standard deviation was 1.22.

From the interview, most of the teachers were willing to be mentors and be responsible and act as mentors. One teacher answered, *"Teachers are willing to be mentors and teach student-teachers to become professional teachers."* *"Teachers are happy to have student-teachers to help and will take good care of them."* *"A teacher could ask the student-teachers to be involved in every task so as to have practical experience of every subject"*

4.2 Part 2: The Development of a Model of Developing Mentor Teacher's Competencies to Enhance Mathematics Learning Provision in the 21st Century

The results of the development of the model of developing mentor teachers' competencies to enhance mathematics learning provision in the 21st century derived from the synthesis of relevant documents and research and the study of the present situation of mathematics learning, and the needs regarding developing their competencies in mathematics learning management in the 21st century. The researcher gathered information on the development methodology, monitoring and evaluating each step. Also, the researcher formulated the principle, concept, purpose, and development process, roles of responsibility, evaluation, and results. After that, all the mentioned data was sent to an expert to define the effectiveness of the model and trial to evaluate the research suitability. The researcher presented the research results in 3 parts as follows:

Part 2.1 The results of the development of a model of developing mentor teachers' competencies to enhance mathematics learning provision in the 21st century

Part 2.2 The results of the model's effectiveness in promoting mathematics learning in the 21st century

Part 2.1 The results of the development of a model of developing mentor teachers' competencies to enhance mathematics learning provision in the 21st century

In this model development, the researcher developed a model from the synthesis of relevant papers and research, and the results of the study on the present situation in the need for developing mentor competencies that promote mathematics learning in the 21st century. From the above development model, the researcher drafted a model for developing the competency of a mentor who promotes the study of mathematics in the 21st century as follows:

The model for developing the competency of a mentor who promotes the study of mathematics in the 21st century is composed of 5 components which are (1) Principle, (2) Purpose, (3) Process, (4) Evaluation, and (5) Result. There were two procedures. The first step included 1) New Motivation, 2) New Knowledge, and (3) New Skill. Followed by the second process which included (4) Collaboration, (5) Action, and (6) Reflection.

An important feature of the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century was a Professional Learning Community (PLC) with the cooperation of mentor teachers, student-teachers, and supervising professors. This can allow mentor teachers to create their mathematics classrooms that promote learning in the 21st century where students are thinkers and problem solvers, while teachers are facilitators as shown in figure 4.2.

The researcher developed 3 forms of models which were (1) A model of follow-up for mentor teachers to bring the curriculum concept of local curriculum to student-teachers' classroom learning management (Karanphon Wiwanthamongkon, 2010). This model is named, "CPPME." The principles focus on following-up on giving help or suggestions when needed, which includes 5 follow-up steps which are (1) Study the current context or situation (C), (2) Prepare (P), (3) Plan (P), (4) Mentoring (M), (5) Evaluating (E). The process to push was PAR which is composed of Preparing (P), Action (A), and Reflection (R). (2) The model of a tripartite professional teachers building. It consists of universities, schools, and student-teachers. Teachers have an image of a smart person (SMART) S-Skills, M-Management, A-Attitude, R-Resource, and T-Technology. There was also a management strategic plan called, "3 treaties, 4 principles, 3 adjustments, 4 plans." The 3 treaties refer to the cooperation of 3 groups, 4 principles refer to the PLC, equality and diversity, accreditation, and structure resources and principles of roles. The 3 adjustments refer to the adjustment of the leader learning which were on an individual level, team level, and system level. The 4 plans refer to the organizational development plan which includes teachers' development plan, curriculum development plan, learning resources development plan, and information and technology development and basic structure plan. (Daorong Charaam, 2004). (3) A counseling model to promote teaching competency and conducting classroom research. This model was named PPME and is composed of principles and purposes, process components and supportive components. It had 4 phases which were (1) Preparation phase (P), (2) Planning phase (P), (3) Mentoring phase (M). In the monitoring stage, the researcher started with (1) Pre-conference, (2) Observation and Data Gathering, (3) Collaborative Reflection and Analysis, (4) Post-conference. The 4th phase was the Evaluating Phase (E) (Kanittha Chaowattanakul, 2010).

The researcher used the synthesis conclusion of this model to develop a model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century. The details of the model were shown in figure

