CHAPTER 4

Research Findings

This research was considered a development of an evaluation model of mathematics teacher competency in the lower secondary school by means of the research and development. The data analysis results were illustrated as set in the objectives as follows.

1. The analysis of elements and indicators of mathematics teacher competency in the lower secondary schools
2. The construction and development of an evaluation model of mathematics teacher competency in the lower secondary schools
3. An application result study on an evaluation model of the mathematics teacher competency in the lower secondary schools
4. The results in identifying guidelines to develop and enhance the mathematics teacher competency in the lower secondary schools

4.1 The results of the analysis of elements and indicators of mathematics teacher competency in the lower secondary schools

4.1.1 Data synthesis gained from studying documents together with the data gained from inquiring the connoisseurs

According to the synthesis and examination of data inclusion gained from Step 1, 63 indicators of mathematics teacher competency in the lower secondary schools were yielded. After examining content validity by analyzing the Item-Objective Congruence Index (IOC) of the connoisseurs and the elements of mathematics teacher competency in the lower secondary schools, including the propriety in applying the indicators in evaluating mathematics teacher competency in the lower secondary schools, it was found that all of the 63 indicators passed the criteria of considering the congruence with

IOC value between 0.82 and 1.00. They also passed the criteria of propriety at the high to the highest levels. Therefore, all of them were adopted to evaluate mathematics teacher competency in the lower secondary schools. The connoisseurs also gave suggestions in terms of modifying language use and the questionnaire model.

4.1.2 The analysis results of elements and indicators of mathematics teacher competency

According to the analysis results of the elements of mathematics teacher competency in the lower secondary schools, there were eight elements and 63 indicators that could explain the variance at 66.70 percent. The analysis results of Eigen values of all eight elements were illustrated in the following table.

Table 4.1 Eigen Values, Covariance Percentage, and Cumulative Percentage of Covariance in Each Element

No. Indicator	Eigen Value	Covariance Percentage	Cumulative Percentage of Covariance
1	28.70	44.84	44.84
2	4.07	6.36	51.19
3	3.82	5.97	57.16
4	1.47	2.3	59.46
5	1.33	2.09	61.54
6	1.23	1.92	63.46
7	1.06	1.66	65.12
8	1.01	1.58	66.70

According to Table 4.1 that illustrated Eigen values, covariance percentage, and cumulative percentage of covariance in each element of eight element, it was found that the Eigen values that were more than or equal to 1.0 between 1.01 and 28.70 could explain the variance at 1.58 – 44.84 percent. There were eight elements out of 63 variables that contained common factors. The covariance was able to be explained at 66.70 percent.

Table 4.2 Factor Loading, Covariance, and Eigen Values of Indicators in Group 1

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Possess knowledge in geometry in the lower secondary level.	0.777
2.	Possess knowledge in number and operations in the lower secondary level.	0.765
3.	Possess knowledge in measurement in the lower secondary level.	0.763
4.	Possess knowledge in algebra in the lower secondary level.	0.736
5.	Possess knowledge in data analysis and possibility in the lower secondary level.	0.726
6.	Possess knowledge in mathematic skills and procedures in the lower secondary level.	0.517
Covariance Percentage		**44.84**
Eigen Values		**28.70**

According to Table 4.2, it was found that Element 1 contained covariance percentage at 44.84 and Eigen values at 28.70. There were six indicators having the factor loading between 0.517 and 0.777. When considering each indicator, all of the six indicators in this element group were named **a knowledge element of mathematics learning content**.

Table 4.3 Factor Loading, Covariance, and Eigen Values of Indicators in Group 2

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Possess knowledge and understanding regarding guidelines in geometry content teaching methods in the lower secondary level.	0.705
2.	Possess knowledge and understanding regarding guidelines in algebra content teaching methods in the lower secondary level.	0.703
3.	Possess knowledge and understanding regarding guidelines in measurement content teaching methods in the lower secondary level.	0.690
4.	Possess knowledge and understanding regarding guidelines in content teaching methods of mathematics skills/procedures in the lower secondary level.	0.685
5.	Possess knowledge and understanding regarding guidelines in number and operations content teaching methods in the lower secondary level.	0.678
6.	Possess knowledge and understanding regarding guidelines in data analysis and possibility content teaching methods in the lower secondary level.	0.666
Covariance Percentage		**6.360**
Eigen Values		**4.069**

According to Table 4.3, it was found that Element 2 contained covariance percentage at 6.360 and Eigen values at 4.069. There were six indicators having the factor loading between 0.666 and 0.705. When considering each indicator, all of the six indicators in this element group were named **a knowledge element of mathematics learning content methods.**

Table 4.4 Factor Loading, Covariance, and Eigen Values of Indicators in Group 3

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Possess knowledge and understanding in selecting technologies and information technologies in managing mathematics teaching and learning.	0.513
2.	Possess knowledge and understanding in innovative media application methods to manage mathematics teaching and learning in the lower secondary level.	0.510
3.	Possess knowledge and understanding in mathematics curriculum goals in the lower secondary level.	0.426
4.	Possess fundamental knowledge in mathematics learning content in the primary level so as to be used as foundation in the lower secondary level.	0.381
Covariance Percentage		**5.97**
Eigen Values		**3.82**

According to Table 4.4, it was found that Element 3 contained covariance percentage at 5.97 and Eigen values at 3.82. There were four indicators having the factor loading between 0.381 and 0.513. When considering each indicator, all of the four indicators in this element group were named **a knowledge element of curriculum goals, innovative media application, and relevant fundamental knowledge.**

Table 4.5 Factor Loading, Covariance, and Eigen Values of Indicators in Group 4

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Possess knowledge of a structural system, concepts, and nature of mathematics.	0.576
2.	Possess knowledge of a curriculum structure, standard content, and understanding in mathematics learning content management methods in the lower secondary level.	0.572

Table 4.5 (continued)

	Indicators of mathematics teacher competency in the lower secondary schools	Factor Loading
3.	Possess knowledge in holding mathematics learning activities that were student-centered.	0.547
4.	Possess knowledge of measurement and evaluation that was in accordance with mathematics learning content standards.	0.546
5.	Possess knowledge in linking mathematics content and applying in teaching and learning in accordance with daily lives.	0.515
6.	Modify and develop mathematics learning content curriculum in the lower secondary level to be in accordance with a core curriculum.	0.514
7.	Possess knowledge in making subject structures, learning design, and mathematics learning unit production.	0.500
8.	Possess knowledge and understanding in mathematics learning psychology.	0.484
9.	Provide mathematics learning activities in accordance with the local and students' contexts.	0.431
10.	Possess mathematic knowledge foundation in the higher secondary level that applied knowledge background from the lower secondary level.	0.378
Covariance Percentage		**2.30**
Eigen Values		**1.47**

According to Table 4.5, it was found that Element 4 contained covariance percentage at 2.30 and Eigen values at 1.47. There were ten indicators having the factor loading between 0.370 and 0.576. When considering each indicator, all of the six indicators in this element group were named **a knowledge element of curriculum and curriculum application.**

Table 4.6 Factor Loading, Covariance, and Eigen Values of Indicators in Group 5

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Teachers possessed techniques and methods in asking questions that stimulated students to have mathematics knowledge concepts by themselves.	0.669
2.	Hold mathematics learning activities enhancing mathematics learning development of students.	0.639
3.	Be able to hold learning activities that created good attitude toward mathematics among students continuously.	0.635
4.	Manage integrative learning so that students could learn to think critically, criticize, and solve problems.	0.623
5.	Be able to use various concepts and measuring and evaluating methods in measuring and evaluating students' achievement in mathematics.	0.595
6.	Be able to use various teaching techniques or mathematics teaching methods.	0.579
7.	Be able to use mathematics teaching concepts accurately and properly.	0.545
8.	Be able to construct and use various tools for student learning systematically in actual situations that were in accordance with standards, indicators, learning content, and expected achievement.	0.536
9.	Analyze evaluation results of student learning and adopt them to modify and develop student learning in mathematics.	0.501
10.	Manage mathematics learning so that students possessed linking ideas, mathematics knowledge, and other sciences.	0.468
11.	Produce, provide, develop, and use mathematics learning innovative media which were in accordance with subject content and indicators.	0.421
Covariance Percentage		**2.09**
Eigen Values		**1.33**

According to Table 4.6, it was found that Element 5 contained covariance percentage at 2.09 and Eigen values at 1.33. There were 11 indicators having the factor loading between 0.421 and 0.669. When considering each indicator, all of the 11 indicators in this element group were named **a skill element of mathematics learning management.**

Table 4.7 Factor Loading, Covariance, and Eigen Values of Indicators in Group 6

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Possess academic work, such as articles, media, projects, research, or other academic work regarding disseminated mathematics.	0.799
2.	Employ community learning sources and local wisdom as media to manage mathematics learning.	0.756
3.	Hold learning activities enhancing self-knowledge search, such as mathematics projects and independent studies.	0.747
4.	Conduct research to develop mathematics learning activity activities.	0.641
5.	Hold learning activities enhancing mathematics thinking processes by their own practice.	0.589
6.	Manage mathematics learning in order for students to learn mathematics reasonably, know how to question, question themselves to get answers needed.	0.497
7.	Manage learning activities to practice key fundamental skills, especially calculation skill as a tool for further education.	0.494
Covariance Percentage		**1.92**
Eigen Values		**1.23**

According to Table 4.7, it was found that Element 6 contained covariance percentage at 1.92 and Eigen values at 1.23. There were seven indicators having the factor loading between 0.494 and 0.799. When considering each indicator, all of the seven indicators in this element group were named **a skill element of solving student problems and self-development.**

Table 4.8 Factor Loading, Covariance, and Eigen Values of Indicators in Group 7

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Possess patience in waiting for student answers without telling answers or summarizing before allowing students to think and solve problems by themselves.	0.635
2.	Enhance students to realize mathematics process skills in order for them to study happily.	0.578
3.	Employ situations or give examples of their own and others who applied mathematics concepts into their daily lives.	0.574
4.	Employ mathematics reasoning to help in making decisions.	0.560
5.	Cultivate good attitude toward mathematics to students during mathematics teaching and learning.	0.520
6.	Enhance student encouragement in linking nearby surroundings so that students realized mathematics value.	0.511
Covariance Percentage		**1.66**
Eigen Values		**1.06**

According to Table 4.8, it was found that Element 6 contained covariance percentage at 1.66 and Eigen values at 1.06. There were six indicators having the factor loading between 0.511 and 0.635. When considering each indicator, all of the six indicators in this element group were named **a knowledge element of student development.**

Table 4.9 Factor Loading, Covariance, and Eigen Values of Indicators in Group 8

	Indicators of mathematics teacher competency in the lower secondary schools	**Factor Loading**
1.	Be fair and possess democratization.	0.824
2.	Love, have faith, and possess pride toward their profession and mathematics teacher status.	0.766
3.	Be responsible for their assigned duties or directly relevant ones.	0.756
4.	Be strong, reasonable, and carefully thoughtful toward belief or faith in anything.	0.745
5.	Enhance students to think about various methods in solving problems and allow them to choose their own methods.	0.704
6.	Give students a chance to study, search, and seek for correct methods based on their ideas independently.	0.688
7.	Be careful and disciplined in their work and work systematically.	0.636
8.	Be thoughtful in thinking over what happened or tended to happen.	0.634
9.	Be enthusiastic in teaching mathematics.	0.605
10.	Accept student opinions and reasons.	0.604
11.	Be interested in enhancing and developing students to be mathematics genius.	0.604
12.	Keep and collect data records regarding student learning systematically.	0.597
13.	Have effort in developing themselves in attending in workshop and seek for additional knowledge regarding mathematics teaching and learning.	0.509
Covariance Percentage		**1.58**
Eigen Values		**1.01**

According to Table 4.9, it was found that Element 8 contained covariance percentage at 1.58 and Eigen values at 1.01. There were 13 indicators having the factor loading between 0.509 and 0.824. When considering each indicator, all of the 13 indicators in

this element group were named **an element of psychological factors in developing students, virtue, morality, and professional ethics.**

4.2 The construction and development of an evaluation model of mathematics teacher competency in the lower secondary schools

As for Part 4.2, the researcher presented the construction result of an evaluation model and a model application manual of evaluating mathematics teacher competency in the lower secondary schools under the Office of the Basic Education Commission. The details of the data analysis were as follows.

4.2.1 The conceptual framework of evaluating mathematics teacher competency at the lower secondary level

The mathematics teacher competency in the lower secondary level was developed from Mc Clelland (1973) whose competency covered knowledge, skills, attitude, and individual qualification enabling people to work more responsibly and create their work more outstanding than others. In addition, the concepts of Benjamin Herry Lindman (1964), Berliner and Tikunotf (1976), Raynold (1998), and Lindman (1978) were synthesized, including those of the mathematics teacher competency of the Pennsylvania State University (2006), mathematics teacher standards of the Institute for the Promotion of Teaching Science and Technology (IPST: 2002), educational standards for evaluating external assessment (regarding teachers) (2001), teacher standards depending expertise level (2005), teacher competency of the Office of the Basic Education (2006), the synthesis of Thai teacher competency (2008), the synthesis of foreign teacher competency (2008), and the teacher competency of Southeast Asia in the 21st century (2008). The mathematics teacher competency of synthesized research on mathematics teacher competency together with information synthesis gained from the connoisseurs in teacher competency and those relevant in mathematics teachers was also included. In operating duties of the teachers, they had to integrate knowledge, skills, attitude, and individual qualification so that they related and reflected in a relating operational behavior form which could be observed, measured, and developed.

In developing this competency evaluation model, the researcher synthesized model elements from the concepts and general system theory of Von Bertalanffy (1968) consisting of four elements, namely inputs, process, outputs, and feedback which were a system of a guideline frame for constructing and developing an evaluation model of mathematics teacher competency. The key elements of evaluating mathematics teacher competency contained five elements which were (1) evaluation goals, (2) evaluation scopes, (3) evaluation operation consisting of assessor qualification, evaluating tools, and evaluating methods, (4) evaluation result judgment consisting of evaluation criteria and a processing program, and (5) result reporting and evaluation result application as detailed in the following figure.

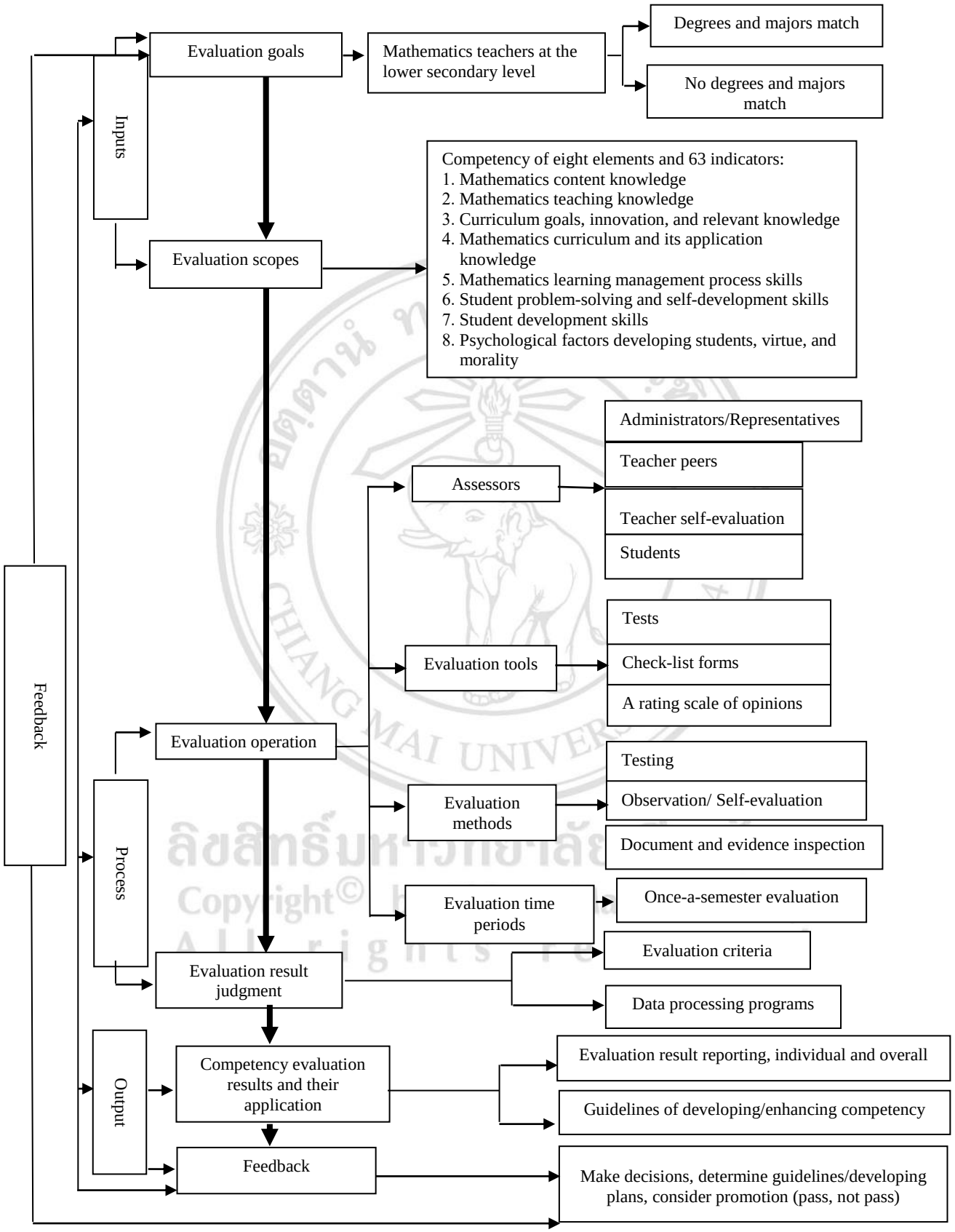

Figure 4.1 An Evaluation Model of Math Teacher Competency (Lower Secondary)

4.2.2 Evaluation goals

This manual was a guideline of evaluating competency in order to:

1. Those evaluated

1.1 Evaluate mathematics teacher competency in the lower secondary level graduating and majoring in mathematics or statistics, or minoring in mathematics.