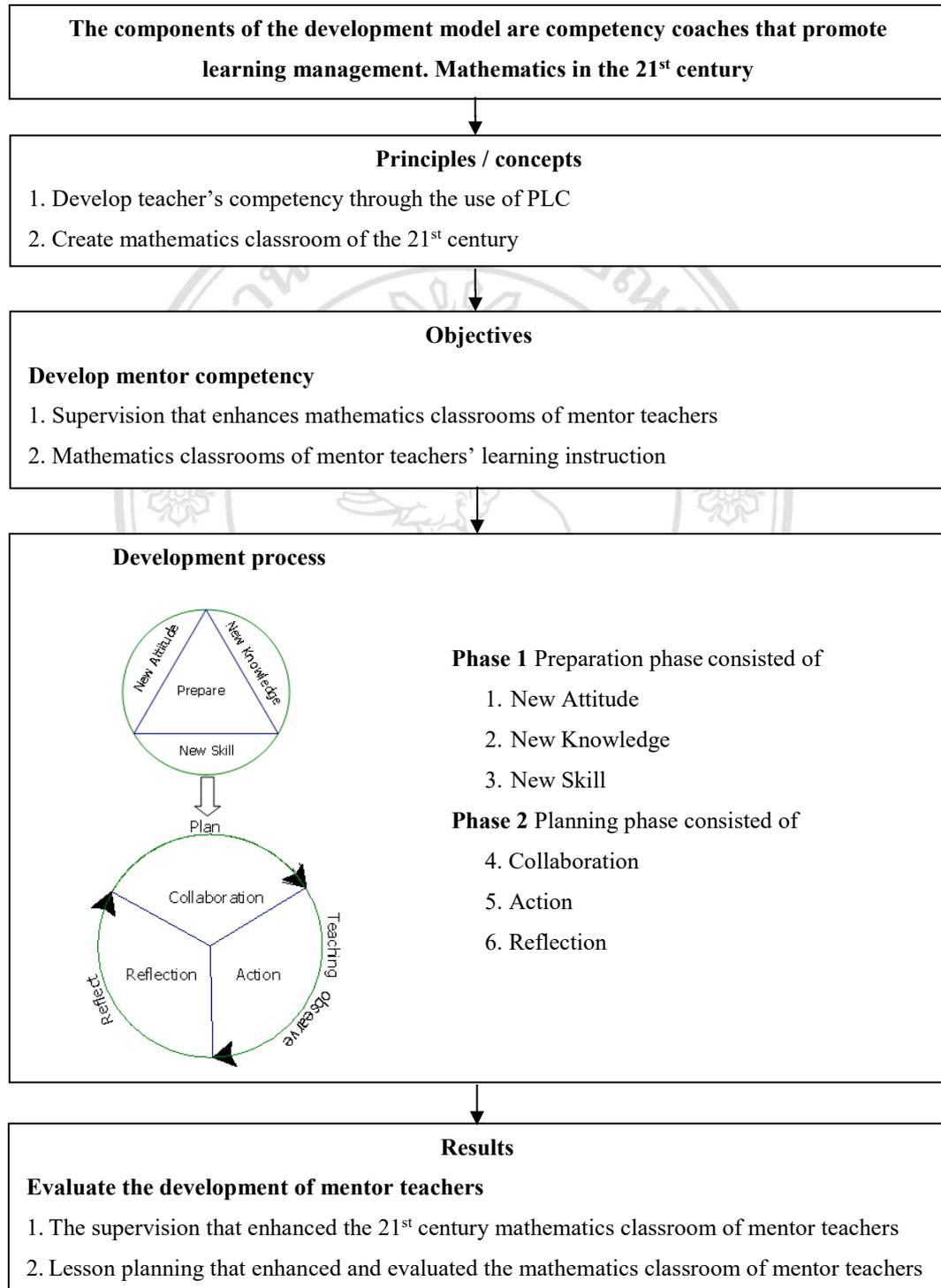


Figure 4.2 Draft

The results of the expert group discussion

After having drafted the format, the researcher presented it to the experts by creating a group discussion to suggest ideas or give feedback about drafting as shown in table 4.11.

Table 4.11 The experts' suggestions and feedback from group discussions

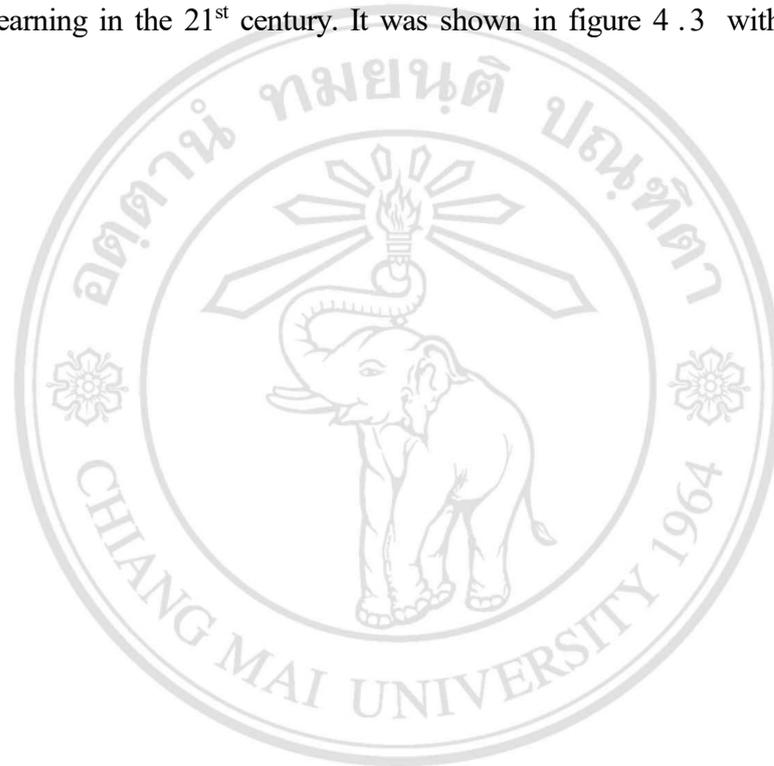
Topics	Suggestions
1. Model components	The overall components were proper just add more details about activities and make them clear.
2. Principles	More references of related paper and researches should be added.
3. Objective	There were 3 components but there was only 1 in content, so the researcher should make them coherent and should have a clear point of to whom the researcher wanted to develop and for what.
4. Development process	The 6 steps are appropriate, but the details of each step should be increased to make the activity clearer. Also, the timing should be adjusted to suit each activity. All activities should clearly state how they would be managed so users can understand the process and the users should be assigned a role to develop, maybe a unit or person who will apply the use of the model. In the first stage, the sequence should be clearly informed. If there was no sequence, then the previous one could be used. However, more details should be clarified.
Phase 1 Preparation	The length of the preparation period was 4 days which was quite long in a participatory workshop that focuses on mentoring and writing, which is written in large numbers. The training should be designed to serve the needs of the trainee in more practical ways. In this case, the researcher could motivate mentors by inviting the expert person to share his/her experiences, watching videos, or visiting the prototype school. In some cases, mentor teachers could have designed their own activities.

Table4.11 (Continued)

Topics	Suggestions
Step 1 New motivation	This step should be in one day, and the content should not be limited to a question and answer format between mentor teachers and the lecturer, because the training given to the wide range of writers may not be writable and will make the participants weary. It should stimulate motivation through an experienced speaker, study from a video, or a visit to the prototype school in order to increase the teachers' eagerness to practice and to help them realize the importance of developing teachers' professional experience.
Step 2 New knowledge	Acknowledging new knowledge is an activity that encourages mentors to participate in discussion mostly by writing a lecture or watching videos, which are included in the same learning technique as writing a lecture. Then, the activity should be adjusted to focus on practical issues, such as giving mentors the opportunity to learn on their own or find solutions to their problems by themselves.
Step 3 New skills	This step should be changed from 2 days to be 1 day, and allow teachers to write a lesson plan for a real classroom. The lesson plan should be adjusted from teachers teaching teachers to be teachers teaching students. Also, all teachers should be allowed to have real experience in real teaching by doing a demo lesson in a real class.
Phase 2 Planning Step 4 Collaboration Step 5 Action Step 6 Reflection	There should be a clear timeline of how the mentor teachers should collaborate with the student-teachers. The student-teachers should know when to be supervised and what they are expected to do within the set time. In short, the duration of each activity should be well defined.
5. Evaluation	Measurement and evaluation should reflect the effects of teacher competency development, covering the three competencies such as knowledge competency. There should be a test of knowledge not only expressing opinion. For skill competency, the evaluation should be from a test of practical practices, and attributes competency should be evaluated from their satisfaction.
6. Result	The result should be presented accordingly to the objective.