1.2 Evaluate mathematics teacher competency in the lower secondary level graduating from other fields, not majoring in mathematics.

2. Evaluation objectives

2.1 To be a guideline enhancing and developing mathematics teacher competency in the lower secondary level.

2.2 To be the information for considering a guideline in making administrative decisions, such as judgment, consideration of promotion, and pass or not pass.

3. Evaluation scopes: the evaluation scopes were mathematics teacher competency in the lower secondary level which consisted of eight elements as follows.

3.1 A knowledge element of mathematics learning content in the lower secondary level

3.2 A knowledge element of guidelines in teaching methods of mathematics learning in the lower secondary level

3.3 A knowledge element of curriculum, learning innovation, and knowledge relevant to mathematics learning content in the lower secondary level

3.4 A knowledge element regarding mathematics curriculum and its application in providing activities of teaching and learning

3.5 A skill element of mathematics learning management in the lower secondary level

3.6 A skill element of solving student problems and their self-development

3.7 A skill element of developing students in learning mathematics

3.8 An element of individual qualification, virtue, morality, and professional ethics

4. Evaluation operation of mathematics teacher competency in the lower secondary level was detailed as follows.

4.1 Assessors consisting of:

4.1.1 Administrators or those assigned in the educational institutions.

4.1.2 Math teacher peers in the same institutions as the teachers

4.1.3 Students taught by the mathematics teachers

4.1.4 Mathematics teachers evaluating themselves

4.2 Evaluation tools consisting of:

4.2.1 A test measuring competency of mathematics content knowledge

4.2.2 A competency evaluating form on learning activity management skills

4.2.3 A competency evaluating form on individual characteristics, virtue, morality, and professional ethics.

4.3 Evaluation methods

4.3.1 The evaluation of mathematics teacher competency in the lower secondary level contained details of the evaluation as shown in the following table.

Table 4.10 Evaluation Methods

Indicators	Evaluation Tools	Evaluation Methods/ Assessors
1. Knowledge competency in mathematics learning content 1.1 Six content groups of mathematics learning content 1.2 Six content groups of mathematics learning content teaching methods 1.3 Curriculum, learning innovation, and knowledge relevant to mathematics learning content 1.4 Curriculum production and its application	A 4-choice objective test	Testing
2. A skill in managing activities for learning mathematics 2.1 Mathematics learning process management in the lower secondary level 2.2 Student problem-solving and self-development 2.3 Student development	An observation form with scoring criteria	Administrators, colleagues, self-evaluation, and students
3. Individual characteristics, virtue, morality, and professional ethics	A 5-rating scale	Administrators, colleagues, self-evaluation, and students

Evaluation tool samples

1. A test in measuring knowledge in mathematics learning content

Table 4.11 A Sample Test in Measuring Knowledge in Mathematics Learning Content

Standard/Indicators	Test Items
Standard 1.2: Understanding results of operations of numbers, relationships of operations, and application of operations for problem-solving Add, subtract, and mix addition and subtraction of cardinal numbers not exceeding 100, and 0, as well as be aware of validity of the answers	If (-100) x [a + (-50)] got a result of a positive integer, "a" was a real number in what item. 1. Less than -50 2. More than -50 3. Less than -50 4. More than -50

2. A test in measuring knowledge in mathematics learning content teaching methods

Table 4.12 A Sample Test in Measuring Knowledge in Mathematics Learning Content Teaching Methods

Standard/Indicators	Test Items
Possess knowledge and understanding in teaching methods regarding number and operations.	In operating number in terms of addition, subtraction, multiplication, division, and mixed power," what was the first step students did? 1. Power 2. Addition and subtraction 3. Multiplication and division 4. Did simultaneously from left to right.

3. A test in measuring knowledge in mathematics curriculum and innovation media application in managing mathematics learning activities

Table 4.13 A Sample Test in Measuring Knowledge in Mathematics Curriculum and Innovation Media Application

Standard/Indicators	Test Items
Possess knowledge and understand in innovation media application methods and technology in teaching and learning mathematics.	Which learning media helped increase channels in learning mathematics among students the best? 1. VDO media 2. Equipment media 3. Information technology environment media 4. Game, song, and play media

4. A test measuring curriculum production and application knowledge

Table 4.14 A Sample Test in Measuring Knowledge in Curriculum Production and Application

Standard/Indicators	Test Items
Possess knowledge in subject structures and mathematics learning unit production	Which was supposed to be considered in arranging mathematics learning content group structures in learning unit production? 1. Score weight determination 2. Analyze thoughts of each indicator. 3. Adopt mathematics process skills into learning activities. 4. Select learning standards/indicators that were harmonious and measure shared learning activities.

5. A skill evaluation form in mathematics management in the lower secondary level

Table 4.15 The Indicators That Used Mathematics Teaching Concepts Properly

Indicator Description/ Evaluation Items	Evaluation Results	Scores	Data of Consideration
Manage mathematics teaching and learning accurately and properly to enhance students to develop thinking skills by the followings.			
1. Review fundamental knowledge that was necessary prior to learning new lessons.	(3) Review fundamental knowledge regularly prior to learning new lessons. (2) Review fundamental knowledge sometimes. (1) Review by sometimes asking.	……...	1. Record after learning activities 2. Observe teaching 3. Learning activity plans
2. Use questions to link to new lessons.	(3) Regularly (2) Sometimes (1) Few or hardly	……...	
3. Do activities by themselves or in groups.	(3) More (2) Sometimes (1) Few or none	……...	
4. Give students a chance to express opinions.	(3) Regularly (2) Sometimes (1) None	……...	
5. Examine understanding of students and give additional suggestions.	(3) More (2) Sometimes (1) Few or none	……...	
Total: 15 scores	**Total scores of Indicator 4**		

6. A skill evaluation form of solving student problems and self-development

Indicator 1: Possess research to solve problems of managing mathematics learning activities.

Table 4.16 A Skill Evaluation Form of Indicator 1 regarding Research

Indicator Description/ Evaluation Items	Evaluation Results	Scores	Data of Consideration
Use knowledge seeking process in investigating fact or solving problems regarding mathematics learning activity development systematically to develop media and mathematics innovative media. This was conducted as follows.			1. Record after learning activities 2. Action research reports 3. Media and innovation developed from the action research
1. Survey and analyze causes and problems, including with collecting data regarding learning activities.	(3) Survey problems and collect data. (2) Survey problems. (1) Know that there were problems in managing learning activities. (0) No problem survey.	……..	
2. Conduct research and adopt the research findings to develop learning and students systematically.	(2) Practice (1) No practice	……..	
3. Participate in research to develop mathematics knowledge.	(2) Practice (1) No practice	……..	
4. Adopt research findings to develop media and mathematics learning innovation.	(2) Possess development in media and innovation derived from action research. (1) No development in media and innovation derived from action research	……..	
Total: 9 scores	**Total scores of Indicator 1**		

7. A competency evaluation form of mathematics teachers on student development

Indicator 1: Enhance and encourage students to link nearby surroundings and realize mathematics value.

Table 4.17 A Competency Evaluation Form of Indicator 1 regarding Student Development

Indicator Description/ Evaluation Items	**Evaluation Results**	**Scores**	**Data of Consideration**
Possess ability in managing learning activities that enhanced students to link mathematics with their nearby surroundings in daily lives. 1. Review fundamental knowledge that was necessary prior to learning new lessons. 2. Explain knowledge or mathematics processes with what happened in daily lives. 3. The link among various mathematics content. 4. Link content to teaching and learning integration in all six content groups.	(3) More (2) Partial (1) None (3) More (2) Partial (1) None (3) More (2) Partial (1) None (3) More (2) Partial (1) None	……... ……... ……... ……...	1. Learning activity management plans 2. Record after learning activities. 3. Observe teaching activity management of teachers.
Total: 12 scores	**Total scores of Indicator 1**		

8. A competency evaluation form on individual characteristics, virtue, morality, and professional ethics

Table 4.18 A Competency Evaluation Form on Individual Characteristics, Virtue, Morality, and Professional Ethics

Competency Indicators		**Competency Level**					**Scoring Criteria**
		5	**4**	**3**	**2**	**1**	
Indicator 1: Possess enthusiasm in teaching mathematics. Indicator description: Possess determination in seeking new knowledge and methods, and follow data and news, be ready in solving problems and obstacles in managing mathematics teaching and learning successfully.	Possess characteristics in managing activities of teaching and learning and operate as follows.						Evaluate based on teacher performance. 5 meant "most." 4 meant "more." 3 meant "moderate." 2 meant "less." 1 meant "least."
	1. Be interested and determined in seeking for new knowledge and methods to develop mathematics teaching and learning.						
	2. Identify guidelines in solving problems and develop innovation to manage mathematics teaching and learning.						
	3. Finish planning for mathematics learning innovation production before or on time determined.						
	4. Be able to operate teaching and learning activities based on operational plan and be flexible on situations.						
	5. Be able to give suggestions to teacher peers when having problems in teaching and learning correctly.						

4.2.3 Guidelines in evaluating mathematics teacher competency were illustrated in the following steps as detailed below.

1. Hold meetings to inform details of an evaluation model of mathematics teacher competency. Study an evaluation manual, steps, and methods in evaluating mathematics teacher competency and those relevant to teacher evaluation.

2. Provide a chance for mathematics teacher to access into the operation based on determined competency indicators assessed by those relevant to evaluation, such as school administrators or those assigned by them, mathematics teacher peers, and students taught by the mathematics teachers so that the evaluation could be done completely.

3. Assessors were supposed to observe, examine document and supplementary evidence, and evaluate behaviors based on competency evaluation lists in a period of time mathematics teacher behaviors emerged. Therefore, the data of mathematics teacher competency evaluation would be reliable.

4. Assessors had to evaluate behaviors as set in the indicators that teachers expressed which were obvious and compare with the determined lists in competency measures by considering each competency until done.

5. On condition that an indicator could not be evaluated due to no situations emerged during the operation, the assessors might examine documents, evidence, interview, and inquiry with those evaluated.

6. When completing the evaluation on all competency, the assessors or those responsible collected the evaluation results from the assessors to fill in the data processing program for further data processing.

7. In terms of analyzing the evaluation results, they were supposed to be considered and summarized in a form of mathematics teacher competency evaluation in an overall aspect and individual.

8. Summarize guidelines of developing and enhancing mathematics teacher competency in case of the need to improve.

9. Adopt the evaluation results of teacher competency to inform those evaluated.

4.2.4 The evaluation period of time

The period of evaluation time of mathematics teacher competency in the lower secondary level was supposed to be determined once a semester by evaluating based on a period of time that mathematics teachers expressed their behaviors. This was divided into three periods as follows.

1. At the beginning of a semester (Weeks 2-3), mathematics teaching content knowledge competency was evaluated.

2. In the middle of a semester and prior to the end of a semester (Weeks 6-8 and Weeks 12-15), mathematics learning management process skill competency was evaluated based on a time period that the behavior of each indicator emerged. However, certain competency schools planned and determined to evaluate once a year, such as action research competency, which might take time to observe, interview, and examine documents and evidence, was supposed to be evaluated once a semester or once an academic year as determined by each school.

3. In the middle of a semester or at the end of a semester (Weeks 11-14 and Weeks 16-18), the competency of psychological characteristics in developing students, virtue, morality, and profession ethics was evaluated.

However, the time period to evaluate mathematics teacher competency, learning activity management skills, and psychological characteristics in developing students, virtue, morality, and profession ethics was based on a time period that the behavior of each indicator emerged. This was supposed to be harmonious and proper based on an operational calendar of each school.

4.2.5 The evaluation result judgment

4.2.5.1 A data processing program for evaluating teacher competency

The data processing program used to analyzing data was developed from an Excel program. The indicator weight and factor loading gained from an opinion mean of the connoisseurs was determined to calculate a total sum of competency evaluation so that the evaluation results were most reliable. The results in determining the factor loading of competency and competency indicators were used on a basis of knowledge

importance ratio and the exploratory factor analysis. The factor loading scores that were analyzed were illustrated as follows.

Table 4.19 The Analyzed Factor Loading Scores

Competency Elements	Total Scores	Score Weight
1. Knowledge of content, mathematics teaching method, and curriculum application	60	15
1.1 Mathematics learning content		
1.2 Mathematics learning content teaching	60	15
1.3 Curriculum, innovative media and technology application, and fundamental knowledge of learning content regarding mathematics learning content in the lower secondary level	20	5
1.4 Curriculum and curriculum application	60	15
Total	**200**	**50**
2. Skills of managing mathematics learning activities		
2.1 Mathematics learning management process in the lower secondary level	178	17
2.2 Student problem-solving and self-development	49	5
2.3 Student development in learning mathematics	78	8
Total	**305**	**30**
3. Psychological factors, virtue, morality, and professional ethics	265	20
Total	**770**	**100**

Remark: The competency evaluation results of mathematics teacher competency in the lower secondary level at a level of educational institutions in Competency Element 1 might not be adopted in judging mathematics teachers. However, it was an evaluation to examine fundamental knowledge for the sake of developing mathematics teachers.

The steps in processing the evaluation data

1. Score each element based on the indicator details

2. Record the scores gained in the data processing program of competency evaluation which were conducted as follows.

2.1 In terms of the data processing on knowledge competency of mathematics teachers by a test, those responsible filled in the evaluated scores in the data processing program in the field of “Knowledge Evaluation.”

2.2 In terms of the data processing on competency evaluation performed by school administrators or those assigned by the administrators, those responsible filled in the evaluated scores in the data processing program in the field of "Administrators, teacher peers, self-evaluation" in the column of "Administrators."

2.3 In terms of the data processing on competency evaluation performed by teacher peers evaluating mathematics teachers, those responsible filled in the evaluated scores in the data processing program in the field of "Administrators, teacher peers, self-evaluation" in the column of "Teacher Peers."

2.4 In terms of the data processing on competency evaluation performed by mathematics teachers themselves, they had to fill in the evaluated scores in the data processing program in the field of "Administrators, teacher peers, self-evaluation" in the column of "Self-evaluation."

2.5 In terms of the data processing on competency evaluation performed by students evaluating mathematics teachers, those responsible filled in the number of students and the evaluated scores in the data processing program in the field of "Student Evaluation."

2.6 In terms of data processing of each particular aspect, the field of "An Aspect" would appear totally when filling in the scores for each aspect item completely.

2.7 In terms of data processing of an overall score, the field of "A sum total" would appear when filling in the scores for each indicator in each element completely.

3. Once filling in all evaluation scores completely, the program would process the results automatically.

4.2.5.2 The result evaluation criteria

After processing the evaluation results, the scores received would be compared with the interpretation criteria in each element as follows.

1. Knowledge competency in mathematics learning content, mathematics content teaching, curriculum knowledge, and curriculum application was interpreted as follows.

Table 4.20 Interpretation of Knowledge Competency

Percentage of Scores	Judgment Criteria
Less than 60 percent	Needed improvement
60 – 79 percent	Fair
More than 80 percent	Good

2. Skill competency in mathematics learning management process

2.1 The evaluation criteria for an observation form in a rating scale

Table 4.21 The Evaluation Criteria for an Observation Form in a Rating Scale

Total Scores of the Indicator	A Score Range Earned		
	Quality Level 1	Quality Level 2	Quality Level 3
8	1-3	4-6	7-8
9	1-4	5-7	7-9
10	1-4	5-7	8-10
12	1-5	6-8	9-12
14	1-6	7-10	11-14
15	1-6	7-11	12-15

2.2 The interpretation criteria of each indicator evaluation and the mean calculation of each indicator to compare with the interpretation criteria determined as follows.

Table 4.22 The Interpretation Criteria of Each Indicator Evaluation

Mean Scores	Quality Level
1.00 – 1.49	Needed improvement
1.50 – 2.49	Fair
2.50 – 3.00	Good

3. Competency of psychological factors in developing students, virtue, morality, and professional ethics

The interpretation criteria of each indicator evaluation and the mean calculation of each indicator to compare with the interpretation criteria determined as follows.