From the discussion group of experts, the researcher gathered all suggestions for further improvements in terms of timeline, method of development, details of activities, and valuation methods. From the researcher's previous proposal, there were 15 activities that had been proposed, but after receiving the comments there were only 11 appropriate activities left.

Summarizing the interview with the mentors and group discussions had led to the adjustment of the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century. It was shown in figure 4.3 with the details as follows.



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The model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century

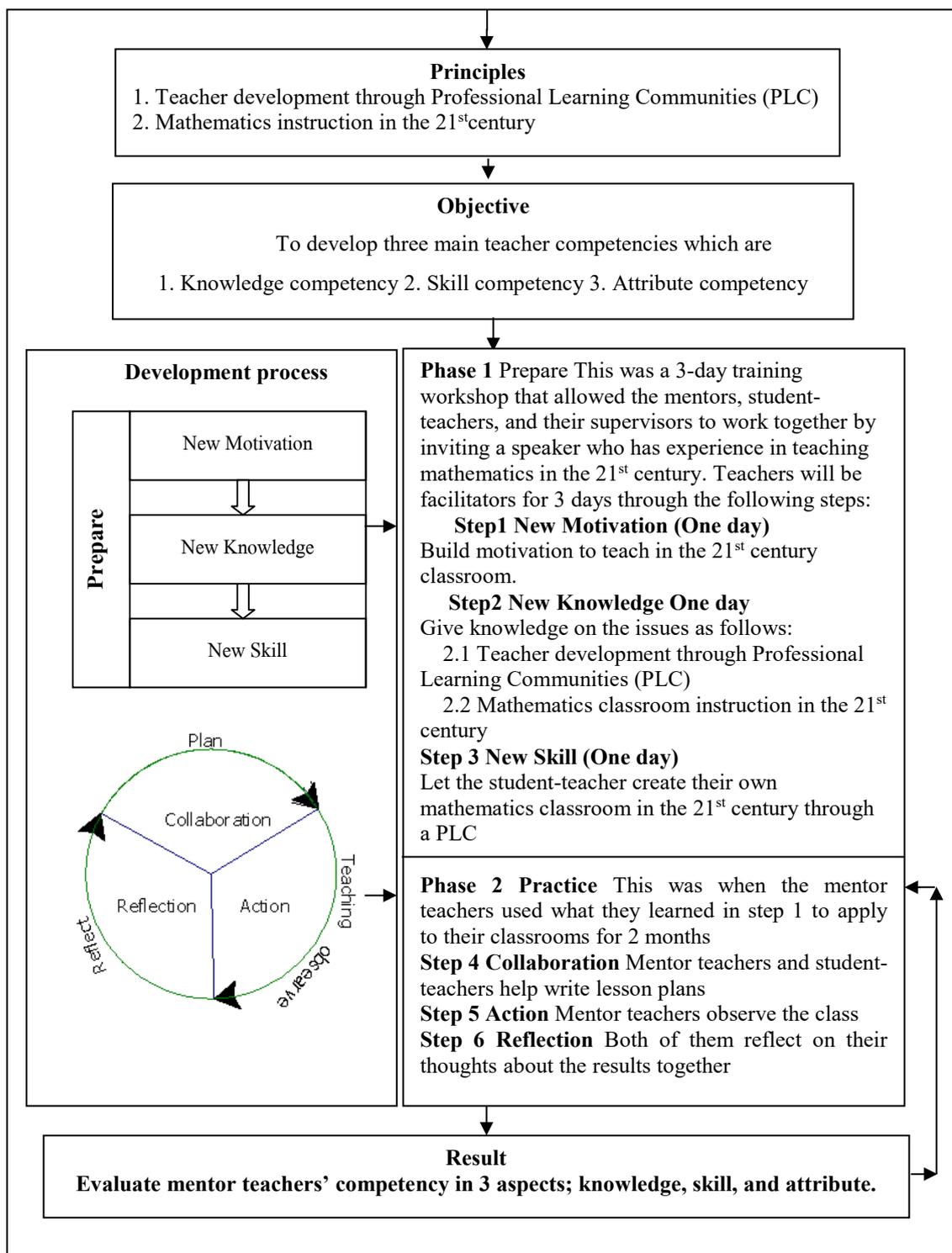


Figure 4.3 The development Model

Shown from figure 4.3 was the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century. The researcher presented the principle, objective, and results of the model that aimed to develop the competencies of mentors that enhanced learning in the 21st century. The model was composed of 2 phases. The first phase had 3 steps as follows: (1) New Motivation, (2) New Knowledge, (3) New Skill, Phase 2 included, (4) Collaboration, (5) Action, and (6) Reflection.

The key feature of the teacher development model is the collaborative development in encouraging teachers to become part of a professional learning community (PLC). It could exist with the cooperation of mentor teachers, student-teachers, and supervisors that assisted the mentors to create the mathematics classroom in the 21st century. This means the classrooms that mainly focus on learners as problem solvers and teachers as facilitators. The details of the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century were shown as follows:

1) Principles and concepts

Building motivation and providing more knowledge based on adult learning theory, having emphasized the development by cooperating with student-teachers with regard to professional experience in order to promote learning in the 21st century. Through the beliefs of social learning theory, the mentor teachers and student-teachers worked, planned lessons together, observed classes, reflected on and evaluated the lessons together. The mentor teachers were developed at the same time as the student-teachers. The mentor teachers can develop their knowledge, skills, attitude, knowledge management and supervision while promoting 21st century mathematics learning from parties for the skills of the 21st century. (Partnership for 21st Century skills, 2009)

Classroom instruction in the 21st century is a learning management system that focuses on learner-centered thinking and problem-solving while the teacher's role is as a facilitator. The mentors and student-teachers must collaborate to build a professional learning community (PLC). Collaboration itself is inadequate, but the process of expression in the community or between communities will help to scrutinize the essential idea of a group where educators believe that social discourse affects creative thinking. (Vygotsky, L. (1978)

Therefore, the creation of the PLC between mentor teachers and student-teachers in the school will lead to the development student-teachers' abilities in designing learning management that focuses on the learners by focusing on how learners solve their problems. They should let students work in groups to collaborate on how to solve many problems. This process will encourage students to solve math problems and gain more skills in mathematics. Learning management that emphasizes learners promotes thinking and problem-solving skills where teachers are facilitators. These skills are crucial for teachers in managing the 21st century mathematics classroom.

2) Objective

To develop mentor teachers' competencies in designing mathematics lessons in the 21st century based on three main competencies: (1) Knowledge competency (2) Skill competency and (3) Attribute competency

3) Development process

There were 2 development phases of the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century (3 New & CAR).