Table 4.23 Interpretation of Knowledge Competency in Terms of Psychological Factors

Mean Scores	**Quality Level**
1.00 – 2.49	Needed improvement
2.50 – 3.99	Fair
4.00 – 5.00	Good

4.2.6 The result reporting and evaluation result application was detailed as follows

1. Type the evaluation results and additional records as stated in a reporting form of the evaluation results of mathematics teacher competency in the lower secondary level. These results were illustrated in two parts as follows.

1.1 The evaluation results of an overall aspect and a particular item

1.2 The evaluation results of each item

2. The assessors recorded the evaluation results and inform those evaluated individually by presenting information together with the evaluation and avoiding revealing the evaluation results to those irrelevant.

3. Give feedbacks regarding the evaluation results of mathematics teacher competency in order to present the outstanding evaluation results and opportunity in developing and guidelines in developing and enhancing mathematics teacher competency in the lower secondary level. This would result in getting information for making decisions in determining guidelines for developing at a right target. These results were as follows.

3.1 The evaluation results of individual competency

3.2 The evaluation results in an overall aspect

3.3 The good competency evaluation results

3.4 The evaluation results that needed improvement and correction

3.5 Guidelines of developing and enhancing competency

4.3 An application result study on an evaluation model of the mathematics teacher competency in the lower secondary schools

4.3.1 The quality evaluation results of an evaluation model by trying out the model

The researcher applied the evaluation model with five mathematics teachers, ten school administrators and teacher peers, and 143 students the mathematics teachers taught. The teachers also evaluated themselves as determined as evaluation methods in the evaluation manual together with an evaluation result processing data program on competency. Then, the results were reported as determined in the form. The results of model application were evaluated in terms of four aspects which were (1) utility, (2) feasibility, (3) propriety, and (4) accuracy. The consideration results were presented in the following table.

Table 4.24 Mean, Standard Deviation, and Opinion Levels of Mathematics Teachers, Administrators, Teacher Peers toward Quality of an Evaluation Model of Mathematics Teacher Competency at the Lower Secondary Level in Terms of Utility Standard

Item evaluated	Mathematics Teachers			Administrators and Teacher Peers		
	μ	σ	Level	μ	σ	Level
1. An evaluation model of mathematics teacher competency gave useful information to those relevant in determining guidelines in developing and enhancing mathematics teacher competency.	4.78	0.44	Highest	4.31	0.75	Highest
2. Information gained from evaluating mathematics teacher competency was useful toward those evaluated.	4.56	0.53	Highest	4.08	0.86	High

Table 4.24 (continued)

Item evaluated	Mathematics Teachers			Administrators and Teacher Peers		
	μ	σ	Level	μ	σ	Level
3. An evaluation model of mathematics teacher competency enabled educational institutions to get ready for their quality assurance.	4.44	0.53	High	4.38	0.77	High
4. An evaluation model of mathematics teacher competency was supposed to be enhanced to be used as guidelines in evaluating teacher competency in other subjects so as to develop the work resulting in better operational efficiency.	4.44	0.73	High	4.38	0.87	High
5. Information gained from evaluating mathematics teacher competency could be utilized in developing school administration quality.	4.56	0.53	Highest	4.69	0.48	Highest
6. Information from evaluating math teacher competency could be used to solve problems so that competency evaluation would be fair and transparent.	4.56	0.73	Highest	4.46	0.66	High
7. An evaluation model of mathematics teacher competency clearly identified those relevant to evaluation.	4.44	0.73	High	4.23	0.73	High
8. Information on mathematics teacher competency evaluation results gained from assessors was reliable.	4.33	0.87	High	4.54	0.78	Highest
9. Data collection covered mathematics teacher competency in the lower secondary level and responded the needs in applying the evaluation results.	4.11	0.78	High	4.46	0.88	High
10. Interpretation and judgment of teacher competency evaluation results was clear.	4.11	0.78	High	4.46	0.66	Highest
11. An evaluation model of mathematics teacher competency in the lower secondary level was acceptable.	4.00	0.87	High	4.31	0.85	Highest
12. An evaluation model of mathematics teacher competency was supposed to be enhanced in evaluating mathematics teacher competency in the lower secondary level.	4.22	0.83	High	4.62	0.77	Highest
Overall	**4.38**	**0.71**	**High**	**4.41**	**0.74**	**High**

According to Table 4.24 expressing the consideration results of the model quality in terms of utility standards based on the opinions of mathematics teachers, administrators, and teacher peers in an overall aspect, it was found that the opinion level was at a high level with a mean of 4.38 and 4.41, respectively. When considering each item, most of them were at high and highest levels in every item evaluated.

Table 4.25 Mean, Standard Deviation, and Opinion Levels of Mathematics Teachers, Administrators, Teacher Peers toward Quality of an Evaluation Model of Mathematics Teacher Competency at the Lower Secondary Level in Terms of Feasibility Standard

Item evaluated	Mathematics Teachers			Administrators and Teacher Peers		
	μ	σ	Level	μ	σ	Level
1. This evaluation model of mathematics teacher competency in the lower secondary level was actually practical.	4.44	0.73	High	4.46	0.66	High
2. The model, methods, and evaluation results of mathematics teacher competency was accepted among those relevant.	4.33	0.71	High	4.69	0.48	Highest
3. The results gained from an evaluation of mathematics teacher competency were worth in terms of time, expense, and resources.	4.22	0.83	High	4.23	0.83	High
4. An evaluation model could be used as a part of assuring educational quality of schools.	4.55	0.53	Highest	4.61	0.77	Highest
5. An evaluation model of mathematics teacher competency could be understood easily.	4.33	0.87	High	4.10	0.80	High
Overall	**4.38**	**0.72**	**High**	**4.43**	**0.73**	**High**

According to Table 4.25 expressing the consideration results of the model quality in terms of feasibility standard based on the opinions of mathematics teachers, administrators, and teacher peers in an overall aspect, it was found that the opinion level was at a high level with a mean of 4.38 and 4.43, respectively. When considering each item, most of them were at high and highest levels in every item evaluated.

Table 4.26 Mean, Standard Deviation, and Opinion Levels of Mathematics Teachers, Administrators, Teacher Peers toward Quality of an Evaluation Model of Mathematics Teacher Competency at the Lower Secondary Level in Terms of Propriety Standard

Item evaluated	Mathematics Teachers			Administrators and Teacher Peers		
	μ	σ	Level	μ	σ	Level
1. This evaluation model of teacher competency was proper in evaluating mathematics teacher competency in the lower secondary level.	4.44	0.73	High	4.46	0.78	High
2. The steps in evaluating mathematics teacher competency as set in this model were properly used.	4.33	0.87	High	4.38	0.77	High
3. An evaluation model of mathematics teacher competency identified what needed to be evaluated clearly.	4.44	0.73	High	4.38	0.65	High
4. This evaluation model of mathematics teacher competency was harmonious and responsive toward teacher performance evaluation as set in a policy of the Office of the Basic Education Commission.	4.22	0.67	High	4.46	0.78	High
5. The evaluation result reporting of teacher competency was complete and fair presenting strengths and guidelines in developing and enhancing mathematics teacher competency.	4.11	0.78	High	4.38	0.77	High
6. Those evaluating teacher competency determined in this model were reliable.	4.22	0.67	High	4.61	0.51	Highest
7. The criteria of evaluating the results of mathematics teacher competency could be used to measure the mathematics teacher competency.	4.44	0.73	High	4.61	0.51	Highest
8. The tools used to evaluate the results of mathematics teacher competency could be used to measure the mathematics teacher competency.	4.33	0.87	High	4.53	0.66	Highest
9. The evaluation result reporting on mathematics teacher competency in the lower secondary level was complete in terms of content.	4.44	0.73	High	4.61	0.51	Highest
Overall	**4.33**	**0.73**	**High**	**4.49**	**0.65**	**High**

According to Table 4.26 expressing the consideration results of the model quality in terms of propriety standard based on the opinions of mathematics teachers, administrators, and teacher peers in an overall aspect, it was found that the opinion level was at a high level with a mean of 4.33 and 4.49, respectively. When considering each item, most of them were at high and highest levels in every item evaluated.