Phase 1: Preparation

This is the preparation of the developer through a participatory workshop for mentor teachers, student-teachers, and supervisors to raise awareness and willingness to focus on the duties of mentors and supervisors. By motivating and providing additional knowledge about the collaboration between mentors and student-teachers to develop their skills in creating 21st century mathematics learning that emphasizes student thinking and problem-solving skills where teachers are facilitators. It will also provide training for teachers to learn and participate in a practical workshop about teaching in the 21st century which was composed of the following:

Step 1 New Motivation is an activity that motivates mentors to develop themselves and the student-teachers to practice in the 21st century. They also observe the professional teachers (or invite them to share their experiences and learn from the video chat or CD with the following activities).

Activity 1: Observe a lesson and activities in mathematics classes taught by mentor teachers and student-teachers. Observe students' thinking and problem-solving skills practice.

Activity 2 Observe the reflection of the learning activities of the student-teachers, mentors and observers.

Activity 3 Share thoughts from student-teachers, mentors and observers/supervisors, and school administrators and learn about the role of mentors and collaboration with regard to preparing lesson plans, designing learning activities, evaluating learning outcomes, and reflecting on learning outcomes of mentors and student-teachers.

Activity 4 Participate in self-reflection activities and goal-sharing for the self-development of mentors and student-teachers.

Step 2 New Knowledge is an activity that encourages teachers to learn about 21st century mathematics management and includes the creation of a professional learning community with activities as follows:

Activity 5 Analyze the creation of a PLC in a foreign country and the direction of creating a PLC in a school.

Activity 6 Learn how to manage what called, “Learning in the 21st Century”

Activity 7 Try to help teachers solve math problems.

Activity 8 Create a 21st century lesson that practices learners’ thinking and problem-solving skills.

Step 3: New Skill is an activity that focuses on classroom learning, focusing on learners' own thinking and problem-solving skills in order to complete learning management skills taught by the mentor teachers as planned in the lesson plan, as well as classroom observation skills, including reflection on learning skill.

Activity 9: Mentor teachers teach according to the set lesson plan and from the observation of the learning management class.

Activity 10: Reflect on classroom teaching and instruction.

Activity 11: Reflect on learning outcomes from preparation phase to practice phase that lead to the implementation in schools with student-teachers.

Phase 2 is the implementation of knowledge gained from phase 1 to apply to schools. The mentor teachers must cooperate with the student-teachers in preparing the lesson plan, observing teaching and reflecting on the lessons for further development of the lesson plans. This process is to be done every week.

Step 4 Collaboration is an activity in which mentors and student-teachers plan to enhance the 21st century mathematics lessons that emphasize students' diverse thinking abilities and problem-solving skills.

Step 5 Action is a learning management activity by student-teachers that emphasizes thinking and problem-solving skills designed by mentors and student-teachers from observation of the class of teachers and supervisors.

Step 6 Reflection is an activity that considers the classroom learning activities of the student-teachers' lessons with observation from mentor teachers and supervisors.

4) Results

Evaluate the performance development of the mentor teacher. The 3 main competencies assessment were knowledge, skills, and attribute competency.

4.1) Measurement and evaluation

Measurement and evaluation were done step-by-step based on the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century.

(1) Knowledge competency means having knowledge about 21st century mathematics classroom management and supervision that promotes mathematics learning, emphasizes students' multi-disciplinary thinking and problem-solving methods, and supervises student-teachers' classes. This should include using professional learning communities with higher scores comparing between pre-test and post-test scores and the post-test score must be at least 80 percent of the full score.

(2) Skill competency meant to be able to design 21st century mathematics lesson where teachers are facilitators. The teachers are patient and wait for answers and allow students to spend time solving problems themselves. These competencies also refer to ability in supervising the class and enhancing learning management as well as creating a qualified lesson plan. After the development process, the evaluation must be higher than before the development and average score be very good.

(3) Attribute competency means that mentors have a good attitude and are willing to cooperate with student-teachers; both help creating professional learning communities to improve the management of mathematics classroom instruction in the 21st century, changing from the original idea. There should be a significantly higher statistical

difference between the assessment of the teachers after development and the average score should be very good.

Part 2.2 The results from evaluating the effectiveness of the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century

An evaluation of the effectiveness of the model of teacher development enhancement that fosters the management of mathematics classroom instruction of the 21st century was evaluated by four standardized performance measures: feasibility, suitability, accuracy, adequacy, and utility standards. There were 2 expert evaluators listed in table 4.12 to 4.16.

Table 4.12 The mean and standard deviation of the 4 -area standardized performance model

Areas	Evaluation results		
	\bar{x}	SD	Interpretation
1. Feasibility	4.50	0.32	highest
2. Appropriateness	4.50	0.38	highest
3. Adequacy	4.55	0.42	highest
4. Utility	4.71	0.39	highest
Total	4.56	0.34	highest

From the table, the overall performance was at the highest level. The highest average standard of utilization had the average of 4.71 and the standard deviation was 0.39.

Table 4.13 The mean and standard deviation of the feasibility standardized performance model

Items	Details	Experts		
		\bar{x}	SD	Interpretation
1	The model can be used at school	4.62	0.51	highest
2	The model is not complicated and is easy to understand	4.52	0.46	highest
3	Use of model can enhance teaching	4.37	0.51	high
4	All related parties were willing to support	4.00	0.75	high
5	The results of the research were worth doing	4.62	0.51	highest
6	The model was feasible to receive financial support	4.50	0.53	highest
7	The model was possible to apply in class	4.37	0.51	high
Total		4.39	0.35	high

The table shows that the results based on overall feasibility criteria were at a high level. Experts had very strong high opinions. The highest mean score was the possibility in practical application in schools and the results from the use of the model are worth doing.

Table 4.14 The mean and standard deviation of the appropriateness standardized performance model

Items	Details	Experts		
		\bar{x}	SD	Interpretation
1	The model matched school context	4.00	0.53	high
2	The model was appropriate with regard to the process of mentors	4.50	0.53	highest
3	The model was suitable to educational requirements	4.50	0.53	highest
4	The time duration of the model was appropriate	4.12	0.35	high

Table 4.14 (Continued)

Items	Details	Experts		
		\bar{x}	SD	Interpretation
5	The evaluation of the model was appropriate	4.12	0.83	high
6	The model was appropriate to continuing doing	4.37	0.51	high
7	The models can enhance mentors to become professional teachers	4.62	0.51	highest
8	The models can enhance student-teachers to become professional teachers	4.62	0.51	highest
Total		4.35	0.37	high

The results from the evaluation based on overall appropriateness showed that the general evaluation from experts was very high. The items with the highest scores were models can enhance mentors and student-teachers to become professional teachers.