Table 4.27 Mean, Standard Deviation, and Opinion Levels of Mathematics Teachers, Administrators, Teacher Peers toward Quality of an Evaluation Model of Mathematics Teacher Competency at the Lower Secondary Level in Terms of Accuracy Standard

Item evaluated	Mathematics Teachers			Administrators and Teacher Peers		
	μ	σ	Level	μ	σ	Level
1. An evaluation model explained objectives and goals clearly.	4.22	0.67	High	4.38	0.77	High
2. An evaluation model of mathematics teacher competency in was flexible in using techniques to collect data of various methods resulting in getting accurate evaluation results.	4.33	0.87	High	4.38	0.65	High
3. Information gained from evaluating mathematics teacher competency covered sufficiently in that it could be used to make decisions among administrators and teachers evaluated.	4.44	0.73	High	4.69	0.48	Highest
4. A report of evaluation results on mathematics teacher competency was valid.	4.22	0.83	High	4.69	0.63	Highest
5. Evaluation results gained from an evaluation model of mathematics teacher competency were accurate matching an actual condition in educational institutions.	4.22	0.97	High	4.31	0.85	High
6. An evaluation model of mathematics teacher competency identified data and information sources with clear data origins.	4.44	0.73	High	4.61	0.77	Highest
7. Tools were developed; data collection was used to evaluate mathematics teacher competency validly.	4.33	0.71	High	4.53	0.78	Highest

Table 4.27 (continued)

Item evaluated	Mathematics Teachers			Administrators and Teacher Peers		
	μ	σ	Level	μ	σ	Level
8. Tools were developed; data collection for evaluating mathematics teacher competency was reliable.	4.44	0.73	High	4.61	0.51	Highest
9. An evaluation model of mathematics teacher competency was a systematic evaluation.	4.44	0.73	High	4.54	0.66	Highest
10. Reports on the evaluation results of mathematics teacher competency in the lower secondary school were objective.	4.44	0.73	High	4.46	0.66	High
11. An evaluation model explained objectives and goals clearly.	4.56	0.73	Highest	4.31	0.75	High
Overall	**4.37**	**0.74**	**High**	**4.50**	**0.68**	**High**

According to Table 4.27 expressing the consideration results of the model quality in terms of propriety standard based on the opinions of mathematics teachers, administrators, and teacher peers in an overall aspect, it was found that the opinion level was at a high level with a mean of 4.37 and 4.50, respectively. When considering each item, most of them were at high and highest levels in every item evaluated.

Suggestions in developing the quality of the evaluation model

Table 4.28 Connoisseurs' Opinions toward the Evaluation Model Quality

Consideration Issues	Suggestions
An evaluation model consisted of five elements.	Appropriate
Element 1: Evaluation goals	Appropriate: However, there was supposed to be an additional evaluation with students in terms of teaching mathematics in their fifth year prior to their internship or teacher professional internship in order for them to develop before graduation. This could be applied to mathematics teachers whose major or minor fields did not directly match so that they would be trained and given teacher experience before teaching by selecting competency elements that important and necessary.

Table 4.28 (continued)

Consideration Issues	Suggestions
Element 2: Evaluation scopes	Appropriate: However, there was supposed to possess more application in daily life when measuring knowledge in terms of mathematics content based on six content groups of mathematics learning content. When measuring knowledge and ability of mathematics in applying mathematics concepts and principles in analyzing student knowledge derived from student disability or misunderstanding toward content or mathematics process skill concepts, a subjective test was supposed to be used to examine reasoning whether it was accurate based on curriculum, concepts, theories, and mathematics concepts procedure examination or not.
Element 3: Evaluation operation 3.1 Assessors	1) Those assessing mathematics teachers, in terms of school administrators in big-sized schools, could be academic affair heads or learning content group heads as appropriate. 2) Students assessing mathematics teachers were supposed to be informed and comprehended on evaluation methods and steps in detail as they were time-consuming and depended on their responsibility. For certain evaluation methods, if students did not understand them, this would affect the evaluation results in that they would match the goals. They might be worried about the evaluation results later.

Table 4.28 (continued)

3.2 Evaluation tools	Appropriate: It was appropriate and clearly detailed. It could be used as guidelines to evaluate mathematics teacher competency well. However, there were some suggestions as follows. 1. The evaluation tools were too long with a lot of details. It took a long time to evaluate which the assessors needed to understand. The teachers who were evaluated were concerned as they were afraid that they might not possess all characteristics as stated in the indicators of the competency evaluation elements. Therefore, the teachers who were evaluated were supposed to be explained for the sake of their understanding. 2. Evaluation tools regarding knowledge were supposed to contain subjective tests in order to monitor thinking processes and mathematics process skill of teachers clearly. 3. When applying the knowledge tools to test teachers, it was supposed to leave a proper period of time for them based on their readiness so that they would be relaxed and would not be worried too much. The time might be determined based on their ability and basis, together with their direct majors.
3.3 Evaluation methods	1. When evaluating the knowledge competency in mathematics content or individual characteristics in terms of psychological factors in developing students, virtue, morality, and professional ethics, the assessors might not be able to perceive actual behaviors. Mathematics teachers who were evaluated might not express the behaviors that were not matched with real characteristics. 2. The research tools were supposed to be used together with behavior record forms. When examining documents and evidence, the accuracy, propriety, and recency was supposed to be considered so that the data were more reliable. 3. As the tools and evaluation methods were various, the evaluation score level determination was supposed to be given symbols or clear marks so that the difference regarding an evaluation level would be reflected. 4. The evaluation atmosphere was supposed to be arranged properly.

Table 4.28 (continued)

3.4 An evaluation time period	Appropriate: However, certain indicators might need time for evaluation differently depending on regulations or a calendar in operating academic affair of each school, such as indicators of action research. Additionally, some indicators of teacher competency elements might need to be evaluated more than once in each semester in order to compare or monitor teacher development individually or entirely in terms of content groups. Operational results were supposed to be reflected intermittently in order to modify the operation efficiently.
Element 4: Evaluation result judgment 4.1 Evaluation criteria	Appropriate: However, it was suggested that some indicator description and result evaluation criteria were supposed to be written. The evaluation criteria might be determined properly for mathematics teacher competency between teachers holding a matched major and those not holding a matched one.
4.2 Processing programs	Appropriate: However, it was suggested as follows. 1. When applying at a school level, there were supposed to be separate processing officers who were specialists. Yet, this was supposed to be operated in confidential for fear of conflict among colleagues. Judgment criteria in each element and indicators might be determined by personnel relevant to the evaluation so that they were flexible to be modified depending on each school context. 2. The package program determined a calculation formula based on the factor loading. In case of decreasing some indicators in evaluating competency, the program of processing data might be newly constructed.
Element 5: Evaluation result application	Appropriate: However, it was suggested as follows. 1. The evaluation results of teacher competency could be efficient provided they could be used to develop students and themselves. They could be used as guidelines of developing in order to promote their academic standing. 2. They were supposed to be proposed to relevant offices, such as the Office of the Basic Education Commission, so as to guarantee knowledge affirmation and mathematics qualification well. 3. Teacher who were going to be evaluated were supposed to be informed prior to the evaluation so that they acknowledged criteria and guidelines of evaluation so as to prepare clues and evidence for the evaluation and get ready for evaluation.

A summary of suggestions in competency evaluation form development

1. The evaluation methods were supposed to be modified so that they were convenient without wasting time, personnel, and capital. They were able to be stored as evidence and information in a long run so as to be adopted as data used to develop teacher competency.

2. When modifying methods in reporting competency evaluation results, this was supposed to be performed carefully while preserving confidential data between assessors and those assessed so as not to have misunderstandings and conflicts among personnel.

3. The elements and competency indicators presented in the manual were important and necessary for mathematics teachers in the lower secondary level. However, a teacher profession organization and educational offices did not possess clarity at the present time in determining specific roles of teachers in various subjects which were considerably different in each subject. Therefore, competency determination used to evaluate was supposed to give a chance to those relevant to teachers so that they could participate in determining indicators and criteria in evaluating based on mathematics teacher affiliation.

4. The researcher presented suggestions regarding a period of time of evaluation in an evaluation manual of mathematics teacher competency additionally, including the number of times of evaluation in each semester.

5. In terms of those assessed who might express actual behaviors that might not be actual characteristics of mathematics teachers, the researcher determined additional guidelines in a manual of applying a competency evaluation model concerning with evaluation methods. These were suggested to the assessors so that they might use an interview, an inquiry, and additional document examination from additional relevant people as another way to evaluate.

6. The explanation of indicators were supposed to be modified and corrected so that it expressed key behavior. The evaluation criteria were supposed to adjust so that they would be more apparent within competency indicators so that the assessors could observe the behaviors accurately and judge the evaluation results more apparently.

7. According to the suggestions on evaluation tools that were too long, detailed, and time-consuming, the researcher suggested that only relevant and important indicators as seen from their factor loading be used in evaluating so that they were harmonious with necessities and needs of organizations in employing them.