Table 4.15 The mean and standard deviation of the adequacy standardized performance model

Items	Details	Expert		
		\bar{x}	SD	Interpretation
1	The compositions covered all the academic principles	5.00	0.00	highest
2	The principles were clear in each step	4.75	0.46	highest
3	The objective was clearly set	4.62	0.51	highest
4	The content helped encourage teachers to improve themselves	4.50	0.53	highest
5	The content was proper and could develop the supervision skills of mentors	4.62	0.51	highest
6	The methods used were systematic	4.62	0.51	highest
7	The evaluation was reliable	4.00	0.92	high
8	The scope was limited to 21 st century learning	4.62	0.51	highest

Table 4.15 (Continued)

Items	Details	Expert		
		\bar{x}	SD	Interpretation
9	The content was enough to develop teachers in the 21 st century	4.12	0.64	high
10	The processes were enough to develop mentors	4.25	0.70	high
11	The evaluation was qualified enough to see the development of the teachers	3.87	0.83	high
Total		4.45	0.45	high

The results of the performance evaluation based on adequacy showed that the highest mean was the composition of the model was correct according to academic principles, followed by the conceptual principles in each stage of development were clear.

Table 4.16 The mean and standard deviation of the utility standardized performance model

Items	Details	Expert		
		\bar{x}	SD	Interpretation
1	The model was beneficial for the mentor teachers to create a 21 st century lesson	4.87	0.35	highest
2	The model can improve mentor teachers' supervising abilities	4.50	0.75	highest
3	The model was beneficial for student-teachers with regard to creating a 21 st century lesson	4.75	0.46	highest
4	The model was beneficial for professional development	4.75	0.70	highest

Table 4.16 (Continued)

Items	Details	Expert		
		\bar{x}	SD	Interpretation
5	The model can improve the quality of education	4.50	0.75	highest
6	The model can help respond to the needs of the users	4.37	0.51	high
7	The model can be applied to the 21 st century classroom	4.62	0.51	highest
8	The result of model was productive for the mentor teachers	4.50	0.53	highest
9	The result of model was productive for the student-teachers	4.50	0.75	highest
10	The result was beneficial for supervision and professional teaching experience	4.50	0.75	highest
Total		4.58	0.43	highest

From the table, the results of the performance evaluation according to the utility standard showed that the experts had the highest agreement level on the usefulness of the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century, followed by the ability of student-teachers in the same area.

4.3 Part 3 Experimental results from the use of the model for enhancing teachers' mathematical teaching in the 21st century competency.

The experimental model was tried on a group of 6 mentor teachers. A group interview was conducted to summarize the problems and suggestions with regard to improving the model. The mentor teachers discussed and suggested the following ideas.

1 . Content of the model, the user of model could not see the full content of the subject since the researcher had only explained the big picture. The teacher preferred to see

the activities in detail. The researcher should clearly define the content that needs to be added to each activity related to 21st century learning activities.

2. The activity has two phases according to the recommendation of the mentor after the experiment. The details are as follows:

Phase 1 Preparation

Owing to the teaching hour, the teacher has the main burden of teaching the students; some teachers were unable to participate full-time in all processes. It is advisable that the preparation of the lesson plans be prepared during break time, before school starts.

Step 1: New motivation. There should be a free right for the users to choose their own method. If there were obstacles in visiting the real setting at the prototype school, there should be other ways to create motivation, such as inviting a person to share teaching experiences, or watching a video, etc.

Step 2: New knowledge. This is appropriate because it is new knowledge that mentors need in order to develop themselves so that learners can think critically and find answers on their own. This is the knowledge gained from working together.

Stage 3 : New Skills. During the experiment, the mentor teachers did not want to be supervised because of Thai culture. Thai people do not want anyone to observe their teaching. Therefore, there should be a way to find a representative who would be the instructor or may identify the level of mentor teachers, and there should also be options for those who are unable to find a trial school, maybe the researcher might have to bring the group of the trial students to a training point.

Phase 2: Practice which covered; step 4: Collaboration, step 5: Practice and step 6: Reflection. There was a problem with the experience of mentor teachers who did not experience a child-centered approach where the teacher is only a facilitator. Thus, the supervisor or expert should assist the mentor teachers in writing lesson plans, observing the class, and reflecting.

3. Timeline, Some teachers agreed to prepare lessons during break time, but some people preferred to do it before the end of the semester so that they could visit and learn from the prototype school. The duration of preparation was appropriate. For practice time, a supervisor should come to the school two times a month instead of once a month, due to the problem of creating media and preparing the mentoring plan. The mentor teacher slack

experience with writing lesson plans since they usually make them during the preparation time and then immediately use them at school.

4 . Problems, obstacles, advantages, and developments area found from real application. Users encountered problems with writing lesson plans and designing learning lessons due to a lack of confidence and a fear of being evaluated. The researcher emphasized that mentors and students work together through trial and error to learn from their own practices. This was a true mutual learning and it also increased the interaction between mentor teachers and student-teachers.

Based on interviews, the researcher improved the model to be more suitable. It allowed the mentors to evaluate the effectiveness of a teacher empowerment model that promotes mathematics learning in the 21st century. The evaluation was set to be evaluated in 4 aspects of standards which include: Feasibility standard, Suitability standard, Accuracy standard, and Adequacy standard. All these aspects would be evaluated by the teacher as a 6-person teacher as shown in Table 4.17 - 4.21.

Table 4.17 The mean and standard deviation of the four standard areas

Areas	Result		
	\bar{x}	SD	Interpretation
1. Feasibility	4.63	0.18	highest
2. Appropriateness	4.55	0.26	highest
3. Adequacy	4.62	0.29	highest
4. Utility	4.64	0.13	highest
Total	4.61	0.04	highest

From the table, the overall performance was at the highest level. The standard with the highest mean is the standard of utilization; the average is 4.64 and the standard deviation is 0.13. Due to the performance evaluation in phase 2, the researcher evaluated the efficiency of the model with experts and in phase 3, it was evaluated by the users which were 6 teachers. The research would like to present the model effectiveness in the comparison table between the experts and users as detailed in table 4.18-4.21

Table 4.18 The mean and standard deviation of the feasibility standardized performance model

Items	Details	Experts			Users		
		\bar{x}	SD	Interpretation	\bar{x}	SD	Interpretation
1	The model can be used at school	4.62	0.51	highest	4.50	0.57	highest
2	The model is not complicated and is easy to understand	4.52	0.46	highest	5.00	0.00	highest
3	Use of model can enhance teaching in the 21 st century	4.37	0.51	highest	4.25	0.50	high
4	All related parties were willing to support and follow the process	4.00	0.75	high	4.50	0.57	highest
5	The results of the research were worth doing	4.62	0.51	highest	4.75	0.50	highest
6	The model was feasible to receive financial support	4.50	0.53	highest	5.00	0.00	highest
7	The model was feasible for the 21 st century mathematics classroom instruction	4.37	0.51	high	5.00	0.00	highest
Total		4.39	0.35	high	4.71	0.00	highest

From the table, the results of the evaluation based on the overall feasibility criteria showed that the experts have a high level of opinion while the users' results are at the highest level. When considering by item, it was found that the opinions of teachers and mentors and experts were at different levels. (1) The stakeholders were able to cooperate in the format ($\bar{x} = 4.00$, $SD = 0.75$) ($\bar{x} = 4.50$, $SD = 0.57$) (2) The model enhance the development of the 21st century learning ($\bar{x} = 4.37$, $SD = 0.51$) ($\bar{x} = 5.00$, $SD = 0.00$). Experts have a high level of opinion while the users' result is at the highest level.

Table 4.19 The mean and standard deviation of the appropriateness standardized performance model

Items	Details	Experts			Users		
		\bar{x}	SD	Interpre- tation	\bar{x}	SD	Interpre- tation
1	The model matched the school context	4.00	0.53	high	4.75	0.50	highest
2	The model was appropriate with regard to the process of mentors	4.50	0.53	highest	4.25	0.50	high
3	The model was suitable for educational requirements	4.50	0.53	highest	4.75	0.50	highest
4	The time duration of using the model was appropriate	4.12	0.35	high	4.50	0.57	highest
5	The evaluation of the model was appropriate. The model was appropriate to continue doing	4.37	0.51	high	5.00	0.00	highest
6	The model can help mentors become professional teachers	4.62	0.51	highest	5.00	0.00	highest
7	The model can help student-teachers become professional teachers	4.62	0.51	highest	5.00	0.00	highest
Total		4.35	0.37	high	4.78	0.18	highest

The table shows the evaluation results based on the overall appropriateness standard. Experts agreed at a high level while the users agreed at the highest level. When considering by item, it was found that that the items that the mentors had the highest level of feedback, while the experts agreed at a high level of opinion were (1) the format is appropriate for school context, (2) the timing and duration of the development model are appropriate, (3) the evaluation of the teacher's capacity development model is appropriate, and (4) the format is appropriate for systematic and continuous implementation. And for the items that the teachers' opinions were at a high level, while the experts' opinions were at the highest level was the suitability of the model's development stages for the mentor teachers.

Table 4.20 The mean and standard deviation of the adequacy standardized performance model

Items	Details	Experts			Users		
		\bar{X}	SD	Interpretation	\bar{X}	SD	Interpretation
1	The compositions covered all academic principles	5.00	0.00	highest	5.00	0.00	highest
2	The principles were clear in each step.	4.75	0.46	highest	4.75	0.50	highest
3	The objective was clearly set	4.62	0.51	highest	5.00	0.00	highest
4	The content helped to encourage teachers to improve the mentor teachers	4.50	0.53	highest	4.75	0.50	highest
5	The content was proper and could develop the supervision skills of mentors	4.62	0.51	highest	4.75	0.50	highest
6	The methods used were systematic	4.62	0.51	highest	4.75	0.50	highest
7	The evaluation results were reliable	4.00	0.92	high	5.00	0.00	highest
8	The scope was enough for 21 st century learning	4.62	0.51	highest	4.50	0.57	highest
9	The content was enough to develop teachers in the 21 st century	4.12	0.64	high	4.50	0.57	highest
10	The processes were enough to develop mentors	4.25	0.70	high	4.50	0.57	highest
11	The evaluation was qualified enough to see the development of the teachers	3.87	0.83	high	4.75	0.50	highest
Total		4.45	0.45	high	4.75	0.30	highest

The table shows the results of the performance evaluation based on the accuracy standard. The users had opinions at the highest level, while the experts agreed at a high level. When considered by item, there were some items users had the highest level of feedback, while the experts agreed at a high level which were (1) the evaluation results were reliable, (2) the content was enough to develop teachers in the 21st century, (3) the processes were enough to develop mentors, and (4) the evaluation was qualified enough to see the development of the teachers.

Table 4.21 The mean and standard deviation of the utility standardized performance model

Items	Details	Experts			Users		
		\bar{x}	SD	Interpre- tation	\bar{x}	SD	Interpre- tation
1	The model is useful for 21 st century classroom instruction	4.87	0.35	highest	5.00	0.00	highest
2	The model can enhance the mentor teacher's ability in classroom supervision	4.50	0.75	highest	5.00	0.00	highest
3	The model is useful for the student-teachers creating 21 st century lessons	4.75	0.46	highest	5.00	0.00	highest
4	The model is useful for professional development	4.75	0.70	highest	5.00	0.00	highest
5	The model is useful for developing the quality of educational	4.50	0.75	highest	5.00	0.00	highest
6	The model responds to the needs of the user and is useful for the work	4.37	0.51	high	5.00	0.00	highest
7	The model can be applied to develop learning in a 21 st century classroom	4.62	0.51	highest	4.50	0.57	highest
8	The result of the model is useful for mentor teachers	4.50	0.53	highest	5.00	0.00	highest
9	The result of the model is useful for the development of student-teachers	4.50	0.75	highest	5.00	0.00	highest
10	The result of the model is useful for teacher professional development	4.50	0.75	highest	5.00	0.00	highest
Total		4.58	0.43	highest	4.95	0.50	highest

From the table, it was found that the results of the utility standardized performance model evaluation were overall at the highest level of feedback given by both experts and users. The only item that the opinion of experts was at a high level, while the user level was at the highest was the model is responsive to the needs of and benefits the user.

4.4 Part 4 : The results of the study using the model of developing mentor teacher's competencies to enhance mathematics learning in the 21st century

From the study of the effects of using the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century, the research results were presented in two parts.