4.3.2 The evaluation results of mathematics teacher competency in the lower secondary level

The researcher would like to try out the evaluation model and adopt problems found to modify or develop better model. Therefore, mathematics teachers were evaluated three times which were a fundamental field experimental group of two mathematics teachers, a core field experimental group of three mathematics teachers, and a final quality evaluation experimental group of five mathematics teachers regarding the model. The experimental results of the final round were illustrated in the following table.

Table 4.29 The Evaluation Results of Mathematics Teacher Competency in an Experimental Group of Evaluating the Model Quality

Competency Elements	Total Scores	Teacher F			Teacher G			Teacher H			Teacher I			Teacher J		
		Scores Earned	%	Quality Level	Scores Earned	%	Quality Level	Scores Earned	%	Quality Level	Scores Earned	%	Quality Level	Scores Earned	%	Quality Level
1. Mathematics content knowledge competency																
1.1 Six content groups of mathematics content knowledge	**15**	11.25	75.00	Fair	9.50	63.33	Fair	11.75	78.33	Fair	11.75	78.33	Fair	11.50	76.66	Fair
1.2 Mathematics content teaching method knowledge	**15**	9.25	61.67	Fair	7.75	51.67	Improve	8.25	55.00	Fair	9.20	61.33	Fair	9.50	63.33	Improve
1.3 Mathematics curriculum goal knowledge	**5**	2.00	25.00	Improve	1.25	15.63	Improve	2.75	34.38	Improve	2.75	55.00	Improve	2.75	34.38	Improve
1.4 Curriculum application and preparation knowledge	**15**	7.75	51.67	Improve	7.00	63.64	Improve	6.00	40.00	Improve	8.00	53.33	Improve	8.00	53.33	Fair
Total	**50**	**30.25**	**50.83**	**Fair**	**25.50**	**51.00**	**Improve**	**28.75**	**57.50**	**Improve**	**31.70**	**52.83**	**Improve**	**31.75**	**63.50**	**Fair**
2. Learning management skill competency																
2.1 Mathematics learning management skills	**17**	14.13	83.12	Good	14.72	74.82	Fair	16.24	83.76	Good	14.35	84.41	Good	13.87	93.35	Good
2.2 Self-development and student problem-solving skills	**5**	4.05	81.00	Good	3.34	66.80	Fair	3.27	65.40	Fair	3.97	79.40	Fair	3.86	77.2	Fair
2.3 Student development	**8**	6.54	81.75	Good	5.74	71.75	Fair	6.36	79.50	Fair	7.05	88.13	Good	6.85	85.63	Good
Total	**30**	**24.72**	**82.40**	**Good**	**23.80**	**79.33**	**Fair**	**23.87**	**79.66**	**Fair**	**25.37**	**84.56**	**Good**	**26.58**	**88.60**	**Good**
3. Psychological factors in developing students, virtue, morality, and professional ethics	**20**	16.35	81.79	Good	15.76	78.80	Fair	17.65	87.80	Good	17.52	87.60	Good	15.82	79.10	Fair
Total	**100**	**71.32**		**Fair**	**65.06**		**Fair**	**70.27**		**Fair**	**74.59**		**Fair**	**74.15**		**Fair**

According to Table 4.29 presenting the evaluation results of mathematics teacher competency in the lower secondary level, it was found that, in terms of mathematics content knowledge competency, most evaluation results were at a level of improvement. In terms of "mathematics learning management skills" and "psychological factors in developing students, virtue morality, and professional ethics," most of them were at a good level. When considering an overall aspect of all three competency aspects, it was found that they were at a fair level among all five teachers.

4.3.3 The examination results of the Rater Agreement Index (RAI) in an evaluation model of mathematics teacher competency

According to the evaluation of mathematics teacher competency in an experimental group in evaluating the model quality in order to identify the evaluating tool quality in a form allowing administrators, teacher peers, and teachers to evaluate themselves, the evaluation results were calculated to identify the Rater Agreement Index as illustrated in the following table.

Table 4.30 Rater Agreement Index (RAI) of Evaluation Tools in an Evaluation Model of Mathematics Teacher Competency in the Lower Secondary Schools within Five Mathematics Teachers in an Experimental Group for Evaluating Quality of the Model

Competency Elements	No. Indicators	RAI of Assessors				
		Teacher G	Teacher H	Teacher I	Teacher J	Teacher K
1. Skills in mathematics learning management	14	0.91	0.93	0.95	0.93	0.93
2. Skills in student problem solving and self-development	5	0.84	0.91	0.90	0.91	0.86
3. Skills in developing students	6	0.89	0.88	0.93	0.93	0.93
4. Psychological factors in developing students, virtue, morality, and professional ethics	12	0.73	0.73	0.67	0.78	0.68

According to Table 4.30 illustrating the Rater Agreement Index (RAI) of evaluation tools in an evaluation model of mathematics teacher competency in three competency

elements of mathematics learning management skills and one psychological factor in developing students, virtue, morality, and professional ethics, it was found that the Rater Agreement Index (RAI) of the tools evaluating assessors performed by three teacher assessors, namely administrators, teacher peers, and teachers evaluating themselves, was between 0.68 and 0.95 approaching "1." This expressed that the assessors could give scores highly harmoniously (Burry-Stock: 1996) in evaluating mathematics teacher competency of all five teachers.

4.4 The results in identifying guidelines to develop and enhance the mathematics teacher competency in the lower secondary schools

According to the results gained from studying guidelines in developing and enhancing mathematics teacher competency in the lower secondary level, the connoisseurs gave suggestions and guidelines in developing and enhancing mathematics teacher competency in various aspects as follows.

4.4.1 Knowledge competency in mathematics content, mathematics learning content teaching methods, and fundamental knowledge regarding in the lower secondary level.

4.4.1.1 Recommendation of guidelines for developing and enhancing mathematics teacher competency in mathematics content knowledge

According to the connoisseurs, the recommendations of guidelines for developing and enhancing mathematics teacher competency in mathematics content knowledge could be summarized in nine aspects as follows.

1. Enhance and develop teachers based on mathematics teacher standards of the Institute for the Promotion of Teaching Science and Technology (IPST).
2. Allow teachers to learn from actual practice in teaching and learning management ultimately.
3. Give teachers a chance to develop themselves in mathematics knowledge constantly.
4. Provide knowledge exchange regularly.
5. Develop learning media via ICT and GSP media.

6. Train the application of problematic situations into teaching by means of leading to actual lessons.

7. Consider teacher cooperation strongly which might take time and readiness of teachers.

8. Development of learning management methods by using teacher-centered method and considering experience of each teacher.

9. Give training and seminar to be in accordance with their teaching classes and group content to be matched with needs.

4.4.1.2 Guidelines in developing mathematics teacher competency of knowledge in mathematics content, mathematics learning content teaching methods, and foundation in the lower secondary level was illustrated in the following table.

Table 4.31 Guidelines in Developing Mathematics Teacher Competency of Knowledge in Mathematics Content, Mathematics Learning Content Teaching Methods, and Foundation in the Lower Secondary Level

Guidelines in developing and enhancing mathematics teacher competency in psychological factors	**Median**	**$Q_3 - Q_1$**	**Quality Level**
1. Training methods			
1.1 Guest-speaker-centered training			
1) Lecture	4.0	1.0	Considerably proper
2) Group discussion	4.0	1.0	Considerably proper
3) Academic meeting	4.0	1.0	Considerably proper
4) Demonstration	4.5	1.0	Extremely proper
5) Work teaching	4.0	1.0	Considerably proper
1.2 Attendant-centered training			
1) Brainstorming	5.0	1.0	Extremely proper
2) Panel discussion	5.0	1.0	Extremely proper
3) Case study	4.0	1.0	Considerably proper
4) Role play	4.0	1.0	Considerably proper
5) Seminar	4.0	0.0	Considerably proper
6) Field trip	5.0	0.0	Extremely proper

Table 4.31 (continued)

Guidelines in developing and enhancing mathematics teacher competency in psychological factors	Median	$Q_3 - Q_1$	Quality Level
7) Workshop	4.0	0.0	Considerably proper
8) Learning from training sets or instant lessons	4.0	1.0	Considerably proper
9) Various distant training, such as radio and TV programs	3.0	1.0	Moderately proper
2. Mentoring	4.0	1.0	Considerably proper
3. Supervision and monitoring	4.0	1.0	Considerably proper
4. Self-study with various media	4.0	1.0	Considerably proper
5. Group meeting for learning exchange	4.0	1.0	Considerably proper
6. Prior-teaching orientation	4.0	1.0	Considerably proper
7. Discussion or summary together	4.0	1.0	Considerably proper
8. Regular meeting	4.0	1.0	Considerably proper
9. Study leave both in and out of time	4.0	1.0	Considerably proper

According to Table 4.31, the connoisseurs considered the guidelines in enhancing mathematics teacher competency regarding knowledge in mathematics content, mathematics learning content teaching methods, and foundation, it was found that the developing guidelines by demonstration, brainstorming, and field trip were extremely proper.

4.4.2 Competency of knowledge regarding mathematics curriculum and curriculum application

4.4.2.1 Suggestions on guidelines in developing and enhancing knowledge competency regarding mathematics curriculum and curriculum application were summarized in the following five aspects.

1. Provide workshop so that teachers participated in expressing opinions and actually practice with supervision and monitoring.

2. Allow teachers propose problems in each side, group for training, or give knowledge based on problem characteristics each group needed.

3. Exchange knowledge by presenting their work on mathematics teaching and learning.

4. Offices relevant to producing mathematics core curriculum were supposed to have good examples and innovative media, allow teachers to develop media and innovation together, and present to their peers for application.

5. Enhance teachers to produce curriculum in applying mathematics in their daily lives rather than focusing on giving mathematics knowledge to students, content, and step work as taught or illustrated by teachers.

4.4.2.2 Guidelines in developing mathematics teacher competency of knowledge regarding mathematics curriculum and curriculum application were presented in the following table.

Table 4.32 Guidelines in Developing Mathematics Teacher Competency of Knowledge regarding Mathematics Curriculum and Curriculum Application

Guidelines in developing and enhancing mathematics teacher competency in psychological factors	**Median**	**$Q_3 - Q_1$**	**Quality Level**
1. Training methods			
1.1 Guest-speaker-centered training			
1) Group discussion	4.0	1.0	Considerably proper
2) Academic meeting	4.0	1.0	Considerably proper
3) Demonstration	4.0	1.0	Considerably proper
4) Work teaching	4.0	1.0	Considerably proper
1.2 Attendant-centered training			
1) Brainstorming	4.0	1.25	Considerably proper
2) Panel discussion	4.0	0.5	Considerably proper
3) Case study	4.0	1.0	Considerably proper
4) Role play	4.0	1.0	Considerably proper
5) Seminar	4.0	0.5	Considerably proper
6) Field trip	4.0	1.25	Considerably proper
7) Workshop	4.5	1.0	Extremely proper
8) Learning from training sets or instant lessons	3.0	1.0	Moderately proper

Table 4.32 (continued)

Guidelines in developing and enhancing mathematics teacher competency in psychological factors	Median	$Q_3 - Q_1$	Quality Level
9) Various distant training, such as radio and TV programs	3.0	1.25	Moderately proper
2. Mentoring	4.0	1.0	Considerably proper
3. Supervision and monitoring	4.0	1.0	Considerably proper
4. Self-study with various media	4.0	1.25	Considerably proper
5. Group meeting for learning exchange	4.0	1.0	Considerably proper
6. Prior-teaching orientation	4.0	1.0	Considerably proper
7. Discussion or summary together	4.0	1.25	Considerably proper
8. Regular meeting	4.0	0.0	Considerably proper
9. Study leave both in and out of time	4.0	1.0	Considerably proper

According to Table 4.32, the connoisseurs considered the guidelines in enhancing mathematics teacher competency regarding knowledge in curriculum and curriculum application, it was found that the development guideline conducted by workshop was extremely proper.

4.4.3 Competency of learning management skills in the lower secondary level

4.4.3.1 Suggestions given by connoisseurs as guidelines in developing and enhancing mathematics teacher competency of learning management skills in the lower secondary level were summarized in four aspects as follows.

1. Enhance teachers to study new teaching methods based on guidelines in their manual provided that they had to openly accept in order to modify and correct.

2. Demonstrate good teaching and learning methods that considered not only clever students but also the difference of a knowledge level among students.

3. Enhance students to learn and understand by themselves which took a long time. Therefore, this was supposed to begin from mathematics process skills.

4. Group students based on their abilities and employ teaching methods increasing skills for teachers so that they were proper to students who were trained to be able to analyze and synthesis questions better.

4.4.3.2 Guidelines given by connoisseurs in developing and enhancing mathematics teacher competency of learning management skills in the lower secondary level was presented in the following table.

Table 4.33 Guidelines in Developing and Enhancing Mathematics Teacher Competency of Learning Management Skills in the Lower Secondary Level

Guidelines in developing and enhancing mathematics teacher competency in psychological factors	**Median**	**$Q_3 - Q_1$**	**Quality Level**
10.Training methods			
1.1 Guest-speaker-centered training			
5) Group discussion	4.0	1.0	Considerably proper
6) Academic meeting	4.0	1.0	Considerably proper
7) Demonstration	4.0	1.0	Extremely proper
8) Work teaching	4.0	1.0	Considerably proper
1.2 Attendant-centered training			
10) Brainstorming	5.0	1.0	Extremely proper
11) Panel discussion	5.0	1.0	Extremely proper
12) Case study	4.0	1.0	Considerably proper
13) Role play	4.0	1.0	Considerably proper
14) Seminar	4.0	1.0	Considerably proper
15) Field trip	4.0	1.0	Considerably proper
16) Workshop	5.0	0.0	Extremely proper
17) Learning from training sets or instant lessons	4.0	1.0	Considerably proper
18) Various distant training, such as radio and TV programs	3.0	1.0	Moderately proper
11.Mentoring	4.0	1.0	Considerably proper
12.Supervision and monitoring	5.0	1.0	Extremely proper
13.Self-study with various media	4.0	1.0	Considerably proper
14.Group meeting for learning exchange	4.0	1.0	Considerably proper
15.Prior-teaching orientation	4.0	1.0	Considerably proper
16.Discussion or summary together	4.0	1.0	Considerably proper
17.Regular meeting	4.0	1.0	Considerably proper
18.Study leave both in and out of time	4.0	1.0	Considerably proper

According to Table 4.33, the connoisseurs considered the guidelines in enhancing mathematics teacher competency in learning management skills in the lower secondary level, it was found that the development guidelines conducted by demonstration, brainstorming, workshop, and supervision and mentoring were extremely proper.

4.4.4 Competency of psychological factors in developing students, virtue, morality, and teacher professional ethics

4.4.4.1 Suggestions on guidelines in developing mathematics teacher competency of psychological factors in developing students, virtue, morality, and teacher professional ethics consisted of four aspects as follows.

1. Enhance teachers to realize, possess responsibilities for their duties, emphasize on accepting, and seek for correct methods.

2. Identify how to praise in order to enhance encouragement and create reliability in terms of virtue, morality, and teacher profession ethics.

3. Provide integrative project activities to develop conscious, virtue, morality, and profession ethics.

4. Select best examples to maintain virtue, morality, and mathematics teacher profession ethics in order to be good models for mathematics teachers.

4.4.4.2 Guidelines in developing mathematics teacher competency of psychological factors in developing students, virtue, morality, and teacher professional ethics were illustrated in the following table.

Table 4.34 Guidelines in Developing Mathematics Teacher Competency of Psychological Factors in Developing Students, Virtue, Morality, and Teacher Professional Ethics

Guidelines in developing and enhancing mathematics teacher competency in psychological factors	**Median**	**$Q_3 - Q_1$**	**Quality Level**
1. Training methods			
1.1 Guest-speaker-centered training			
1) Group discussion	4.0	1.0	Considerably proper
2) Work teaching	4.0	1.0	Considerably proper
3) Good example demonstration	4.5	1.0	Extremely proper
1.2 Attendant-centered training			
1) Brainstorming	4.5	1.0	Extremely proper
2) Case study	4.0	1.0	Considerably proper
3) Role play	4.0	1.0	Considerably proper
4) Seminar	4.0	0.75	Extremely proper
5) Field trip	4.0	1.0	Considerably proper
6) Workshop	4.0	1.0	Considerably proper
7) Action plan preparation	4.0	0.0	Considerably proper
8) Panel discussion	4.0	0.75	Considerably proper
2. Mentoring	4.0	0.5	Considerably proper
3. Supervision and monitoring	4.0	1.0	Considerably proper
4. Prior-teaching orientation	5.0	1.0	Extremely proper
5. Discussion or summary together	4.0	1.0	Considerably proper
6. Regular meeting	4.0	1.0	Considerably proper
7. Teaching facility provision	4.0	1.0	Considerably proper
8. Independent comment giving	4.0	0.75	Considerably proper
9. Academic stage provision	4.0	1.0	Considerably proper
10. Weakness acknowledgement and guideline in developing themselves	4.0	1.0	Considerably proper

According to Table 4.34, the connoisseurs considered the guidelines in enhancing mathematics teacher competency in psychological factors in developing students, virtue, morality, and professional ethics, it was found that the development guidelines conducted by good example demonstration, brainstorming, and prior-teaching orientation were extremely proper.