Part 4 .1 The results of the study using the model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century are classified into three categories as follows:

Section 4.1.1 The results of the knowledge competency assessment of the mentor teachers with regard to promoting mathematics learning in the 21st century and developing teaching professionals' abilities by creating a Professional Learning Community

Section 4.1.2 The results of the skill competency assessment of the mentor teachers with regard to promoting mathematics learning in the 21st century

Section 4.1.3 The results of the attributes competency assessment of the mentor teachers with regard to promoting mathematics learning in the 21st century

Part 4 .2 A Study of mentor teachers' satisfaction with the use of Competency Development Models for mentor teachers with regard to promoting mathematics learning in the 21st century

Part 4 .3 A Study of student satisfaction with supervision of the student-teachers towards the mentor teachers' supervision with regard to promoting mathematics learning in the 21st century

Part 4.1 The Study of the Use of the Model of Developing Mentor Teachers' Competencies to Enhance Mathematics Learning in the 21st Century

The researcher studied the results of using the model for teachers' development to promote mathematics learning in the 21st century. The research was classified into 3 categories: knowledge, skill, and attribute competency. The data was collected from 2 questionnaires: (1) A cognitive competency assessment from mentor teachers who were teaching mathematics in the 21st century and enhancing learning through the creation of a Professional Learning Community (PLC), and (2) Skill assessment from mentor teachers who were teaching mathematics in the 21st century. The findings are in the following:

Section 4.1.1 The Study on the Use of a Model of Developing Mentor Teachers' Competencies to Enhance Mathematics Learning in the 21st Century with regard to Knowledge competency

The evaluation of knowledge competencies was designed by the researcher as true or false for 14 general items and 30 detailed items for a total score of 30 points. There was the evaluation before and after the use of competency development models that promote mathematics learning in the 21st century; see Table 4.22.

Table 4.22 The scores before and after using the model in knowledge competency

Mentor teachers	Total scores (30 points)		Differences	Percentage of progress
	Before	After		
The 1 st one	15	24	9	60.00
The 2 nd one	18	27	9	75.00
The 3 rd one	16	25	9	64.29
The 4 th one	16	26	10	71.43
The 5 th one	16	25	9	64.29
Average	16.20	25.40	9.20	67.00

From the table, it was found that the mentor teachers had an average score before the use of the model equaling 16.20 and an after score of 25.40. When comparing the scores before and after, it was clearly shown from the table that the scores after the development were higher than before the development. The progressive score was 67.00% and all the mentor teachers had a development score improvement of more than 60.00%.

Section 4.1.2 The Study on the Use of Competency Development Models for Mentor Teachers in Promoting Mathematics Learning in the 21st Century in Skill competency

For the evaluation of the skill competency of mentor teachers in promoting the use of mathematics instruction in the 21st century, the researcher collected data from the mentor competency assessments of pre and post-development teachers. The data was collected by the 5 teachers as shown in table 4.23.

Table 4.23 The mean and standard deviation of the mentors promoting mathematical instruction in the 21st century in skill competency

Items	Areas	Results					
		Before		Interpre tation	After		Interpre tation
		μ	σ		μ	σ	
1	Ability in lesson planning that encourages learners to acquire 21 st century learning skills	2.80	0.45	medium	4.40	0.55	high
2	Ability in creating mathematics lessons that encourage learners to acquire 21 st century learning skills in the following areas						
	2.1. Critical Thinking	3.00	0.00	medium	3.80	0.45	high
	2.2. Problem-solving	3.60	0.55	high	4.80	0.45	highest
	2.3. Collaboration	3.80	0.45	high	5.00	0.00	highest
	2.4. Learning facilitation (Teach Less, Learn More)	2.80	0.45	medium	4.60	0.55	highest
3	The evaluation skills of the student's performances according to 21 st century learning	3.40	0.55	medium	4.20	0.45	high
4	Ability in doing authentic assessment	3.60	0.55	high	4.80	0.45	highest
5	Collaboration with university professors in supervising student-teachers	2.20	0.45	low	4.80	0.45	highest

Table 4.23 (Continued)

Items	Areas	Results					
		Before		Interpre tation	After		Interpre tation
		μ	σ		μ	σ	
6	Collaboration with student-teachers in the following areas: 6.1 Writing a lesson plan for teaching mathematics based on 21 st century classroom management 6.2 Creating classroom activities based on learning mathematics in the 21 st century 6.3 An assessment of learners' learning based on 21 st century mathematics learning management 6.4 The creation or production of modern instructional teaching materials in the 21 st century with student-teachers 6.5 The application of technology in the class	2.00	0.71	low	4.80	0.45	highest
		2.80	0.84	medium	4.60	0.55	highest
		3.20	0.45	medium	4.60	0.55	highest
		2.80	0.45	medium	5.00	0.00	highest
		2.40	0.55	low	4.00	0.00	high
7	The friendly supervision process as follows: 7.1 Building faith to gain acceptance 7.2 Motivating learners 7.3 Making learners feel confident with using their knowledge 7.4 Working and brains to making ideas together	4.20	0.45	high	5.00	0.00	highest
		3.80	0.45	high	4.80	0.45	highest
		3.80	0.84	high	4.60	0.55	highest
		3.20	0.45	medium	5.00	0.00	highest
Total		3.14	0.14	medium	4.58	0.17	highest

From the table, it was found that the mentors were capable of managing the learning and supervising skills for promoting mathematics in the 21st century before was at an average level. However, the average score after the use of the development model was at the highest level. When considering the items from highest to lowest, there was collaboration with students on writing a plan to manage mathematics learning in accordance

with 21st century mathematics, followed by collaboration with university professors on student supervision, practicing teachers' professional experience and the collaboration with student-teachers with regard to the management of mathematics learning in the 21st century.

Section 4.1.3 The Study on the Use of Competency Development Models for Mentor Teachers in Promoting Mathematics Learning in the 21st Century in Attribute competency

For the study on the use of the model for developing mentor teachers' competencies to promote mathematics learning in the 21st century, the researcher collected data from 5 teachers with regard to attribute competency as shown in table 4.24.

Table 4.24 The mean and standard deviation of the mentors promoting mathematical instruction in the 21st century with regard to attribute competency

Items	Areas	Result					
		Before		Interpre- tation	After		Interpre- tation
		μ	σ		μ	σ	
1	The teacher had the willingness, pride, and happiness of being a mentor	3.80	0.45	highest	4.80	0.45	highest
2	The teacher was proud to be a role model for students to practice professional experience as a student-teacher	4.60	0.55	highest	4.60	0.55	highest
3	The teacher was determined and had faith to develop student-teachers	4.40	0.55	highest	4.80	0.45	highest
4	The teacher created a good relationship with the students before starting a lesson	4.40	0.55	highest	4.60	0.55	highest
5	The teacher was friendly and smiled in the class	4.00	0.71	highest	4.80	0.45	highest
6	The teacher was patient when waiting for answers from students	3.20	0.45	medium	4.40	0.55	highest
7	The teacher believed that learners could develop their learning skills	3.40	0.55	medium	5.00	0.00	highest

Table 4.24 (Continued)

Items	Areas	Result					
		Before		Interpre tation	After		Interpre tation
		μ	\square		μ	\square	
8	The teacher believed that 21 st century skills are important in the present time	3.20	0.45	medium	4.60	0.55	highest
9	The teacher was proud and willing to be a mentor teacher	4.40	0.55	high	5.00	0.00	highest
10	The teacher was a good model teacher for the student-teachers	4.60	0.55	highest	4.80	0.45	highest
11	The teacher had love for and faith in the profession and was willing to help the student-teachers become professional teachers	4.60	0.55	highest	5.00	0.00	highest
12	The teacher believed that supervision was one of the tools that could improve the classroom instructional ability of student-teachers	4.60	0.55	highest	4.80	0.45	highest
13	The teacher had confidence in his / her mathematics classroom in the 21 st century supervision and how to apply it	4.60	0.55	highest	4.80	0.45	highest
Total		4.14	0.27	high	4.77	0.15	highest

From the table, the mentors had the attribute performance of enhancing mathematics learning management in the 21st century. The average score was at a high level before the use of the development process, and after attending teacher development, it was at the highest level. When considering by item, it was found that the difference between the mean scores from the highest to the lowest order were the belief that students could develop the skills of learning mathematics in the 21st century, followed by the belief that 21st century learning is essential to learning mathematics, and the teachers had patience to wait and let the students figure out and find answers on their own.

Part 4.2: A Study of Teachers Satisfaction on the Use of a model of developing mentor teachers' competencies to enhance mathematics learning in the 21st century

In this study, the researcher had an informal interview with 5 mentors. The researcher started from the question of how they felt about being in this program. The results were that they were all satisfied and happy to be in this program because they were able to collaborate with mentor teachers, supervisors, and student-teachers. This program allowed them to learn and solve problems on their own. Teaching the student-teachers to prepare lessons with mentor teachers is quite new, but it can help the student-teachers understand the content of mathematics by themselves. The answers from the mentor teachers were likely to be the same answers that the project has provided with a variety of activities to be carried out and more knowledge from visiting the prototype school. They learned new things that they did not know before. They also worked together with professional teachers who usually work as student-teachers' professors, who help improve student-teachers' teaching abilities. This event rarely happened in the past. Student-teachers are more active than in the past. Preparing lesson plans and activities for learners to think and find solutions to a variety of problems made them act as facilitators. Normally, the teacher explains, gives examples, and has students' complete exercises, but this new kind of activity makes the students feel more excited and interested in learning because it is something they were not allowed to do before. They can learn and help each other in a group, making them proud of their ideas and ideas of the group. Teachers also learn from students and the students can learn from friends and teachers. The mentor teachers were very satisfied with this performance and saw that there was more knowledge that could be used to enhance the instruction of mathematics classrooms in the 21st century.

The researcher would like to propose the results of an interview with a mentor who participated in the development program. One teacher said, *"The teacher knows that the thinking skill, whether creative thinking or critical thinking, is needed to manage mathematics in the 21st century classroom."* Another one said *"It was never known that working with student-teachers is a 21st century skill,"* Another said, *"The idea that teacher-facilitated teaching must be taught in math is now a guiding approach to teaching students to become self-aware problem-solvers."* and *"Supervision helps student-teachers understand their roles and also prepares them for actual teaching and gives them self-confidence."* Some described that, *"The previous groups of student-teachers taught the*

wrong concept and also lacked teaching materials. Working together requires both mentor teachers and student-teachers to prepare the lesson to teach students and make them understand the content. If they do not understand as the previous group, they will not be able to organize effective activities for the students.” “The learning management of these student-teachers differs from the past. This group emphasizes student thinking and encourages them to find a variety of ways to think. Sometimes, it is a different way of thinking from the mentor teachers.” “The collaboration between student-teachers and their supervisors is impressive. The common building plans prepare the teaching and learning materials and they also observe the students to get a sense of whether the students will meet their goals.” “Seeing that, there are many developed countries that have collaboration between new teachers and experienced teachers, we should have these ideas in our country.” “We can see from Thai textbooks that they are ready-made books. Everything is explained in all the books, so we cannot not think on our own.” “Normally, the supervisor teacher stands outside the room, or sits at the back of the classroom to supervise the teaching of the student-teachers, but when those student-teachers organize the activity, we just hope that the student-teachers will do things as we had predicted.” “Only one teacher thinks activities are harder than just teaching therefore learning, which was done by many people in the past, sharing will make each other know how to teach.” “When I see the students do group work, I am so happy to see them think by themselves. And I wonder how nice it would have been if our classroom had been like this before.” “The bad thing is we rarely have time to discuss and share ideas. Most of the time, the student-teachers will write the lesson plan.” “Another problem is we must cover all required content according to Thai curriculum and standardized tests.” “Usually, there is no reflection or giving feedback from the class observation about personality, controlling the class, speaking in front students, or writing on the board, but reflection on the learning activities makes the student-teachers consider their understanding and ideas which can be a good thing that leads to the furthering of teaching development.”

Part 4.3 A Study of Student-teachers' Satisfaction on Classroom Supervision according to the Process of Using the Development Model of Promoting Mathematics learning in the 21st Century

With regard to the suggestion of the student-teachers according to the process of using the model in promoting mathematics in the 21st century, the student-teachers are advised by mentor teachers about writing a learning plan based on problem-based learning theory, classroom activities, classroom control, such as writing a lesson plan that focuses on learners and promotes thinking and finding solutions to a variety of problems. Student-teachers are satisfied with the mentor teachers in terms of providing counseling in all matters, helping to write lesson plans, and observing and giving feedback on teaching. Normally, the mentor will have the student-teachers teach the class by themselves. Mentor teachers and student-teachers have the ability to write learning plans that focus on solving student problems and reflect the results of the learner's learning activities. Student-teachers are satisfied with the mentoring and classroom supervision made by the mentor teachers. The mentor teachers helped to prepare the lesson plan, assisted in learning management, and gave reflection on learning outcomes which is different from the past. In the past, mentor teachers would only focus on teaching plan evaluation and giving a teaching score. The cooperation in this development program can develop appropriate learning management activities. The reply was, *“Previously, I have never shared plans with mentor teachers giving instruction, so I am not sure about the correctness of the content”* *“Attending and observing the classes of mentor teachers made me feel more confident to teach. I was not criticized on my teaching.”* *“Creating a Professional Learning Community (PLC) has encouraged teachers and students and reduced the gap between mentor and student-teachers.”*

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